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CONTRACEPTIVE FORECASTING HANDBOOK FOR FAMILY PLANNING AND HIV/AIDS PREVENTION PROGRAMS

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CONTRACEPTIVE FORECASTING HANDBOOK FOR FAMILY PLANNING AND HIV/AIDS PREVENTION PROGRAMS

FPLM

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Abstract

The Contraceptive Forecasting Handbook for Family Planning and HIV/AIDS Prevention Programs is designed as a reference book for forecasting commodity needs for family planning and HIV/AIDS prevention programs. Topics include general methodological considerations, data sources and alternative techniques for preparing forecasts of consumption, special considerations in forecasting for new programs and HIV/AIDS prevention programs, methods for validating the forecasts, procedures for calculating quantities of contraceptives required based on the consumption forecast, and methods for monitoring the forecast over time.

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Note to Readers

The *Contraceptive Forecasting Handbook for Family Planning and HIV/AIDS Prevention Programs* is designed as a reference book for forecasting commodity needs for family planning and HIV/AIDS prevention programs, not as a book to be read cover-to-cover. The *Forecasting Handbook* follows the sequence of steps required to produce and validate a complete forecast, and then to estimate procurement requirements and monitor progress and performance over time. However, each chapter is written to be as independent as possible of other chapters without being unnecessarily repetitive. You can turn to particular chapters for help and guidance whenever you need to accomplish a particular forecasting task—preparing a forecast using one or more of the different forecasting methodologies, validating or reconciling forecasts made by different forecasting methods, or calculating quantities of particular commodities to procure based on your forecast of consumption. The exceptions to this general rule are chapters 2 and 3 (*Extrapolation from Historical Data* and *Corrections for Missing or Erroneous Data*), which describe techniques applicable to all forecasts made from historical data.

All readers should review the *Preface*, which describes the purpose and intended audiences for the *Forecasting Handbook*. A reader new to forecasting should study chapter 1 (*Introduction*) carefully to understand the basic concepts of forecasting and requirements estimation; all readers should skim this chapter to learn the terminology used throughout the handbook.

Anyone who needs to prepare a forecast based on historical data (i.e., logistics data or service statistics) should review chapters 2 and 3 (*Extrapolation from Historical Data* and *Corrections for Missing or Erroneous Data*) carefully. These chapters describe the essential techniques for such forecasts.

Chapters 4 through 7 describe techniques for preparing forecasts based on four different data sources—logistics data, service statistics, population data, and distribution system capacity. Readers who want to make one or more forecasts using these sources should study the appropriate chapter or chapters.

Chapter 8 (*Estimating Consumption for New Programs*) describes special considerations for forecasting in new programs. This chapter assumes that the reader is familiar with the basic forecasting techniques described in chapters 4 through 7.

Chapter 9 (*Estimating Consumption for HIV/AIDS Prevention Programs*) describes special considerations for forecasting condom needs for HIV/AIDS programs. This chapter also assumes that the reader is familiar with the forecasting techniques described in chapters 4 through 7.

Chapter 10 (*Validating and Reconciling the Forecast[s]*) describes techniques for validating forecasts by comparing two or more forecasts made by different techniques. All readers who prepare forecasts should study this chapter.

Chapter 11 (*Requirements Estimation*) explains how to calculate quantities of product that must be procured or obtained from donors after the forecast has been made. Readers who must make such calculations should study this chapter.

Chapter 12 (*Monitoring the Forecast and the Distribution Cycle*) describes the process of monitoring progress over time, so that procurement quantities and future forecasts can be adjusted as circumstances change. In many cases, this task does not fall to the forecaster who prepared the original projections. However, he or she should make sure that *someone* undertakes this monitoring function; otherwise, the forecasting job is not complete.

The appendices to the handbook provide detailed additional information for specific topics covered in the text. Of particular interest to general readers is appendix 1 (*Related Publications*), which lists additional references and contact information for organizations that can provide further information or assistance. For readers who need a thorough understanding of *all* the techniques described in the text, appendix 6 (*An Example Forecast Using All Data Sources*) provides a complete example of a forecast and requirements estimate prepared using all of the techniques.

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Preface

Family planning and HIV/AIDS prevention programs must manage their logistics systems properly if they are to be successful in meeting the demand for services. In particular, logistics managers must properly forecast the quantities of each method and brand of contraceptive (or condom) required, procure or arrange for the procurement of the required commodities, receive and clear products through customs as they arrive, distribute commodities through in-country distribution channels in a way that prevents stock imbalances, and dispense commodities in good condition to the clients who need them.

This handbook describes forecasting procedures and techniques that are useful in forecasting contraceptive or HIV/AIDS condom needs, though, in fact, the methodologies are applicable to any health commodity. Topics include—

- general methodological considerations;
- data sources and alternative techniques for preparing forecasts of consumption;
- special considerations in forecasting for new programs and HIV/AIDS prevention programs;
- methods for validating the forecasts;
- procedures for calculating quantities of commodities required based on the consumption forecast; and
- methods for monitoring the forecast over time.

Anyone who must prepare national-level forecasts of health commodity requirements can use this handbook. Thus the audience includes procurement and logistics management personnel in host-country family planning and HIV/AIDS prevention programs, national and international donor staff and expatriate advisors, and external technical assistance personnel.

In an ideal situation, forecasting is not a periodic (annual or quarterly) activity, but is accomplished through constant monitoring of inventories, usage rates, and other information that may affect future demand. If the logistics management information system (LMIS) of the program is properly designed and kept up-to-date, the needed information will be available to staff responsible for forecasting and procurement. This handbook does *not*, however, provide a complete description of appropriate LMIS forms and procedures or the many other components of the logistics management system that must also be in place. These related issues are covered extensively in the various documents listed in appendix 1.

This handbook is the work of a number of people from USAID's Family Planning Logistics Management (FPLM) project, both at John Snow, Inc. (JSI) and the Division of Reproductive Health, Centers for Disease Control and Prevention (CDC).

As readers will quickly perceive, forecasting of contraceptive and HIV/AIDS condom needs (like forecasting for most other reasons) remains more of an art than a science. The techniques described here can help produce better forecasts. But constant monitoring of the supply situation, along with a willingness to modify shipment plans and the forecasts themselves, are the keys to ensuring that the right goods, in the right quantities, in the right condition are delivered to the right place, at the right time, for the right cost.

1. Introduction

The *Forecasting Handbook* describes the process of planning for the acquisition of commodities that are needed for the successful operation of a family planning or HIV/AIDS prevention program. Chapter 1 discusses the methodological considerations of forecasting and the general processes of forecasting consumption, forecast validation, and commodity needs estimation.

1.1. Overview and Methodological Considerations

Forecasting contraceptive consumption is as much an art as a science, especially in new programs with no historical data. For this reason, the *Forecasting Handbook* recommends using multiple approaches to forecast preparation, rather than a single approach.

1.1.1. Why Forecasts Are Prepared

One important reason for attempting to predict future contraceptive or condom needs is the time that elapses between the request for a commodity and the arrival of that commodity at the location where it is to be used. Because preparing an order and then sending, processing, approving, dispatching, and ensuring that it reaches its destination takes time, it is essential to have advance knowledge of the quantities that must be purchased or produced.

Other reasons for doing everything possible to determine product requirements in advance are the consequences of *not* having such forecasts available when they are needed. In the case of contraceptives, obvious consequences include forcing a couple to change from a method or brand with which they are satisfied to a new product; payment of higher prices for the same product; loss of time and money caused by unsuccessful visits to service centers; or discredit to the program when timely services are not provided. Such problems result in program dropouts and unwanted pregnancies. In the case of an HIV/AIDS prevention program, a condom stockout may be fatal to the client. To all this must be added the additional costs resulting from underused services or emergency orders for commodities.

1.1.2. Short- versus Long-Term Forecasting

It is useful to distinguish between short- and long-term forecasting efforts. Although there is much overlap (indeed, it is difficult to get experts to agree on a definition), short- and long-term forecasts tend to be prepared by different program staff, for different purposes, using somewhat different techniques.

Short- and medium-term projections of contraceptive or condom needs are made primarily to meet the immediate tactical objectives of any logistics system—obtaining appropriate amounts of each commodity to be issued throughout the distribution system and ultimately dispensed to clients. The output of this type of projection exercise is clear—quantities of contraceptives needed over a fixed period of time; schedules by which they should arrive; budgets and cost estimates where appropriate; and, if necessary, requests to donors for assistance in obtaining the products.

This function tends to be the responsibility of middle managers, who must make these projections on a fixed timetable regardless of the quality of data available or the degree of specificity of their program's short- and medium-term plans. This handbook presents ideas and procedures that can be applied immediately in such situations, using simple methods easily understood by anyone directly involved with the management of supplies.

Long-term projections, which are more strategic than tactical in nature, require a greater knowledge of both the history and evolution of family planning programs worldwide and also the determinants of supply and demand for contraceptive services and materials in a particular society. Long-term projections may be prepared by local program managers or by a combination of program staff and outside consultants. Such forecasts are more complex to produce, requiring more extensive knowledge of forecasting techniques. However, because long-term projections are used for macro-level applications such as estimation of demographic trends and evaluation of program impact, they typically do not require the same precision as short-term forecasts used for procurement. Long-term forecasting issues are not covered explicitly in this handbook, although the mathematical techniques are basically the same as those used for short-term forecasting.

1.2. Definitions

Logistics is the branch of management that ensures that resources needed by a working group—or the products required by a group of consumers—reach their destination in the required amount, in the least possible time, and at the least possible cost. This objective is often described as the *six rights*. The logistics system ensures—

- ❒ the right goods,
- ❒ in the right quantities,
- ❒ in the right condition,

delivered

- to the right place,
- at the right time, and
- for the right cost.

To achieve this objective, logistics managers must quantify future consumer needs. *Webster's Ninth New Collegiate Dictionary* defines *forecasting* as—

> … to calculate or predict some future event or condition, usually *as a result of rational study and analysis of available pertinent data***.**

The accuracy of the forecast is directly related to the inherent predictability of the event, and to the completeness and the quality of the information available about past and present activity. For the purposes of this handbook, forecasting means estimating the *consumption* and *losses* for each contraceptive that will be distributed by a family planning or HIV/AIDS prevention program during some future period of time.

Webster's definition of *demand* is—

> … the quantity of a commodity or service wanted at a *specified price and time*.

In the context of family planning or HIV/AIDS prevention services, price includes not only monetary and program personnel costs, but also the cost in time and inconvenience for the client who wishes to obtain services.

Most programs want to increase the number of people who demand family planning (or condoms for HIV/AIDS prevention), but, in fact, they may be prevented from meeting that demand by a variety of constraints. Therefore, logisticians not only must try to forecast true demand, but also must take into consideration the program's ability to deliver the commodities and services. In logistics terminology, managers are ultimately interested in the amount *dispensed to clients*—the quantity actually given to clients at the clinic, dispensary, shop, or field level of the distribution system. This is carefully distinguished from the amount *issued*—the quantity that is issued from one level to another within the distribution system (for example, from the central store to the regional stores). For reasons discussed in chapter 4, it is very important that dispensed-to-client data, rather than issues data, be used for forecasting wherever possible.

Losses are those quantities of product that leave the distribution system for any reason other than being dispensed to clients. Losses are usually classified as either *system* losses or *client* losses. System losses are those that occur within the logistics system, such as expiration, damage, or theft. Client losses are those that occur after the client takes possession of the product. Because client losses are extremely difficult to measure and, in any case, largely beyond the control of a program's logistics system, the terms *use*, *con-*

sumption, *dispensed to users*, and *dispensed to clients* are usually considered interchangeable for logistics purposes. They are used interchangeably throughout this handbook.

Consumption forecasts, no matter how they were made, should always be validated before use. Webster's definition of *validate* is—

> … to support or corroborate *on a sound or authoritative basis*.

For our purposes, validation means comparing two or more forecasts made using different methodologies to determine whether the forecast results are consistent, and, where they are not consistent, identifying strengths and weaknesses of each forecast to arrive at a best forecast of anticipated consumption and losses.

After a forecast of the amounts expected to be dispensed to clients during a particular time period is finalized, program staff must take account of stocks that may already be on hand or on order before deciding how much to purchase or request from donors. This calculation process is known as *requirements estimation*.

With estimates of quantities needed in hand, program managers must acquire the necessary products in a timely fashion. Webster's definition of *procure* is—

> … to get possession of; obtain *by particular care and effort*.

For our purposes, procurement means acquiring the contraceptives (through purchase, donation, or other means) and scheduling the contraceptive shipments.

Finally, Webster's definition of *monitor* is—

> … to watch, observe, or check, especially for a special purpose.

Our special purposes in monitoring are to ensure that products are available at all times and in sufficient quantities to meet the anticipated demand of the program's clients, and to ensure that losses are kept to a minimum.

1.3. Steps in the Process

The entire forecasting process can be inferred from these definitions. The forecaster must—

1. **Forecast** not only the true demand for commodities, but also quantities that the program will actually dispense to clients and quantities that will be lost in the process.

2. **Validate** the estimates by comparing forecasts made by several methodologies.

3. **Estimate requirements** for obtaining commodities that are not available in sufficient quantities to meet anticipated needs.

4. **Procure** the commodities required through purchase or donations.

5. **Monitor** commodity consumption over time to correct supply imbalances that inevitably will occur, and gather data that will be needed for the next forecast.

The basic steps that should be followed in completing these tasks are to—

1. Prepare a preliminary written schedule of the work, including travel schedules, appointments with key officials, and a final report to the program director and other responsible officers. Revise this schedule as the process proceeds, and keep it for future reference.

2. Collect, review, and evaluate data sources and other documents.

3. Visit key locations to interview staff and collect data, preferably following the supply chain down several distribution channels. Use these visits to determine data quality and identify gaps that must be filled before a forecast can be prepared.

4. Visit other programs and private sector outlets to determine the effect their activities will have on future demand and service delivery.

5. Analyze the information collected, focusing on the relevance of the data to future contraceptive use, and take steps to fill in gaps and correct for errors or identified deficiencies.

6. Prepare one, two, three, or four forecasts as discussed in the following chapters, depending on the number of separate data sources available and the purpose and scope of the final forecast.

7. Validate the primary forecast by comparing it to at least one forecast made by another technique.

8. Discuss the forecast(s) with host-country program managers and, where appropriate, with U.S. Agency for International Development (USAID) and other donor staff to obtain consensus on the selection of a reasonable forecast.

9. Calculate procurement requirements by comparing stocks on hand or already on order to usage and loss forecasts.

10. Assist program staff in identifying source(s) of supply for quantities required.

11. Prepare proposed shipping schedules (separately for each source of supply) for quantities that must be procured.

12. Assist program staff in preparing documentation that they (or appropriate donor or procurement agencies) may require for ordering commodities.

13. Monitor procurements, shipments, and consumption during the period of the forecast, adjusting both forecasts and procurement/shipment schedules as necessary based on actual quantities dispensed to clients.

These elements could form the basis of a job description for the person responsible for forecasting.

For family planning programs, the forecasting effort might focus on contraceptive methods that require relatively large quantities for constant resupply to clients (sometimes called *major supply methods*)—usually oral contraceptives, condoms, intrauterine devices (IUD), implants, injectables, and/or vaginal foaming tablets. However, other methods, such as foams, jellies, diaphragms, voluntary surgical contraception (VSC), rhythm, traditional methods, and others, should not be ignored; changes in the use of these methods will surely affect the demand for the major supply methods.

In any case, early and frequent meetings with program staff are vital to the forecasting effort. Time can be wasted and dissatisfaction can result when all the players do not understand the “rules of the game.” Once everyone involved agrees on the procedures, the technical work of the forecast can begin.

1.4. Forecasting Methods and Data Sources

Most of this handbook is devoted to quantitative methods for forecast preparation. The most important parts of the definitions of forecasting and procurement are those that say “as a result of rational study and analysis of available pertinent data” and “by particular care and effort.” Without reliable data and careful analysis, forecasting and procurement are little better than guesswork.

Those preparing the forecast should collect relevant program and logistics information from their own data systems and, if possible, from suppliers, other programs, and other sources of family planning commodities and services in the geographical area served by the program. These documents include—

- ❐ Records from the central contraceptive logistics management information system (LMIS).
- ❐ Previous forecasts and requirements estimates.
- ❐ Previous contraceptive procurement records.
- ❐ Program policy statements on service delivery.
- ❐ Relevant program planning documents.
- ❐ Demographic data.
- ❐ Demographic and Health Survey (DHS) reports and/or other survey reports that contain information on contraceptive prevalence, method mix, target population, clients’ sources of contraception, and others.

- ❒ Other program documents that show past performance and planned future directions of the program. Reports of program evaluations are particularly useful.
- ❒ Correspondence and other documents related to procurement for contraceptives, shipments, and scheduled shipments.
- ❒ Lists of principal program and current supplier officials, and resident officials of other potential suppliers and donor agencies.

The primary requirement for accurate forecasts and procurement schedules is a reliable logistics database on contraceptive procurement, use, losses, and inventory levels, over time, at *all* program locations. In addition to logistics data, the forecaster should analyze program performance data and program plans for the future as well as the program's existing or planned service delivery capacity. Demographic data for the catchment area should also be examined. These data are usually available from surveys, program evaluations, program plans, service statistics, and the program's LMIS.

The following chapters describe methods for forecasting contraceptive consumption (or, for HIV/AIDS prevention programs, condom consumption), based on four different data sources—

- ❒ Logistics data (i.e., program data on historical consumption or issues).
- ❒ Service statistics from the organization distributing the product (i.e., data on clients and visits).
- ❒ Population data (i.e., demographic surveys).
- ❒ Distribution system capacity of the organization.

Each of these sources, discussed in subsequent chapters, has advantages and limitations. Many programs, especially new ones, will not have data from all four sources. The types of forecasts that should be prepared depend on the types of data available and on the quality and reliability of data from each source. Other criteria for deciding which type(s) of forecast to use are the time period covered by the projection (short-, medium-, or long-term); the scope (for a town, region, country, or group of countries); and the purpose of the projection (for purchasing, budgeting, planning, or evaluation of program impact). Table 1 shows the forecasting methodologies FPLM typically uses for different types of forecasts.

When projections are prepared for an entire country, or a major portion of the country, or when considerable volumes of product or large quantities of money are involved, it is advisable to use two, three, or, ideally, all four methods of projection, comparing the results to arrive at the "best" estimate. This strategy will increase considerably the probability of producing an accurate forecast. It allows projections made by one method to be compared with those made by a different procedure, providing an opportunity to discover weaknesses in the basic data or strengths that can be used later to validate the results of the calculations. The additional effort required to prepare several different types of projections is always more than compensated by gains in accuracy and reliability, and by reduction in the risk of projecting excessive or insufficient quantities, thus avoiding the losses that either error would cause.

Table 1. Common Forecasting Situations

Short- or Medium-Term Forecasting for Existing Programs

- Historical logistics (consumption) data
- Service statistics
- Population (demographic) data

Short- or Medium-Term Forecasting for New Programs

- Service statistics
- Population (demographic) data
- Distribution system capacity

Long-Term Forecasting for New or Existing Programs

- Service statistics
- Survey data
- Distribution system capacity

Because good data are so important to the forecasting process, the quality and completeness of the data should be evaluated as the forecast is being prepared, and steps should be taken to correct any deficiencies. This will make the next forecasting cycle much easier. For all these techniques, it cannot be stressed enough that the quality of the forecast depends entirely on the quality of the data used in making it. Data are almost always incomplete or inaccurate to some extent; therefore, the ability to assess and compensate for data flaws is the *key* skill of the forecaster. Unless such adjustments are made appropriately, the forecasts will also be flawed, despite the mathematical precision of the calculations described in the following chapters. As you work through the procedures or use the tools described here, you must remember the first rule of data processing—

Garbage in .... Garbage out.

2. Extrapolation from Historical Data

The first two types of projections for family planning or HIV/AIDS prevention programs—those based on logistics data and service statistics—use an identical mathematical technique called *extrapolation* to prepare the forecast. Indeed, *any* forecast based solely or primarily on historical data uses some form of this technique, which assumes that there is a discernable pattern of change in the historical data, and that this pattern will continue in the future.

This chapter describes several variations of the extrapolation technique that can be performed manually. Readers with access to a personal computer can find many software programs that automate these calculations. Although logistics data are used in the examples, the same techniques and formulas are used in making forecasts based on service statistics.

2.1. Organizing Data in a Time Series

The first step in preparing an extrapolation is always to organize historical data into a time series, which is simply a table of contraceptive consumption over time. The quantity of IUDs consumed in each of the 12 months of a year, for example, form a time series. Table 2 presents four time series representing quantities of IUDs consumed in four different clinic locations during calendar year 1999. These data will be used to illustrate the different extrapolation techniques for preparing a forecast for calendar year 2000.

The purpose of organizing data in this fashion is to observe the trend of the data items in the series, the variability of these values around an average or median value, and any patterns or models of change that repeat themselves. The time series also establishes the starting point for the projection into the future.

Table 2. IUD Consumption in Four Facilities in CY1999

Month	Clinic 1 (Series 1)	Clinic 2 (Series 2)	Clinic 3 (Series 3)	Clinic 4 (Series 4)
January	10	10	18	10
February	11	11	16	13
March	12	12	20	17
April	13	13	22	22
May	14	14	19	30
June	15	15	23	27
July	16	16	24	29
August	17	17	20	19
September	18	18	27	21
October	19	19	28	14
November	20	20	30	11
December	21	32	26	12

The data from table 2 are obviously not very helpful organized simply as lists of numbers. The first step in extrapolating from any time series should always be to graph the historical data. It is customary to show time on the horizontal (x) axis of the graph and the variable being projected on the vertical (y) axis, though this is not mandatory. However, the divisions for each axis must be of equal value, and each axis must extend far enough to allow the future projection to be drawn in. The steps to be followed are—

1. Create a graph with time on one axis and the quantity to be projected on the other axis (the quantity axis should be as long as possible, so the projection can be read more accurately).

2. Aggregate, smooth, or adjust data if necessary, using the techniques described in this and the following chapters.

3. Plot the available historical data for each time period.

4. Identify any observable trend in the data (stable, downward, upward, or cyclical).

5. Identify the magnitude and variability of deviations from the trend and decide, based on careful examination of the data, what data points, if any, must be corrected or discarded.

6. Select the trend line that most closely represents the historical data.

7. Choose the starting value for the forecast.

8. Draw a line representing the most probable extrapolation of the historical data through the future forecast period.

9. Read the values of the projection from the graph.

The method used to make the extrapolation depends on what you see when you draw the graph. Possible manual techniques are the simple average, linear trend, drawing a line *by eye*, the procedure of semi-averages, linear regression, and more sophisticated *decomposition* techniques for non-linear trends.

2.2. Extrapolation Using Simple Averages

The easiest mathematical technique for extrapolation—and, unfortunately, the least useful—is the simple average. The forecaster assumes that the future values of the variable being projected are just the average of the available historical data. Mathematically, the formula is expressed as—

$$\begin{array}{c}\text{Estimated use}\\\text{for next}\\\text{period}\end{array} = \frac{\begin{array}{c}\text{Total quantity consumed}\\\text{in past } n \text{ periods}\end{array}}{n}$$

The letter *n* is the number of past periods being considered. For the IUD consumption data at Clinic 1 in table 1, for example, the calculation is—

$$\begin{array}{c}\text{Estimated use}\\\text{for January}\\\text{2000}\end{array} = \frac{\begin{array}{c}\text{Total quantity consumed}\\\text{in past 12 months}\end{array}}{12}$$

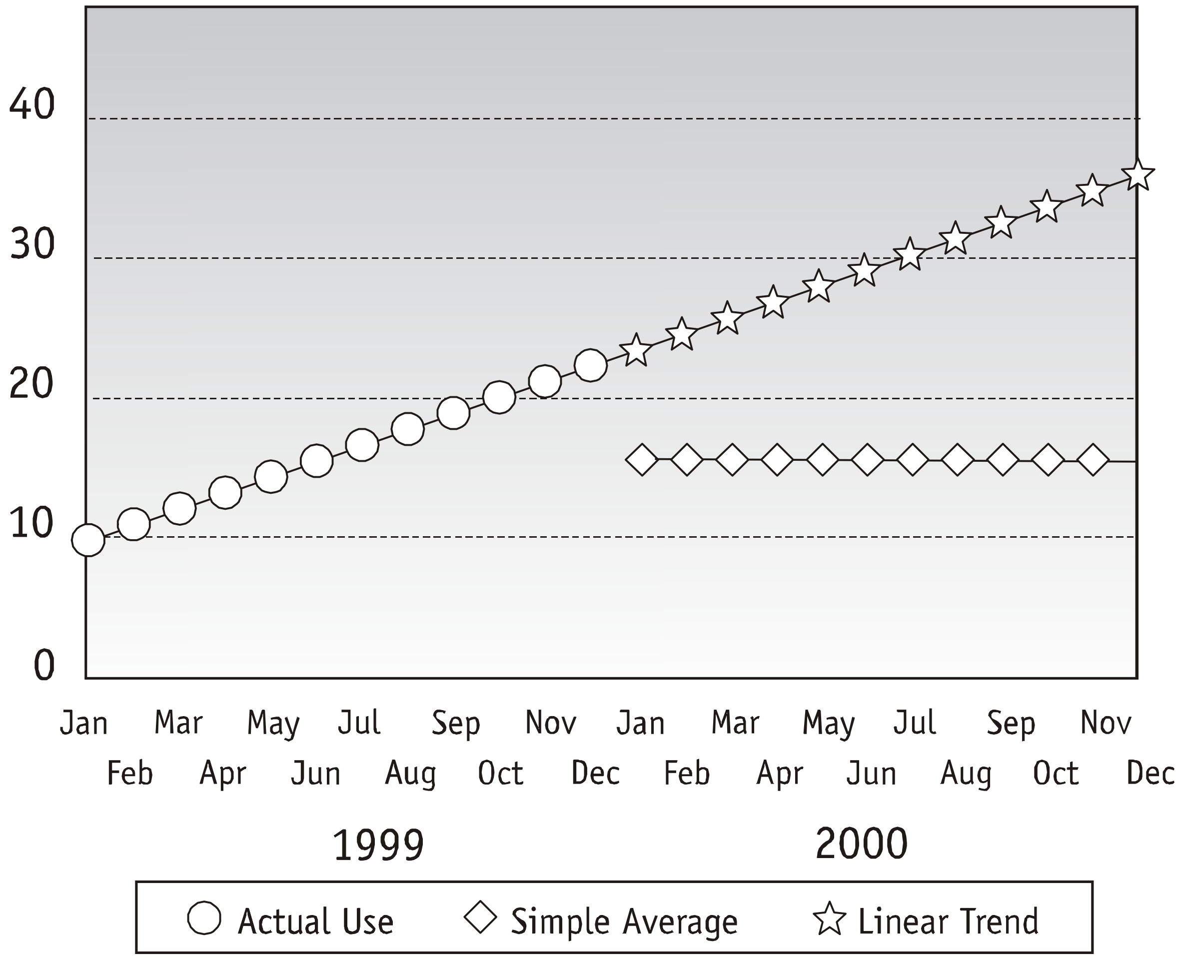
$$= \frac{186}{12}$$

$$= 15.5$$

This same figure is used for the remaining 11 months of 2000. Thus, the IUD consumption projection for 2000 for Clinic 1 is 15.5 x 12 = 186.

Figure 1 shows the graph of historical IUD consumption for Clinic 1, along with two possible extrapolations. It is clear from the graph that the simple averages technique does not provide an appropriate forecast—the line for the simple average forecast is nothing like the pattern of historical data. This is because the historical data show a uniformly increasing trend in consumption of IUDs at Clinic 1. In such situations, a different extrapolation technique is needed. If the consumption figures at Clinic 1 were stable instead of increasing, however, simple averages would provide an adequate extrapolation.

Figure 1. Quantity of IUDs Consumed by Clinic 1 in 1999 and Forecasts for 2000



2.3. Extrapolation Using Linear Trends

In cases such as Clinic 1, where a reasonably consistent increase or decrease in the variable being projected is found, a technique called *linear trend* can be used for extrapolation. This technique uses historical data from the first and last period to calculate the slope of the historical trend, projecting a straight line based on this slope. This is done most easily with a ruler, by drawing a straight line through the first and last historical points on the graph. The line is extended into the future for the period of the forecast. Mathematically, the formula for linear trend is—

$$\begin{array}{c}\text{Estimated use}\\\text{for next}\\\text{period}\end{array} = \begin{array}{c}\text{Use in the}\\\text{most recent}\\\text{period}\end{array} + \begin{array}{c}\text{Average change}\\\text{in use over}\\\text{past } n \text{ periods}\end{array}$$

where—

$$\text{Average change in use over past } n \text{ periods} = \frac{\text{Use in period } n - \text{Use in period 1}}{n-1}$$

So, in the example of Clinic 1—

$$\text{Average change in use over past 12 months} = \frac{21 - 10}{12 - 1} = \frac{11}{11} = 1$$

Thus, usage is increasing at the rate of one IUD per month. Therefore—

$$\text{Estimated use for January 2000} = 21 + 1 = 22$$

Continuing this logic, the estimated use is 23 for February, 24 for March, and so on.

This line best represents the projection for 2000, based on simple examination of the graph in figure 1. In real life, of course, historical data rarely fall so precisely onto a straight line. The data for Clinic 2 in table 2 show performance identical to that of Clinic 1, except during the month of December. In this case, the linear trend calculation is—

$$\text{Average change in use over past 12 months} = \frac{32 - 10}{12 - 1} = \frac{22}{11} = 2$$

Thus, usage is increasing at the rate of two IUDs per month. Therefore—

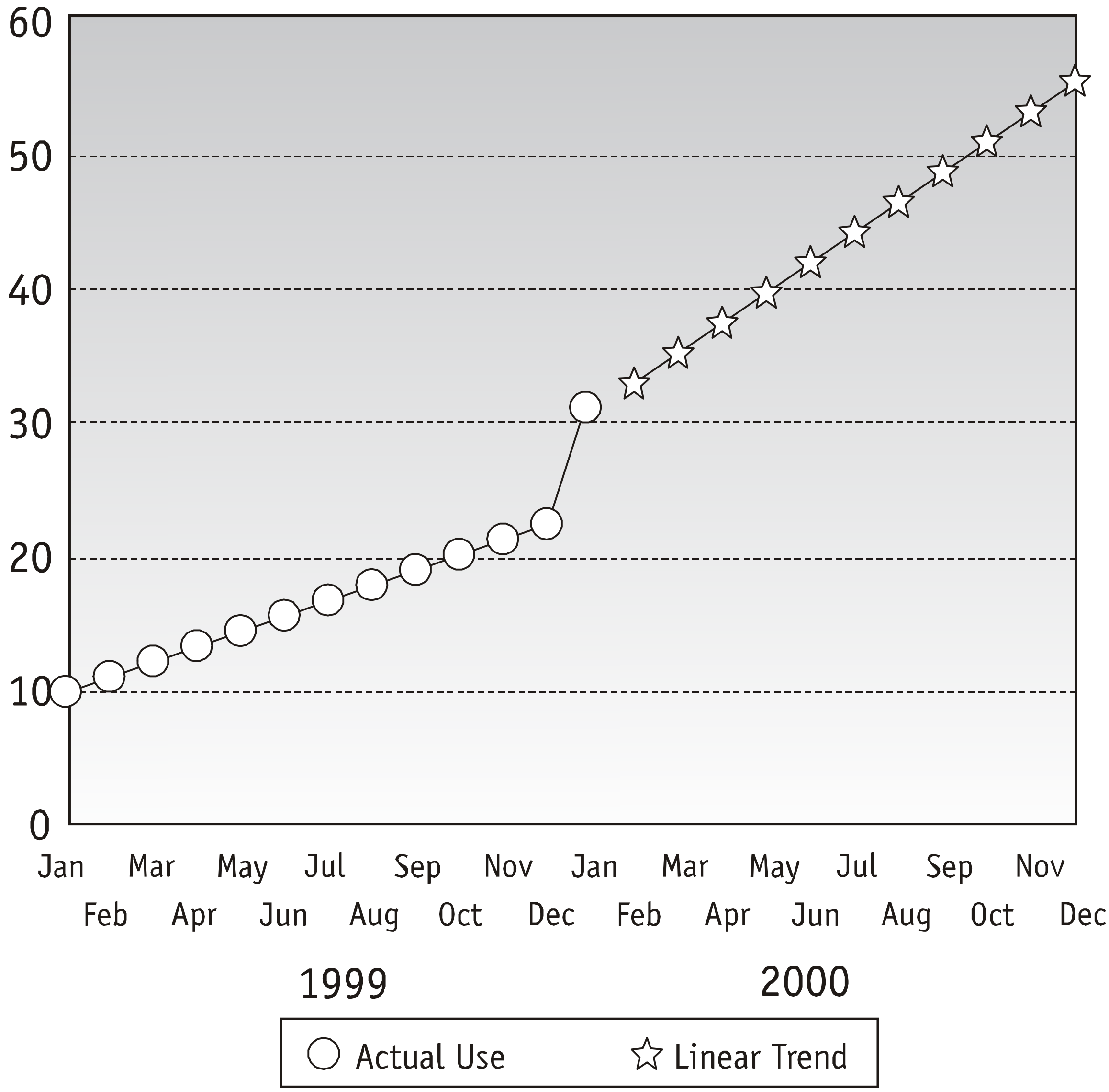
$$\text{Estimated use for January 2000} = 32 + 2 = 34$$

with a projection of 36 for February, 38 for March, and so on.

This projection, shown in figure 2, is probably *incorrect*, demonstrating the limitations of the linear trend technique. The forecast is entirely dependent on the first and last historical data points; if these do not follow the pattern of the other data, the forecast may be completely wrong.

In the case of Clinic 2, the forecaster must determine why the data for December 1999 are so different from the clinic's experience earlier in the year, and decide whether to use different end points for the extrapolation. Was it simply a reporting error? If so, the error should be corrected or the data should be omitted for purposes of extrapolation. Did the same thing happen in December 1998? If so, perhaps December data should not be used for preparing the extrapolation, but an allowance should be made for a similar jump in December 2000. Was the sudden increase due to a staffing change at the clinic; a new information, education, and communication (IEC) program; or some other permanent change? If so, perhaps the linear trend extrapolation *is* realistic, or even low. These judgments must be made in collaboration with management staff of Clinic 2.

Figure 2. Quantity of IUDs Consumed by Clinic 2 in 1999 and Forecasts for 2000

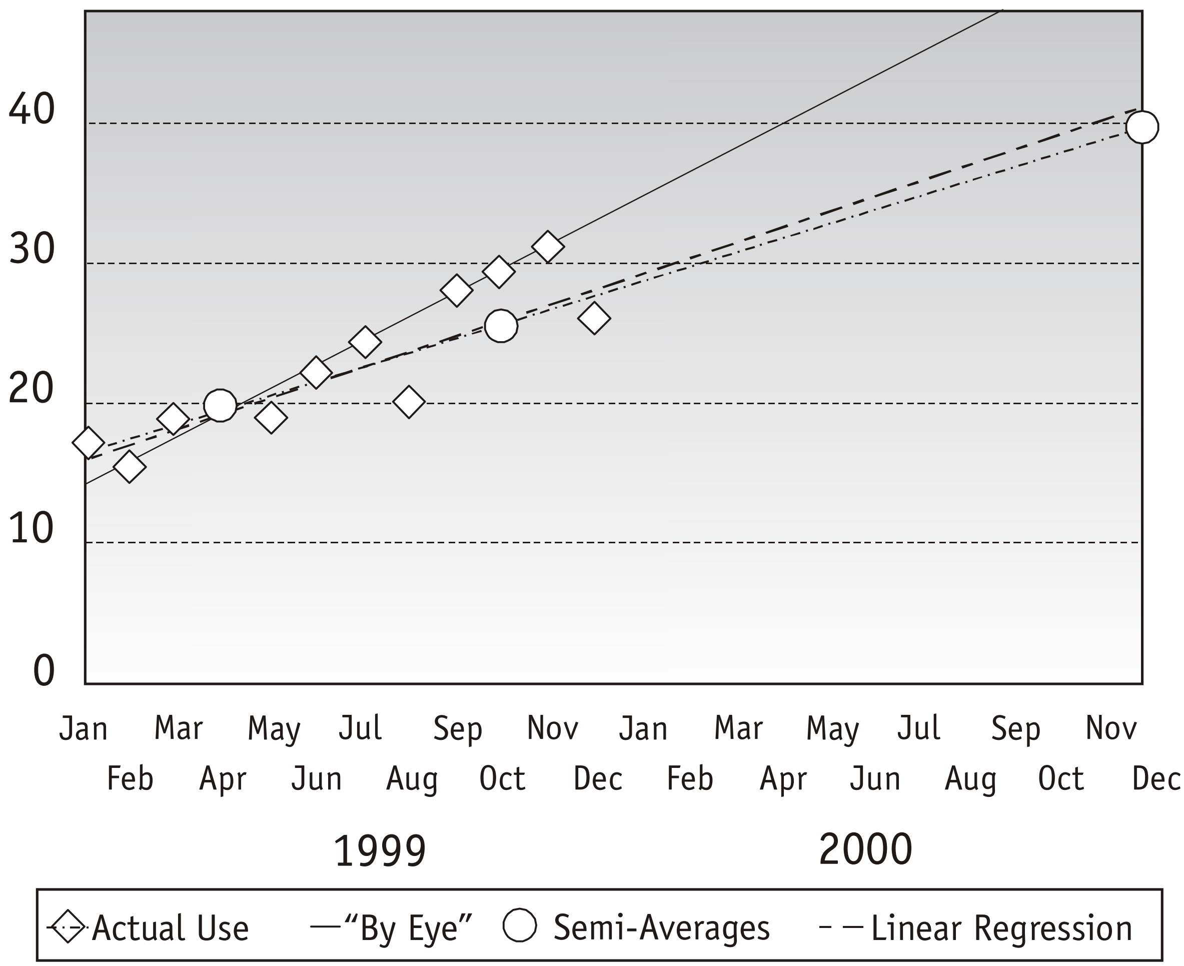


2.4. Drawing a Line by Eye

Figure 3 plots the data and several projections for Clinic 3. These historical data are more realistic. There is some consistency and a perceptible (upward) trend, but the data do not fall neatly into a line. In such cases, the simplest technique consists of drawing a straight line with a ruler through the historical data, attempting to leave the same number of data points on each side of the line, both at the beginning and end of the line if possible. The *by eye* line in figure 3 satisfies the first of these criteria, but not the second—there is no way to do both.

In this case, the results of the *by eye* extrapolation seem plausible. If program managers at Clinic 3 are comfortable with these results, then this extrapolation could be used as the projection. If not, one of the mathematically more precise techniques discussed later in this chapter should be used.

Figure 3. Quantity of IUDs Consumed by Clinic 3 in 1999 and Forecasts for 2000



The major drawback to the *by eye* technique is not its accuracy—certainly the projection shown in figure 3 appears reasonable. However, a *by eye* projection may be difficult for the forecaster to defend, and it is not replicable; another forecaster's eye may see a slightly different line. If these issues are a concern, a mathematical technique should be used instead.

2.5. Extrapolation Using the Procedure of Semi-Averages

Another option is to calculate an average for the first half of the series and another for the second half, using the formula for simple averages shown earlier. These two values are plotted on the graph at the midpoint of the appropriate half of the series. A line is then drawn between the two dots and extended forward for the time period of the projection. This is called the procedure of *semi-averages*.

Using the example of Clinic 3—

$$\begin{array}{c}\text{Estimated use}\\ \text{in first half}\\ \text{of series}\end{array} = \frac{\begin{array}{c}\text{Total quantity consumed}\\ \text{in January – June}\end{array}}{6}$$

$$= \frac{(18 + 16 + 20 + 22 + 19 + 23)}{6}$$

$$= \frac{118}{6} = 19.7$$

And—

$$\begin{array}{c}\text{Estimated use}\\ \text{in second half}\\ \text{of series}\end{array} = \frac{\begin{array}{c}\text{Total quantity consumed}\\ \text{in July - December}\end{array}}{6}$$

$$= \frac{(24 + 20 + 27 + 28 + 30 + 26)}{6}$$

$$= \frac{155}{6} = 25.8$$

The first of these points is plotted at the midpoint of the January–June series (i.e., between March and April), and the second is plotted at the midpoint of the July–December series (i.e., between September and October). As figure 3 shows, the extrapolation using semi-averages in this case gives a projection similar to the *by eye* technique. This projection also appears to be reasonable. Results obtained with this procedure are generally acceptable, and are usually better than the results of any of the techniques described earlier.

2.6. Extrapolation Using a Straight Line of Regression

Another procedure—requiring more elaborate math and a larger number of historical data points—involves calculating a straight line of regression using the technique of least squares or another equivalent method. While the mathematics are complicated to describe, regression is essentially an automated version of the *by eye* technique. The regression technique draws a straight line through the data that minimizes the total of the differences between the actual data points and the values depicted by the regression line. Prior to the age of computers, this technique required considerable time and effort. Today, it can be managed easily with a personal computer and even with some calculators. The formulas can be found in any of the statistical references in appendix 1.

Figure 3 also shows the results of a linear regression forecast for Clinic 3. A regression line is the most reliable projection of the trend of any series of data that can be represented by a straight line. When computer software or a calculator with regression capability is available, this technique should be used instead of the mathematically simpler techniques shown in the preceding examples.

2.7. Extrapolation When the Data Show Non-Linear Trends

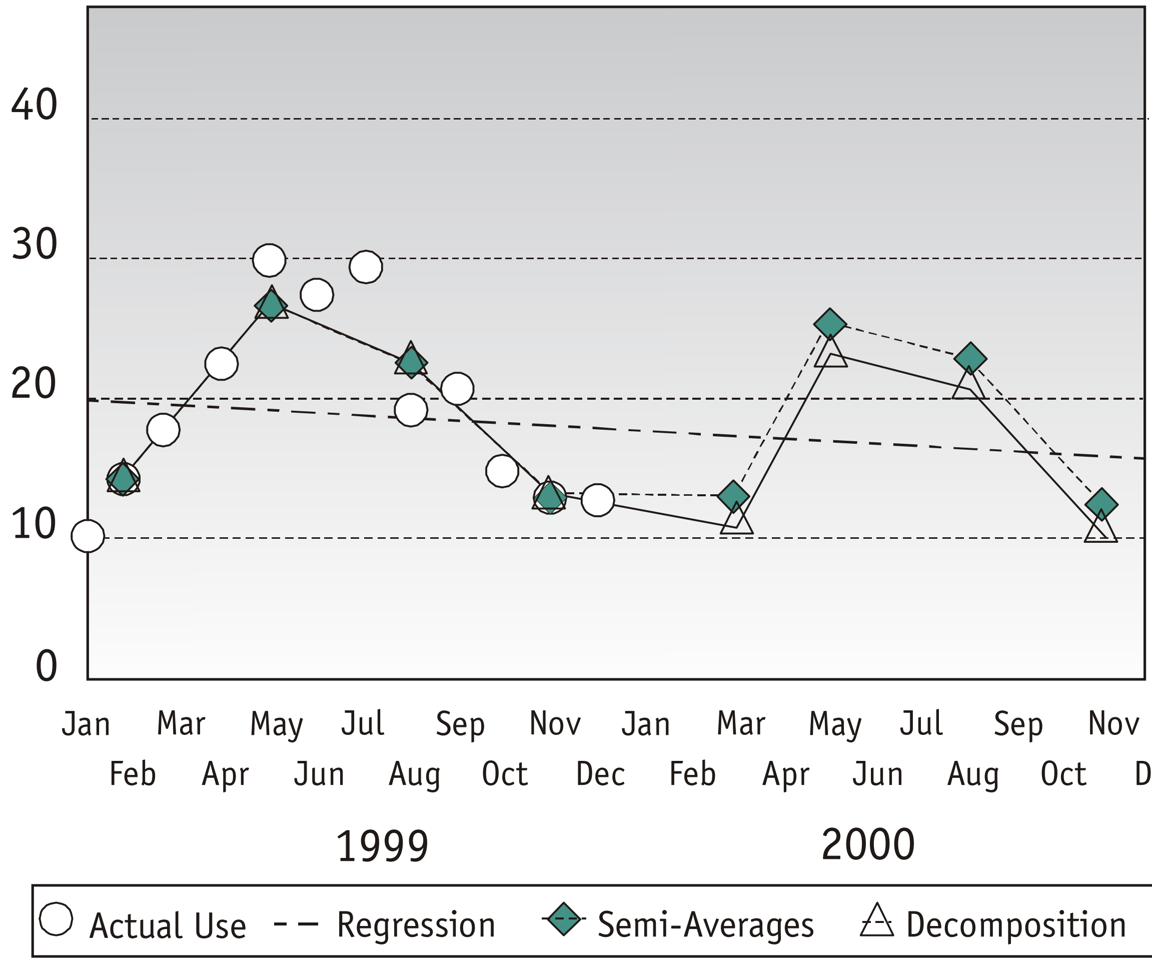
Time series do not always exhibit a straight-line trend. When this is the case, it is not appropriate to attempt a projection by *any* of the procedures described so far. Many phenomena are represented more accurately by curved lines, and must be analyzed using more sophisticated statistical techniques. Such analyses are mathematically complex. This handbook presents a single manual procedure that may be used if computers are not available. The reader requiring more sophisticated techniques should review any of the statistical texts listed in appendix 1.

Figure 4 is a graph of the data from table 2 for the quantity of IUDs dispensed by Clinic 4. This time series presents a different problem from the cases discussed earlier. When the values of the series are plotted in the same way as the previous examples, they produce a curved trajectory, with a peak in the months of May and June and lower levels at the beginning and end of the year. If this curved line pattern is repeated over several consecutive years, the forecaster should suspect that consumption of IUDs in this location is affected by *seasonal variations*—factors related to the different seasons of the year. If this is the case, a similar, although not necessarily identical, curved line trajectory will probably occur in the following year.

None of the above procedures will directly forecast this curved trajectory. In cases like this, automated techniques ranging from the very simple to the very complex are the best techniques for forecasting. Lacking these, it may be possible to make a satisfactory estimate manually, using a variation of the procedure of semi-averages.

In the example of Clinic 4 in table 2, it is possible to calculate four quarterly averages using the simple average formula. For Clinic 4's 1999 data, these would be 13.3, 26.3, 23, and 12.3. These quarterly averages are then represented by dots placed on the central month of each quarter (February, May, August, and November). The four dots are joined by lines, giving a trajectory which represents the trend of the preceding year better than a straight regression line, as figure 4 shows.

Figure 4. Quantity of IUDs Consumed by Clinic 4 in 1999 and Forecasts for 2000



These quarterly averages could be used directly as the projection for 2000. Note, however, that the trend indicated by the straight regression line shows that consumption is decreasing, although relatively slowly. Actually, between the first and second semesters there was a decrease of about 10 percent. In this case, a more accurate forecast for the coming year could be calculated by decreasing the value of each quarterly average by 10 percent. Such a correction should definitely be made if the increase from one year to the next were greater.

Figure 4 also shows this projection. This is an elementary example of *decomposition,* a statistical term that simply means calculating different aspects of a time series separately. Here, the seasonal variations and the trend were calculated in this fashion. More complicated patterns can be extrapolated using more sophisticated variations of the decomposition technique, but the assistance of a statistician (or a computer program) is needed to do so.

Depending on the purpose and scope of the forecast, a projection that ignores the nonlinear data pattern may still give a satisfactory result. Suppose, for example, that the purpose of the forecast is to estimate an aggregate *annual* consumption figure for procurement purposes. Rather than plotting monthly data and quarterly averages, as shown in figure 4, the forecaster might plot *annual* consumption totals for several years and then see if the annual trend can be projected using one of the linear methods. This strategy might produce a sufficiently accurate annual estimate for Clinic 4, though it does not allow the forecaster to estimate monthly or quarterly shipping schedules.

3. Corrections for Missing or Erroneous Data

Reporting of logistics and service data is rarely complete. There might be missing or incomplete reports; consolidated groupings, such as several brands of oral contraceptives being grouped together and reported as pills; or other problems. In some cases, current reports may be missing, but earlier reports may be available.

In these cases, the reported quantities must be adjusted to account for the missing and/or consolidated data. Making these adjustments requires good judgment and an understanding of the trend patterns shown by the data that *are* available. The adjustment techniques described in this chapter are equally applicable to logistics and service data-based forecasts, or to any extrapolation made from a historical time series.

3.1. Adjustment for Incomplete Reporting

When good-quality data are available, but reports from some facilities are missing, the values can be estimated by increasing the reported quantities by the percentage of missing reports. If the forecaster accepts that quantities were dispensed from the nonreporting outlets at the same rate as from the outlets that *did* report, the quantities should be increased by using the formula—

$$\begin{array}{c}\text{Estimated} \\ \text{use} \\ \text{during period}\end{array} = \frac{\text{Quantity reported used}}{\text{Proportion of outlets reporting}}$$

For example, if 85 percent of outlets reported 850,000 Lo-Femenal orals dispensed last year, then—

$$\text{Estimated use during period} = \frac{850{,}000}{0.85}$$

$$= 1{,}000{,}000$$

However, it is frequently (though not always) the low-producing outlets that do not report. Moreover, program locations that miss a reporting period might make up for the missing quantities on the next report. For these reasons, the formula above may be too simplistic. For example, program managers may determine (or estimate) that the 85 percent reporting rate represents 90 percent of the contraceptives dispensed. In such cases, this proportion should be used instead of the proportion of outlets reporting—

$$\text{Estimated use during period} = \frac{850{,}000}{0.90}$$

$$= 944{,}000$$

This type of adjustment is not practical in situations where the reporting is very incomplete. Confidence in the accuracy of forecasts decreases as the proportion of facilities reporting decreases. If the level of nonreporting is very high, the program manager should turn to other forecasting techniques described in later chapters.

3.2. Adjustment for Missing Time Periods

In some programs, data are reasonably complete for some time periods, but non-existent for others. This situation occurs when facilities report routinely but sometimes neglect to report, or when reports are occasionally lost in transit. It might also occur when there is no service activity to report, either because of stockouts or some other program problem.

The first step in such cases is to identify why data are missing and to determine whether it is likely that service activity during the missing time period(s) differed greatly from activity during the periods for which data *are* available. If significant differences in service activity during the time periods for which data are missing are suspected, corrections must be made based on expert judgment or the missing data must be collected. If great differences in service activity are not suspected, mathematical adjustments to correct for missing periods can be made. The form of such adjustments depends on the trend pattern observed in the data that *do* exist.

3.2.1. Where the Trend Is Reasonably Stable

The easiest mathematical correction for a missing time period is the simple average of time periods for which data do exist. This is done in the same way as in the extrapolation example of chapter 2—

$$\text{Estimated use for each missing period} = \frac{\text{Total quantity used in other } n \text{ periods}}{n}$$

If the existing data show a reasonably stable pattern over time, then this technique will work well. Of course, if multiple time periods are missing, the accuracy of the estimate produced using these corrections will be less certain.

3.2.2. Where the Trend Is Upward or Downward

If existing data show an increasing or decreasing trend over time, it may be more accurate to correct for a missing period by using the average of the period before and the period after the one for which data are missing—

$$\text{Estimated use for each missing period} = \frac{\text{Quantity used in previous period} + \text{Quantity used in following period}}{2}$$

Returning to the example of Clinic 3 (shown in table 2), if the forecaster had found June's data missing, he or she could have estimated consumption as—

$$\text{Estimated use for June} = \frac{\text{Quantity used in May} + \text{Quantity used in July}}{2}$$

$$= \frac{19 + 24}{2} = 21.5, \quad \text{rounded} = 22$$

Note that the *actual* consumption for June shown in table 2 was 23; thus, this technique produced a reasonable correction in this case.

3.2.3. Where the Trend Shows a Seasonal Pattern

If the data that do exist show a seasonal pattern such as Clinic 4 (table 2 and figure 4), then a mathematical correction can be made only if complete data are available for a previous cycle. Such a case is shown in table 3: Clinic 5 had exactly the same seasonal consumption pattern in 1998 as Clinic 4's pattern for 1999, and a similar seasonal pattern (but with higher consumption rates overall) in 1999. Unfortunately, Clinic 5's report for May 1999 is missing.

Table 3. IUD Consumption in Clinic 5 in CY1998 and CY1999

Month	CY1998	CY1999
January	10	12
February	13	16
March	17	20
April	22	26
May	30	??????
June	27	32
July	29	35
August	19	23
September	21	25
October	14	17
November	11	13
December	12	14
Total	225	233 + ?????

In this case, the forecaster can correct for the missing data point by assuming that the proportion of total consumption for 1999 represented by May 1999 is the same as the proportion of total consumption for *1998* represented by May *1998*. The proportion is calculated simply by dividing the figure for the time period in question by the total—

$$\text{Proportion of use represented by a single period} = \frac{\text{Use in single period}}{\text{total consumption}}$$

So—

$$\text{Proportion of use represented by May 1998} = \frac{30}{225} = 0.133$$

It is probably reasonable to assume, therefore, that May *1999* represents 0.133 of *1999's* total consumption.

Of course, 1999's total consumption is not known, because May 1999's data are missing. However, the 1999 total figure can be estimated using the process for incomplete reporting discussed earlier. The formula is—

$$\text{Estimated total use} = \frac{\text{Quantity reported used}}{\text{Proportion of total use reported}}$$

The proportion of 1999's use that *was* reported is 0.866 (i.e., everything but the 0.133 assumed to represent May 1999) and the 1999 consumption excluding May's figure was 233, as shown in table 3. Thus—

$$\text{Estimated total use for 1999} = \frac{233}{.866} = 269.05$$

Finally, this estimated total is multiplied by May's estimated proportion to arrive at the correction for the missing data point. The formula is—

$$\text{Estimated use for missing period} = \text{Estimated total use} \times \text{Proportion of use represented by period in previous year}$$

So—

$$\text{Estimated use for May 1999} = 269.05 \times 0.133 = 35.7, \text{ rounded} = 36$$

Of course, data for multiple time periods may be missing, in which case there will be no complete data sets to which these formulas can be applied. In such instances, the forecaster can go back to the graphical representation of the data and fill in the missing points by eye—or make further field visits to collect the missing reports.

3.3. Adjustment for Both Incomplete Reporting and Missing Time Periods

It is also possible that reporting is incomplete *and* that data for some periods are missing. The above formulas can be applied sequentially to make such corrections. When this is necessary, the correction for incomplete reporting should be made first; then the appropriate formula for correcting for missing data should be applied.

4. Estimating Consumption Using Trends in Logistics Data

All the preceding examples are projections based on quantities of product dispensed to clients (and assumed to be consumed). In programs where data from the LMIS are complete and of good quality, a logistics data-based forecast can be prepared by simply following the procedures described in chapters 2 and 3. Because these procedures require very few assumptions on the part of the forecaster, logistics data-based projections normally provide the best basis for short- and medium-term forecasting of future product use. Of course, brand new programs do not have historical data of any kind and, so they cannot use this projection method.

4.1. Data Sources and Limitations

Historical consumption data are drawn from the program's LMIS, and may be referred to as distribution, sales, dispensed-to-user, or dispensed-to-client data. Consumption data are also sometimes called *issues* data, though, as mentioned earlier, logisticians prefer to reserve this term for quantities issued from higher levels of the distribution system to intermediate levels. Regardless of the terminology, reports of quantities dispensed to clients *at the lowest level in the distribution system* should be used for forecasting wherever possible, because historical trends in consumption are the single best predictor of future consumption. When data from the lowest level are incomplete or incorrect, the forecaster must use distribution data from the lowest level for which there are reasonably complete and accurate data. In practice, it is often necessary to strike a balance between completeness of reporting and nearness to the lowest level. Use great caution, however, in substituting issues data from a higher level for dispensed-to-client data; if the lowest-level facilities are stockpiling commodities (or letting them expire or be lost), issues data may be completely unrelated to actual consumption.

Some of the advantages and disadvantages of logistics data for forecasting are summarized in table 4.

Table 4. Forecasts Using Logistics Data

Advantages	Disadvantages
❑ Based on the quantity you are trying to predict—consumption. ❑ Requires few assumptions. ❑ Automatically takes distribution/service delivery constraints into account. ❑ Easy to understand and prepare. ❑ Requires little knowledge of forecasting. ❑ Easy to systematize and institutionalize.	❑ Assumes that the future will be similar to the past. ❑ Assigns equal value to old and new experience. ❑ Incorrect if there have been instances of over- or undersupply (or stockouts) in the past. ❑ Often ignores losses. ❑ May confuse distribution (issues) with consumption (dispensed-to-client) data. ❑ Does not take into account changing program plans.

In general, the data sources for consumption figures include—

- ❐ The reporting system or LMIS (where contraceptives dispensed to clients are reported directly from outlets on a monthly or quarterly basis).
- ❐ Receiving records.
- ❐ Records of contraceptives issued and/or dispensed.
- ❐ Records used for stock accounting and/or monitoring (e.g., inventory control cards, stores registers).
- ❐ Financial records, including budgets, records of payment, and others.
- ❐ Suppliers' shipping records.
- ❐ Records of physical inventories.

4.2. Evaluating the Quality of Logistics Data

Unfortunately, many programs lack complete and accurate dispensed-to-client data. The initial activity in these cases is evaluation of the available data.

The quality of any data source depends on three factors—

- ❐ Design of the data collection system.
- ❐ Accuracy of the data.
- ❐ Completeness of the data.

The *appropriateness* of the system design can be evaluated by the following—

- ❒ Determining if all the data required (in this case, consumption or dispensed-to-client data) are collected and reported by the system.
- ❒ Assessing the difficulty of data collection, data entry, and processing.
- ❒ Assessing the completeness and format of the output.
- ❒ Determining if the instructions for operating and maintaining the system are clear and complete.
- ❒ Determining if "nice to know" but unnecessary data overburden the system.
- ❒ For automated systems, determining whether data are collected, entered, and processed in a timely manner.

If consumption data are not gathered or are gathered by a system so flawed that its output is clearly unreliable, the program's routine reporting system cannot be used to prepare the forecast.

The *accuracy* of MIS or LMIS reports should be checked in a representative sample of facilities by comparing reports from higher levels with local records. Even if done in only a small sample of sites, such verification must be completed before the forecaster can confidently prepare a logistics data-based forecast. It may be that some sites maintain no records, or that their records are inaccurate. For example, losses and/or contraceptives borrowed from another outlet might not be recorded or reported. The verification effort will reveal such problems.

If the MIS is automated, the accuracy of the data entered into the computer system must also be checked by comparing data reported at higher levels with corresponding data recorded at lower levels.

Completeness of the data can be verified by the following—

- ❒ Determining whether reporting is up-to-date.
- ❒ Counting the number of reports submitted and comparing this number with the number required.
- ❒ Determining if all required data are contained in each report.

Appendix 2 contains more complete guidelines for assessing an LMIS. Common problems with LMIS data, with possible solutions, are summarized in table 5.

Table 5. Logistics Data: Problems and Solutions

Problems	Typical Solutions
Issues data versus dispensed-to-client data	❑ Use data from lowest level available. ❑ Beware of double counting. ❑ Check inventory control and data collection processes.
Incomplete data	❑ Compensate through extrapolation and interpolation. ❑ Adjust for factors such as volume and seasonality.
Timeliness	Same as for incomplete data.
Data quality/reliability	❑ Are data recording and reporting procedures understood and followed? ❑ Crosscheck— ▪ dispensed-to-client records with stock records; ▪ stock records with actual stock levels; ▪ records from different levels on movement of same stock. ❑ Validate with other forecasts.
Incorrect data collected	❑ Collect correct data. ❑ In cases where records/reports are kept by method, not brand: ▪ limit number of brands to one; ▪ do a clinic survey to determine brand mix.
Stockouts and stock imbalances	❑ Compensate through extrapolation or interpolation, if not severe. ❑ If severe or prolonged, don't use.
Losses not distinguished from consumption	Reduce consumption by estimated losses.

4.3. Correcting for Flawed Logistics Data

At the conclusion of these investigations, the forecaster must decide whether the quality of available data is sufficient to proceed with a logistics data-based forecast. A number of techniques beyond those discussed in chapters 2 and 3 can be used to compensate for common flaws in logistics data, as discussed below.

4.3.1. When Consumption Data Do Not Exist

The scarcity of reliable stock balance and consumption data at the service delivery level of many programs has led logisticians to seek substitutes or surrogates for consumption data. Unfortunately, there are no adequate substitutes. However, because commodity planning must proceed (usually under severe time constraints), issues data are often used as a proxy for consumption. For example, it is common to assume that everything the central medical store has issued to the districts during a particular time period has been dispensed, and that this figure can be taken to represent the level of total consumption.

In a perfectly operating maximum-minimum (max-min) inventory control system, stock is issued on a replacement basis, and the quantities issued from any program level closely approximate consumption.[1] However, a max-min system can only operate perfectly if its information system operates perfectly, because the control procedures are based on consumption data. Thus, where consumption data are not available, it must be presumed that the inventory control procedures do *not* work well. In such cases, using issues data as a surrogate for consumption data will only perpetuate current and past stock imbalances and forecasting errors. The higher the level in the distribution system from which issues data are used, the greater the possibility of grievous error.

In these situations, it is usually still possible to prepare a forecast using logistics data. In small countries, site visits can be made to most or all higher-level facilities and a sample of service delivery points (including those with the largest volume of contraceptive distribution or, perhaps, all of them). In larger countries, only a sample of outlets and higher-level facilities can be visited. In either case, the review should follow one or more distribution channels from top to bottom (or bottom to top). At each level, physical counts of stock on hand should be taken and compared to inventory records, receipts data should be cross-checked with issues data from the level above, and issues data should be crosschecked with receipts data from the level below. These data can be used to prepare a reasonably good estimate of consumption.

In some countries where information systems are quite inefficient, such a review is conducted annually, not only to collect information on service delivery and contraceptive supply, but also to supervise, evaluate, and gradually improve the information system.[2] This special effort is feasible in most situations, and is even more important when the quantities of contraceptives donated or distributed are large.

Logistics data gathered in this fashion can be complemented with small client surveys, taken to determine how much those clients normally purchase (or consume) in a given period of time—for example, one month or one week. Such data can be used to estimate annual or quarterly consumption. If these mini-surveys are conducted annually, comparisons can be made against the results obtained in earlier years to establish consumption trends.

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1 For a full discussion of maximum/minimum inventory control systems, see JSI/DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs*. Arlington, Va.: JSI/DELIVER, for the U.S. Agency for International Development.

2 Procedures for taking these physical inventories can be found in JSI/DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs*. Arlington, Va.: JSI/DELIVER, for the U.S. Agency for International Development.

All of these are very simple techniques, within the reach of any country or organization. In all countries, even the least developed, there are firms that specialize in marketing, advertising, and survey-based market studies. It is usually cheaper and more efficient to contract with one of these local agencies to conduct such surveys, rather than to train the staff of family planning organizations or use foreign consultants.

4.3.2. When Consumption Data Are Not Reported

If consumption data are not gathered or reported, but other logistics data are, stock records can be used to estimate historical consumption patterns. These records must include receipts, issues, and inventory levels for (at least) the most recent two years, preferably for the lowest level in the distribution system. Ideally, these data would be available for all program locations over a longer period of time. Where these data exist, consumption can be estimated by adding receipts during the year to the beginning inventory and subtracting the ending inventory. The formula is—

$$\begin{array}{c}\text{Estimated use}\\ \text{at lowest level}\\ \text{during period}\end{array} = \begin{array}{c}\text{Beginning inventory}\\ \text{at lowest level}\end{array} + \begin{array}{c}\text{Receipts}\\ \text{at lowest level}\end{array} - \begin{array}{c}\text{Ending inventory}\\ \text{at lowest level}\end{array}$$

If receipt data from the lowest level are not available, issues data from the next higher level can be used.

There are dangers in using this technique. First, the formula makes no distinction between consumption and losses or expiration. This problem is discussed further below. Substituting issues data from the next higher level assumes that no product is lost in transit or storage, which may also be untrue.

When lower-level logistics data are not available, it is common to apply this technique with data from the central store and, perhaps, the next level down. This is even more dangerous, because the above problems may exist at *every* level, thus compounding errors of estimation. Worse, inventory fluctuations at lower levels are ignored by this technique. For example, applying the formula at the district level corresponds to the assumptions that district-level issues equal service delivery-level consumption, and that lower-level inventory control systems are completely functional. These assumptions are questionable at best, and should be verified by site visits to selected outlets. It may be that commodities are simply piling up at the lowest level unused, or worse, that the outlets have used *everything* and have run out of stock. It is preferable, in such cases, to take a physical inventory at a sample of outlets, as described earlier. In any event, field inventories collected during this investigation should be recorded and preserved, because they will be needed when preparing estimates of quantities to be procured.

4.3.3. When Consumption and Losses Are Not Distinguished

Even where consumption data are reported from the lowest level to the highest, there may be no data that indicate the quantities of a product that were used and the quantities that were lost, making it necessary to assume that everything not still in storage was consumed.

This assumption overestimates use by the amount of losses that actually occurred, with the result that the next forecast overestimates consumption, perhaps leading to oversupply and additional losses in the future. An essential task for the forecaster is to investigate whether this is happening, and, if so, to reduce reported consumption figures by the estimated amount of losses. Chapter 11 discusses procedures for estimating losses.

4.3.4. When There Were Stockouts

It is important to understand that even when logistics records accurately reflect true consumption, they might not reflect true demand. This happens when some contraceptives are out of stock for extended periods.

If stockouts were a problem during the period covered by the historical data, it may be possible to adjust the consumption data to reflect true demand using a formula similar to the one used for missing reports. That is—

$$\text{Estimated consumption during period} = \frac{\text{Quantity reported consumed}}{\text{Proportion of time stocks were available}}$$

For example, if outlets reported that 850,000 cycles of Lo-Femenal orals were dispensed last year, and it is known that they were stocked out, on average, 25 percent of the time, then—

$$\text{Estimated consumption during period} = \frac{850{,}000}{0.75} = 1{,}133{,}333$$

This calculation assumes a more or less even distribution of stockouts during the period. In adjusting actual consumption data in a time series, it is important to verify this assumption, as discussed in chapters 2 and 3. If, for example, all the outlets were stocked out during the last quarter due to a missed shipment, and if consumption had been rapidly rising until then, this formula underadjusts the consumption figures.

It is also important to note that facilities may be effectively stocked out even though inventory records do not show zero stock balances. In undersupply situations, it is common for staff to hoard small (or large) quantities for emergency use or other reasons. The forecaster must be alert to this possibility, looking both for actual stockouts and for situations in which stock is not moving.

Stockouts are not the only reason that consumption may underestimate (or overestimate) true demand. Other constraints at the service delivery points, as well as the program's service delivery policies, may significantly influence quantities dispensed to clients. For example, consumption records may under-represent true demand for Depo-Provera® if staff at a significant proportion of facilities are not trained or authorized to provide injections.

4.4. Completing and Adjusting the Logistics Data-Based Forecast

When the necessary corrections to historical consumption figures have been made, the forecaster can complete an initial logistics data-based forecast by direct extrapolation, as described in chapter 2. An example of such a forecast for the fictitious country of Anyland is included as appendix 6.

Remember, however, that extrapolation by definition assumes that the future will repeat the patterns of the past. This assumption is not always valid. Future program plans, such as opening a new clinic or beginning an intensive education and distribution program, may mean that future consumption patterns will be quite different than the past.

The forecaster, working with program managers, must take these differences into account when adjusting the logistics data-based forecast. If new clinics are opening, it may be possible to understand their likely growth patterns by examining historical consumption data from old clinics with similar catchment areas. Similarly, consumption patterns around the time of past IEC programs may indicate the likely result of new IEC programs. Where such data exist, they should be used to quantify the anticipated effect of new program plans on the consumption forecast. Perhaps the most difficult adjustments are those required when a new contraceptive method is introduced; such changes may cause *decreases* in consumption for other methods, rather than increases.

In any case, the forecaster *should not* simply add a fixed percentage to the estimate for each commodity to account for program growth. The “last year plus 10 percent” method of projection is perhaps the most common and least accurate of forecasting methods; programs almost never show such a historical pattern of growth. Increases in the use of some methods are often accompanied by decreases in the use of other methods.

Other forecasting methods that more readily reflect such changes in program plans and operating environments are discussed in the following chapters.

5. Estimating Consumption Based on Service Statistics

Consumption projections based on service statistics are made using the extrapolation techniques described in chapter 2. An additional step, multiplying estimated numbers of clients by the estimated quantities of supplies required by each client, is needed to convert the resulting service projections into consumption estimates. This conversion requires additional assumptions that may reduce the accuracy of the service data-based forecast.

5.1. Data Sources and Limitations

Service data are taken from regular management reports at service delivery sites. In some programs, such data are not available. Other programs may measure many aspects of services provided, including demographic characteristics of clients, data on quality of services, and so forth. The most commonly counted service statistics are—

- **New acceptors or new clients.** The number of persons visiting a program and accepting a method for the first time. (There are many variations of this indicator, including clients new to modern contraception, clients new to the particular facility, and clients new to a particular contraceptive method.[3])
- **Revisits.** The number of repeat visits made by all clients during a particular time period.
- **Users** or **current users.** The number of individuals served by the program who are using a particular method at a particular point in time, whether or not they have actually made a visit during the reporting period.

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3 For details, see the USAID EVALUATION Project's *Handbook of Indicators for Family Planning Program Evaluation* (reference in appendix 1).

Note that these data items measure quite different things. Service statistics systems that gather *visit* data count how many visits are made to their facilities; programs that collect *continuing user* data count how many clients they consider to be active, regardless of how many times each client has visited. *New acceptors* or *new clients* are the number of unique individuals new to family planning (or new to the specific program, clinic, or method, depending on the definition being used) during the reporting period. The sum of new acceptors plus revisits equals the total number of visits made during the time period. If a single individual made three visits, that person is counted three times. Measurements of users or current users, on the other hand, count this individual only once. Accurate counts of users or current users are very difficult to obtain except in programs with sophisticated computer systems that track individual clients through time. The trend today is to encourage programs to track numbers of visits rather than numbers of clients because of the difficulties associated with tracking individuals who may change clinics, switch from a public to a nongovernmental organization (NGO) provider, or change names due to marriage.

If new acceptor or new client and revisit data are available, they can be used to forecast commodity requirements. Some advantages and disadvantages of service statistics for forecasting purposes are shown in table 6. The most important limitation of these data for commodity forecasting is that a specific assumption must be made regarding the amounts dispensed at each client visit.

Table 6. Forecasts Using Service Statistics

Advantages	Disadvantages
❑ Automatically takes distribution and service delivery constraints into account. ❑ Easy to modify forecast to account for program service targets. ❑ Focuses discussion on client services. ❑ Easy to understand and not difficult to prepare. ❑ Requires little knowledge of forecasting. ❑ Easy to systematize and institutionalize.	❑ Requires critical assumption regarding dispensing protocols. ❑ Assumes that the future will be similar to the past. ❑ Assigns equal value to old and new experience. ❑ Incorrect if services have been interrupted for any reason. ❑ Definitions of critical data items (e.g., new client, revisit, new user, user, continuing user) likely to be unclear or applied inconsistently. ❑ Brand-specific data (or even method-specific data) may not be gathered. ❑ Produces unrealistic forecast if service targets are unrealistic.

Basic service statistics data should be available from an organization’s MIS, and dispensing policies should be found in the organization’s policies and procedures or training materials. Unfortunately, service statistics reporting systems are frequently very weak, and dispensing practices may not be standardized (or standards may not be enforced).

5.2. Evaluating the Quality of Service Data

This data source, like logistics data, may suffer from inaccuracy because of poor reporting system design, nonreporting, and/or inaccurate reporting. Comments in chapter 4 regarding appropriateness, accuracy, and completeness of logistics data apply equally to service statistics. The same processes of information system evaluation and field verification of data should be applied before a decision is made to prepare a service data-based forecast. This evaluation can be completed simultaneously with the logistics information system analysis.

In addition to these concerns, there are often problems with service statistics definitions. Different programs, sometimes within the same country, may use different definitions for new acceptors, continuing users, active users, or any of the other measures. Even within a single organization, program managers may redefine the terms without giving proper training to staff who record the data at the clinic level. When this occurs, service data are unreliable, and only marginally useful for forecasting contraceptive needs. Further complicating the process, service statistics may categorize clients by method but not by brand. Knowing the total quantity of oral contraceptives required is not sufficient for forecasting if the program offers four different brands. In such cases, the forecaster is required to determine the *brand mix* from other data. Table 7 summarizes common problems with service statistics data sources, and offers common solutions.

Any of these difficulties may preclude preparation of a service data-based contraceptive forecast. It is suggested that service data-based forecasts be prepared only in cases where the following criteria are met—

- The service statistics reporting system reports data on visits (either in total or broken down by new acceptors or new clients and revisits).
- Method mix can be determined, either because visit data are reported by method or brand, or because other data exist that allow the forecaster to reasonably estimate a method mix breakdown to apply to total visits.
- Prescribing protocols are reasonably standardized throughout the program, so that commodity use can be calculated from the service data-based forecast, as described below.

5.3. Completing and Adjusting the Service Data-Based Forecast

If the decision is made to proceed with a service data-based forecast, then graphs of historical visit data should be prepared, as described in chapter 2, and the appropriate extrapolation technique should be used to make the forecast. If service data reporting is incomplete, the formulas shown in chapter 3 can be used to adjust for missing data. Depending on the prescribing protocols of the program, it may be necessary to make different consumption calculations for different types of visits, or at least for new acceptors and revisits; reasons for this are discussed at the end of this chapter.

Table 7. Service Statistics Data: Problems and Solutions

Problems	Typical Solutions
Definitions ❑ Unclear. ❑ Reporting and recording procedures not understood or followed.	❑ If not defined clearly or correctly collected, don't use. ❑ Define each statistic clearly. ❑ Ensure that service statistics recording and reporting procedures are understood and followed.
Visits ❑ Do clinic personnel know and follow guidelines for number of units to dispense to clients?	❑ If no guidelines, or guidelines not followed uniformly, don't use. ❑ If guidelines are known and followed, multiply number of visits by standard quantity dispensed to convert to quantities of contraceptives.
Users	Don't use for commodity forecasting.
Timeliness/incomplete data	❑ Compensate through extrapolation and interpolation. ❑ Adjust for such factors as volume and seasonality.
Lack of brand-specific data	❑ Use method-specific data as upper boundary for aggregate brand estimates made by another method (e.g., logistics data-based). ❑ Do a field-based study of brand mix.

5.3.1. Adjusting the Projection Based on Program Plans

Some programs frame their plans in terms of service delivery targets—for example, anticipated numbers of new acceptors and revisits, either in total or broken down by method. Such plans must be accommodated in the forecasting process, but unrealistic targets should not simply be incorporated into the forecast.

Future targets should be analyzed in light of current trends, and discussions should be held with program planners and managers to help them develop realistic targets. A major service that the forecaster can provide in this process is comparing service targets to extrapolations based solely on historical data. Since planning targets are frequently *very* optimistic, a compromise between such plans and historical reality is usually required. Another frequent error is the assumption that use of all methods will increase uniformly over time—the *last year plus 10 percent* method of forecasting. As stated in chapter 4, this assumption is almost always wrong. While a new program may initially experience growth in every method, more mature programs usually experience a gradual shift from less effective traditional methods to more effective modern methods, and from temporary modern methods to permanent methods. As this transition occurs, consumption for some methods may actually *decrease*. These trends can also be identified through service data-based forecasts made using actual historical data.

5.3.2. Calculating Commodity Consumption from Visit Projections

After the forecasts of service levels are prepared and agreed upon, commodity consumption for the projected service levels can be estimated. Table 8 and figure 5 show sample service statistics data for 1999 and an extrapolation for 2000, which are used to illustrate these calculations.

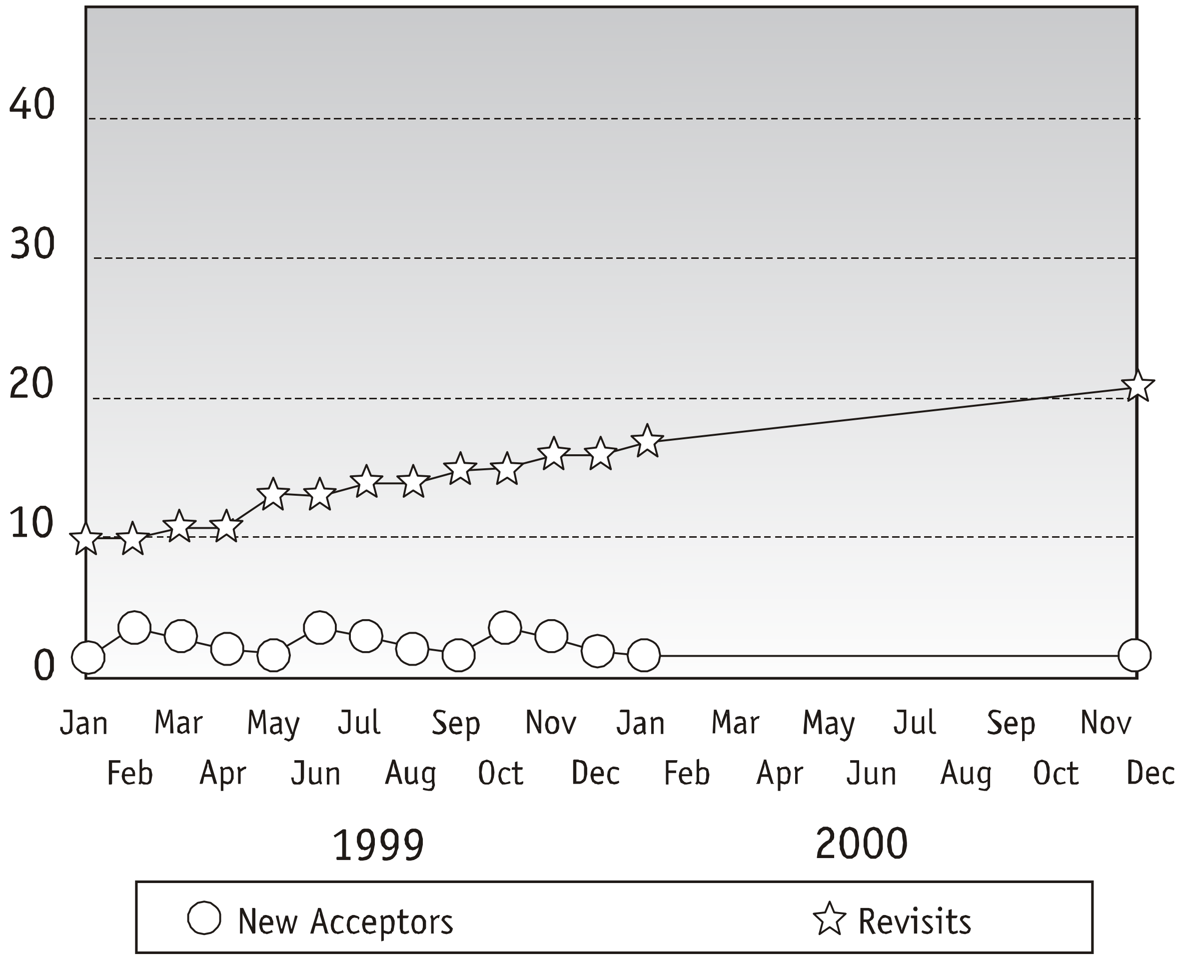
Table 8. CY1999 Service Activity at Clinic 5 and Projections for CY2000 Oral Contraceptives

Month	1999 (Actual)		2000 (Projected)	
	New Acceptors	Revisits	New Acceptors	Revisits
January	2	10	2	16
February	3	10	2	16
March	2	11	2	17
April	1	11	2	17
May	2	12	2	18
June	3	12	2	18
July	2	13	2	19
August	1	13	2	19
September	2	14	2	20
October	3	14	2	20
November	2	15	2	21
December	1	15	2	21

Most programs have stated policies on the quantities of contraceptives to be dispensed when clients visit an outlet. For example, the policy might be, "Clients who accept oral contraceptives for the first time are to be given one monthly cycle (mc) at the first visit and three mc on subsequent visits, providing there are no contraindications." If all outlets follow this policy and there are rarely any contraindications, pill use is estimated by adding the number of first (or initial) visits by pill clients to three times the number of subsequent visits (or revisits). That is, for each type of visit and method, the following formula applies—

$$\begin{array}{c} \text{Estimated use} \\ \text{for next} \\ \text{period} \end{array} = \begin{array}{c} \text{Estimated} \\ \text{total visits} \\ \text{of this type} \end{array} \times \begin{array}{c} \text{Quantity of product} \\ \text{given at each visit} \\ \text{of this type} \end{array}$$

Figure 5. CY 1999 Service Activity at Clinic 5 and Forecasts for 2000: Orals



Using the above dispensing policy and the data for clinic 5 from table 8—

$$\text{Estimated use for 2000} = \left(\text{Estimated new visits for 2000} \times 1\text{ mc}\right) + \left(\text{Estimated revisits for 2000} \times 3\text{ mc}\right)$$

$$= (24 \text{ new visits} \times 1\text{ mc}) + (222 \text{ revisits} \times 3\text{ mc})$$

$$= 690 \text{ monthly cycles}$$

In this example, commodity usage for initial visits and revisits must be calculated separately, because the program policy for contraceptive distribution differs by visit type. If program policy does not distinguish among visit types ("All condom clients are given twelve condoms at each visit."), only one calculation is required.

This calculation is accurate when the policy regarding quantities dispensed at each visit is followed faithfully in all or almost all service outlets. However, dispensing policies often are *not* followed faithfully. In programs where contraceptives are sold, the amount purchased differs from one client to another. Even where commodities are provided free of charge, the norm may vary from time to time, or from one site to another. If there have been commodity shortages, quantities dispensed at each visit may have been reduced. Conversely, if contraceptives are nearing their expiration dates, quantities dispensed at each visit may have been *increased*, so that the products can be used before they expire. Quantities dispensed at each visit might also be higher if service delivery points are under pressure to increase overall distribution levels.

When such difficulties are encountered, the forecaster and program managers must agree on necessary adjustments to the figures used for the quantity of product given at each visit. Of course, the degree of confidence in the final forecast depends on the accuracy of these adjustments. At a minimum, dispensing practices should be investigated explicitly at a sample of service delivery points before these decisions are made.

The formulas for estimating consumption presented here can be applied equally well to service targets or to estimated service levels extrapolated from historical data. Thus this forecasting method can be used in new programs that have no historical data on either services or consumption.

A complete example of a service data-based forecast for the fictitious country of Anyland is included in appendix 6.

6. Estimating Consumption Using Population Data

Both of the preceding forecast methodologies use trends in historical data to predict future patterns of contraceptive consumption. A different forecasting technique—population data-based forecasting—uses demographic data from the Demographic and Health Surveys (DHS) and other sources of population and family planning data to estimate future contraceptive demand. Because these population surveys are conducted at odd, infrequent intervals, and because different questions are asked from one survey to the next, there are rarely enough comparable historical data points to apply the extrapolation methodologies discussed in chapter 2 to a population data-based forecast.

However, it is possible to prepare a forecast using population data by setting a goal for the *total fertility rate* (TFR) or *contraceptive prevalence rate* (CPR) for the ending year of the forecast and determining how many contraceptive users are required to reach this goal. Numbers of contraceptive users are then converted into estimates of consumption using the *couple-years of protection* (CYP) conversion factors, which are simply the estimated quantities of contraceptives required to protect a couple from unwanted pregnancy for one year.

A major consideration in making a population data-based forecast is that the quality of the forecast depends on the accuracy of the TFR or CPR goal used. Setting an appropriate goal requires familiarity with the individual program and country, and an understanding of historical precedents regarding rates of TFR or CPR change in developing countries. Goal setting is complicated further by the fact that many family planning programs have already established overly optimistic goals. Significant errors in selecting the ending-year goal will cause large errors in the forecast.

On the other hand, this methodology has a significant advantage over logistics- and service statistics-based forecasts because it does not require historical program data. Consequently, population data-based forecasts are particularly appropriate when historical service or logistics data are unavailable or inaccurate, and for new programs that lack historical data.

However, the assumptions underlying population data-based forecasts may significantly affect their accuracy. Because they are not based on program performance data, population-based forecasts do not take into account limitations of the service delivery or logistics systems. Furthermore, even if a population-based forecast accurately reflects demand by the population at large, important assumptions must be made regarding the portion of that demand that will be fulfilled by a particular program. While population-based forecasts may give an accurate estimate of need, such estimates may not be indicative of quantities clients will actually demand, or of quantities that they will finally consume. These issues require additional assumptions that may further reduce the forecast's accuracy.

For these reasons, population-based projections are more often used for long-range forecasting, or for validation of short-term forecasts made by other methods. Table 9 summarizes some of the advantages and disadvantages of population-based forecasts.

Table 9. Forecasts Using Population Data

Advantages	Disadvantages
❑ Independent of existing service delivery system(s). ❑ Does not suffer data limitations of other methods (missing reports, incomplete data, low quality of recording/reporting). ❑ Where survey design is sound and data processing rigorous, may provide more accurate estimates of consumption. ❑ Provides estimate of maximum need or demand. ❑ Usable in new programs with no historical data.	❑ Does not automatically take account of service delivery or logistics system limitations. ❑ Requires critical assumption for client usage rates of each method (CYP factor). ❑ Since contraceptive source data are frequently inadequate, requires critical assumption regarding portion of total demand to be met by program. ❑ Often requires critical assumptions regarding trends in *total fertility rate*, *contraceptive prevalence rate*, and *method mix*, which may be overly optimistic. ❑ Subject to sampling and non-sampling errors (particularly for methods with very low prevalence). ❑ Data rarely broken down by brand. ❑ Survey data on condom use as backup method or for HIV/AIDS prevention frequently inadequate. ❑ Survey data frequently old. ❑ Losses cannot be estimated from survey data alone.

6.1. Manual versus Automated Projections

As with the logistics- and service data-based forecasting techniques presented earlier, population data-based forecasting can be done manually. The manual method is presented in full here, and is also the basis for the Anyland population data example shown in appendix 6. Because the manual technique requires a very large number of mathematical calculations, and because an excellent software program (Spectrum/*FamPlan*) for carrying out the same tasks is available, this chapter concludes with a brief explanation of the Spectrum software. Appendix 3 presents a more in-depth description of Spectrum/*FamPlan* and the required input data. Data requirements and sources, considerations in evaluation of data quality, and issues in selecting ending-year values for *method mix*, *brand mix*, CPR, and *source mix* are the same for preparing either a manual or a Spectrum/*FamPlan* forecast.

6.2. Data Requirements and Sources

Population and family planning data are the results of survey, census, or operations research studies of a geographical area or specific population group. The key demographic and program data required for contraceptive forecasting are—

- **Number of women of reproductive age (WRA).** Number of women in their reproductive years (15–49).
- **Percentage of WRA married (MWRA) or in union.** An estimate of the percentage of WRA who are potentially at risk of pregnancy.
- **Contraceptive prevalence rate (CPR).** Percentage of the base population (WRA or MWRA) using a contraceptive method, frequently disaggregated by modern versus traditional methods and by individual contraceptive methods.
- **Method mix.** Mix of contraceptive methods used by the population, expressed as the percentage that each method constitutes of all contraceptives used.
- **Total fertility rate (TFR).** Average number of live births a woman would have if she survived to age 49 and had births at the prevailing age-specific rates.
- **Source mix.** Source of supply for contraceptives, as reported in the DHS. This is needed because most prevalence surveys report on *all* national use, whereas most forecasts are prepared for a specific program, such as a ministry of health (public sector) program.
- **Population growth rate.** Annual rate of population growth, measured as births minus deaths plus migration, or the more commonly available *rate of natural increase*, which is simply births minus deaths. It should be noted that these rates measure the growth of an entire population and may differ somewhat from the rate of growth for MWRA.

These population data are typically available from one of several sources—

- **Demographic and Health Surveys (DHS).** A regular worldwide series of surveys, including such indicators as total fertility rate (TFR), percent of women in union, contraceptive prevalence rate (CPR), source of family planning services, and method mix. DHSs are ultimately the property of the host country (through the

MOH) but are often published jointly with Macro International, Inc., under contract to USAID or the United Nations Population Fund (UNFPA).

- ❒ **Reproductive Health and Family Planning Surveys.** A series of national surveys, similar to the DHS, coordinated and published by the U.S. Centers for Disease Control and Prevention (CDC), Division of Reproductive Health.
- ❒ **National censuses.** Complete population counts taken by national census bureaus every 10 years. They detail the age and sex structure of a national population and various subpopulations, providing figures for women of reproductive age (WRA) and percent married (MWRA) or in union.
- ❒ **Intercensal surveys.** Sample surveys conducted between national censuses also provide data on WRA or MWRA.
- ❒ **Other local and national population or family planning surveys.** Additional surveys made for a variety of reasons by national or local governments, foreign donors, or others; these report population, family planning, and/or HIV/AIDS data.
- ❒ **World Population Prospects.** Population projections published every other year by the United Nations Department of International Economic and Social Affairs Statistical Office. They provide estimates of future levels of demographic variables, including TFR and WRA.
- ❒ **Levels and Trends of Contraceptive Use.** Historical contraceptive prevalence information by country, published every four years by the United Nations Department of International Economic and Social Affairs Statistical Office. This is *the* essential data source for setting CPR targets.
- ❒ **World Contraceptive Use (wall chart).** A summary of CPR trends and other data from *Levels and Trends of Contraceptive Use*, published annually by the United Nations Department for Economic and Social Information and Policy Analysis, Population Division.
- ❒ **International Data Base.** Population projections, by age and sex, for all developing countries, published by the Center for International Research of the U.S. Census Bureau; particularly useful for obtaining yearly estimates of WRA (see www.census.gov).
- ❒ **Population Reference Bureau (PRB) World Population Data Sheet.** Current worldwide estimates of family planning and demographic data, including total population, TFR, CPR, and annual rate of natural increase.

6.3. Evaluating the Quality of Population Data

Of the above sources, the DHSs and CDC surveys are the most useful for making a population data-based forecast. However, even if recent DHSs are available, it is necessary to use other sources for estimates of WRA and for guidance in setting goals for the ending year of the forecast. Though it is desirable to use local survey data when preparing contraceptive estimates, it is essential that the forecaster assess such local surveys for methodological flaws that may make the data unusable.

Some countries have none of these surveys, and in other countries the most recent survey is so old or flawed that it cannot be used with confidence. In such cases, a population data-based forecast should not be made. If population data appear serviceable, it still may be necessary to adjust data from older surveys to obtain current estimates. In any case, the forecast must be based on the same population as the surveys from which the input data are drawn.

Table 10 summarizes common problems encountered in using population data for forecasting, and offers possible solutions.

Table 10. Population Data: Problems and Solutions

Problems	Typical Solutions
Old data	If more than five or six years old, don't use them.
Unreliable data due to sampling or non-sampling errors	Don't use them.
Lack of program-specific data	❑ Get program-specific data. ❑ Estimate proportion from national data, if possible. ❑ Use national data as upper boundary for forecasts made by other methods.
Biases in survey data	❑ Be aware of them. ❑ Percentage of WRA married often underestimates percentage of WRA at risk; may need to adjust up.
Lack of brand-specific data	❑ Use method data as upper boundary for aggregate brand estimates made by another method (e.g., logistics data-based). ❑ Do a field-based study of brand mix.
CYP conversion factors	❑ Use country-specific CYP factors, whenever possible; if none, use global recommendations.
Data do not account for multiple method use (e.g., condoms as backup)	❑ Adjust CYP factor to compensate or, preferably, prepare separate projection for condom use for HIV/AIDS prevention.
Overly optimistic TFR targets	❑ Use established guidelines regarding program growth.

(continued on next page)

Problems	Typical Solutions
Partial data (e.g., regional operations research data)	❑ Decide how representative they are of country as a whole; if they are, extrapolate.
Survey data do not account for losses	❑ Estimate separately and adjust requirements estimate.

6.4. Steps in Preparing a Population Data-Based Forecast Manually

Manual preparation of a population data-based forecast requires conversion of population data into estimates of commodities needed for the various time periods covered by the forecast. In particular, the forecaster must—

1. Gather the necessary demographic and programmatic data (WRA, percent in union, method mix, brand mix, source mix, and CPR) for the beginning year of the forecast from the sources listed previously, adjusting, if necessary, for out-of-date data.

2. Forecast changes in these variables over the time period of the forecast. Interpolate between beginning- and ending-year values, and calculate the numbers of users of each method for each year of the forecast.

3. Convert numbers of contraceptive users to quantities of contraceptives required using couple-years of protection (CYP) factors.

Each of these steps is discussed in the following sections.

6.5. Gathering and Adjusting Data for the Beginning Year of the Forecast

Data for the fictitious country of Anyland are summarized in table 11. Two common difficulties with population data-based forecasting are immediately apparent: no single source contains all the necessary data for the forecast, and the data from different sources are likely to be from different time periods. In this example, it was necessary to use five different sources—the country DHS, the International Data Base of the U.S. Census Bureau, the PRB *World Population Data Sheet*, local logistics data, and the UN's *Levels and Trends in Contraceptive Use*. While the DHS and PRB data are both from 1999, the U.S. Census WRA figure is from 1996, three years out of date.

Table 11. Population Data for Anyland for 1999 Base Year Forecast

Data Item	Source	Value
Beginning (Base) Year: 1999 Ending Year: 2002		
Women of reproductive age (WRA)	U.S. Census Bureau International Data Base (1996)	4,940,447
Annual rate of population increase	PRB *World Population Data Sheet* (1999)	3%
WRA in union	DHS (1999)	100% (See following discussion)
Contraceptive prevalence rate (CPR) —all methods	DHS (1999)	16%
Annual CPR increase (percentage)	UN *Levels and Trends of Contraceptive Use* (1998)	1.0
Method mix: Condoms Orals Other	DHS (1999)	 9.0% 45.4% 45.6%
Brand mix (orals): Lo-Femenal Other	Anyland logistics MIS (1999)	 50% 50%
Source mix (all methods): Public sector Other	DHS (1999)	 65% 35%
CYP conversion factors: Condoms Orals	 USAID Defaults	 120 15

6.5.1. Choosing the Base Year for the Projection

Adjusting old data to obtain current estimates of population parameters is time-consuming and problematic, potentially requiring the forecaster to make assumptions about trends in many of the variables shown in table 11. Such additional assumptions may introduce significant error into the forecast. To minimize the number of such adjustments, the date of the survey used as the major data source for the projection should be chosen as the base or starting year of the forecast. In table 11, the 1999 DHS is the source of most of the data items, so 1999 should be the first year of the projection, even if 2000 is the first year for which a forecast is actually desired.

6.5.2. Estimating Women of Reproductive Age for the Base Year

Both the U.S. Census Bureau and the United Nations have invested substantial effort in preparing demographically sound estimates of population growth. The U.S. Census Bureau Center for International Research's International Data Base provides estimates of WRA for all developing countries for each year between 1995 and 2005, and for the year 2010. The UN *World Population Prospects* also publishes estimates of WRA, divided by country. If possible, one of these two sources should be consulted to obtain a current estimate of WRA.

If the forecaster does not have access to these data sources, it is possible to adjust older census enumerations of WRA, using an annual population growth rate to obtain an estimate for the beginning year of the projection. It should be noted that subpopulations (such as WRA) usually have different growth rates from national populations. However, given the inherent imprecision introduced by other assumptions that must be made in preparing the forecast, and the relatively short timeframe of projections made for procurement purposes, this approximation can be used when the forecaster cannot obtain U.S. Census Bureau or UN estimates. The formula is—

$$\begin{matrix}\text{Estimated}\\ \text{WRA for}\\ \text{year } n+1\end{matrix} = \begin{matrix}\text{Estimated}\\ \text{WRA for}\\ \text{year } n\end{matrix} + \left(\begin{matrix}\text{Estimated}\\ \text{WRA for}\\ \text{year } n\end{matrix} \times \begin{matrix}\text{Annual rate}\\ \text{of population}\\ \text{increase}\end{matrix}\right)$$

Population growth rates are reported in one of two ways—the *annual rate of population increase*, which takes into account estimated births, deaths, and effects of migration; or the *annual rate of natural increase*, which takes into account only births and deaths. The first figure is more appropriate and should be used when it is available. If it is not, then the annual rate of natural increase can be substituted.

In table 11, the 1996 WRA figure is 4,940,447, and the annual rate of population increase is 3 percent. If U.S. Census Bureau or UN projections are not available, then the 1999 base year WRA figure would be calculated by using this formula repeatedly—

$$\begin{matrix}\text{Estimated}\\ \text{WRA for}\\ 1997\end{matrix} = 4{,}940{,}447 + (4{,}940{,}447 \times 0.03)$$

$$= 4{,}940{,}447 + 148{,}214 = 5{,}088{,}661$$

Similarly—

$$\begin{matrix}\text{Estimated}\\ \text{WRA for}\\ 1998\end{matrix} = 5{,}088{,}661 + (5{,}088{,}661 \times 0.03)$$

$$= 5{,}088{,}661 + 152{,}660 = 5{,}241{,}321$$

And finally—

$$\text{Estimated WRA for 1999} = 5{,}241{,}321 + (5{,}241{,}321 \times 0.03)$$

$$= 5{,}241{,}321 + 157{,}240 = 5{,}398{,}561$$

6.5.3. Estimating the Actual Population at Risk of Pregnancy

The data sources discussed earlier will provide estimates of the percentage of WRA currently married and/or the percentage of WRA in union. However, neither of these figures is a good estimate of the number of women at risk of pregnancy. In many societies, substantial numbers of women and men are sexually active without being married or "in union." Active teenage women, in particular, are often underreported, though more recent surveys in some countries have targeted teenagers specifically.

Accordingly, it is frequently necessary to adjust reported figures to give a more accurate estimate of the population actually at risk. Adding the percentage of WRA reported in the DHS as living together to the percentage of WRA currently married yields an estimate of WRA in union; this figure should always be used instead of WRA currently married when data are available.

Although WRA in union gives a more accurate picture of the population at risk, it may still seriously underestimate the target population in some countries. When the forecaster has reason to believe that the WRA in union significantly underestimates the actual population at risk of pregnancy, a different strategy can be used to prepare the forecast—*all* women of reproductive age can be considered at risk, and the CPR for *all* women, as opposed to *currently married women*, is then used for the projection. Because it is never true that all women are at risk of pregnancy, this assumption is obviously illogical. Mathematically, however, using the CPR for all women, which is lower than the CPR for WRA currently married, compensates for the assumption that 100 percent of women are at risk, allowing the forecaster to complete the projection without making a potentially incorrect guess about the number actually at risk.

6.5.4. Choosing the Appropriate Contraceptive Prevalence Rate for the Base Year

The initial CPR estimate is best obtained from the most recent DHS table, "Current use of contraception, by age." This table provides CPR figures for both WRA currently married and all women. If the projection is to be made using WRA in union or WRA currently married, the first CPR figure should be used; if the projection is to be based on total WRA, then the second CPR figure should be used.

If a survey other than the DHS is used, the same principle should apply. The forecaster must be certain that the base population for WRA and the base population for CPR are the same.

6.5.5. Calculating the Method Mix

Most surveys provide data on contraceptive users by method. If the DHS is used, for example, the desired figures are contained in the table, “Current use of contraception, by method.” This table provides data for all women and WRA currently married. As with CPR, the choice of which figure to use depends on which WRA figure has been selected as the basis for the projection.

The DHS and most similar surveys present data for each method as a percentage of all women or WRA currently married, including women who are not contracepting. For projection purposes, the forecaster needs the method mix expressed as percentages relative to all women or WRA currently married *who are using any method of contraception*. This percentage can be obtained by dividing the DHS figure for women using each method by the percentage of women using any method—

$$\begin{array}{c}\text{Method mix}\\ \text{for}\\ \text{a method}\end{array} = \frac{\text{Percentage using method}}{\text{Percentage using any method}}$$

For example, if all women are being used for the projection, and the survey reveals that 8 percent use the pill and 30 percent use any method, then—

$$\begin{array}{c}\text{Method mix}\\ \text{for}\\ \text{orals}\end{array} = \frac{8}{30} = 26.6\%$$

In other words, orals represent 26.6 percent of overall contraceptive use. This calculation is repeated for all other methods. Where surveys other than the DHS are used, it is likely that this same calculation will be needed.

6.5.6. Estimating the Brand Mix

If the forecast is being made for procurement purposes, it is usually not sufficient to know just the number of users of each method. Unless the program provides only a single brand of each method, the forecaster needs a further breakdown into individual contraceptive brands to complete the projection.

Very few surveys tabulate data by brand. The most obvious source of information on brand mix within a method is the program’s LMIS. If consumption data or low-level issues data are available, a brand mix can be calculated and used to disaggregate method figures into brands. If there is no functional LMIS, then a representative sample of service sites should be visited, records should be reviewed, and service providers and program managers should be interviewed to determine the brand mix. As with the overall method mix, the desired figure is the percentage that each brand represents of the total use *of that method*.

Of course, for new programs, no such data are available. In these cases, program targets or historical experience of other established programs should be used to make brand estimates.

6.5.7. Estimating the Proportion of National Contraceptive Use Attributable to the Program (Source Mix)

Most surveys on which population data forecasts are based are national in scope. These data can be used directly to prepare national-level consumption estimates. However, consumption estimates are often needed for individual service delivery programs (i.e., for an NGO program or for the public sector program only).

To prepare program-specific estimates, the forecaster must estimate the *source mix*—the proportion of national contraceptive use attributable to the particular program for which the forecast is being prepared. This proportion may be very different for different methods. For example, an HIV/AIDS prevention program may contribute a significant portion of the national condom CPR, but nothing at all for other contraceptive methods. Thus, the source mix will likely have to be estimated separately for each method.

As shown in appendix 3, DHSs include a table called "Source of supply for modern contraceptive methods." In many cases, this table can be used to estimate the source mix. In other cases, however, the DHS breakdowns may be too general, or the survey may be too old. A special problem in preparing forecasts for social marketing programs is that many survey respondents report the source of their supply as "pharmacy," making it difficult to distinguish between social marketing and purely private sector activities. When such problems are encountered, the forecaster and program managers should estimate source mix based on local data or program managers' experience. However, errors in these estimates yield proportional errors in the consumption forecast. If data are lacking and managers are unsure of their estimates, less confidence can be placed in the final forecast.

In the Anyland example in table 11, the DHS showed that the public sector accounts for 65 percent of contraceptive use for every method. To prepare a projection for the MOH, the forecaster should use a source mix of 0.65 for each method, assuming the MOH is the only public sector program that provides contraceptives.

6.6. Estimating WRA, CPR, Method Mix, and Source Mix for the Final Forecast Year

The above formulas and procedures provide the necessary population parameters for a single year—the base year of the projection. Before consumption estimates can be made, it is necessary to project how these parameters will change over the forecast period. The three population parameters most likely to change significantly over the course of a short- or medium-term forecast are WRA, method mix, and CPR. Consequently, at least these parameters require estimates for the future years of the forecast. The most common technique is to estimate values for these data items for the last year of the projection and then calculate intermediate values using the formulas for linear trend projections shown in chapter 2.

In a mature and relatively stable program, it may be reasonable to assume that both method mix and CPR will remain constant for a period of up to four years, so that the linear trend calculation is needed only for WRA. In a less stable environment, the CPR and method mix must be adjusted as well, and the brand mix may also differ. A similar judgment must be made regarding the source mix. In such situations—and in the case of longer-range forecasts covering more than four years—manual calculations are extremely tedious. In these instances, automated techniques (preferably Spectrum/*FamPlan*) should be used to make the projection.

Regardless of whether a manual or automated projection is made, the forecaster needs to present the estimated future values for WRA, CPR, method mix, source mix, brand mix, and the other parameters in a form similar to that shown in table 12, ensuring that program managers and other concerned individuals (e.g., donors) agree that the figures are reasonable.

Table 12. Population Data for Anyland for Final Forecast Year (2002)

Data Item	Value
Women of reproductive age (WRA)	5,899,153
Annual rate of natural increase	3%
WRA in union	100%
Annual CPR increase (in percentage points)	1%
Target contraceptive prevalence rate (CPR)—all methods	19%
Method mix: Condoms Orals Other	 9.0% 45.4% 45.6%
Brand mix (orals): Lo-Femenal Other	 50% 50%
Source mix (all methods): Public sector Other	 65% 35%
CYP conversion factors: Condoms Orals	 120 15

6.6.1. Estimating WRA for the Final Forecast Year

The WRA figure for the final year of the forecast should be taken from the source used for the base year, again preferably either the U.S. Census Bureau's International Data Base or the UN's *World Population Prospects*. If neither of these sources is available, the formula given above for adjusting older WRA data for the base year can be used repeatedly to calculate WRA figures for the forecast years, though this methodology is much less desirable.

6.6.2. Estimating CPR for the Final Forecast Year

The CPR estimate for the final forecast year is *the* crucial assumption in a population data-based forecast. A special danger derives from the fact that programs and governments often set national targets for increases in CPR that are very optimistic. The forecaster is likely to come under pressure to use these in the population data-based forecast. Except for the UN's *World Contraceptive Use* wall chart and *Levels and Trends of Contraceptive Use* there are few generally recognized data sources for historical rates of change in CPR that can be used to confirm realistic goals or refute unrealistic ones.

Given the relatively short time period of forecasts made for immediate procurement purposes, major CPR increases or decreases during the forecast period are unlikely. For reference, appendix 4 contains the most recent data from *Levels and Trends of Contraceptive Use*. Historical changes in CPR are summarized and categorized in table 13.

It is immediately apparent from these figures that the most successful family planning programs in the world have increased contraceptive prevalence by only one or two percentage points per year. In countries with lower levels of prevalence and less commitment to family planning, the change is closer to one-half of one percentage point growth per year, ranging all the way down to negative growth. One rational way to set the target CPR for the country or program in question is to check the rates of change in countries with similar programmatic and cultural settings, using the data from table 13 and appendix 4.

Another strategy is to prepare the population data-based forecast based on estimates of the trends in the TFR rather than the CPR, using Spectrum/*FamPlan* to calculate CPR changes as described later in this chapter. A great deal of effort *has* been invested in the study of TFR trends throughout the world. For example, there are country-specific and average figures for TFR decline by strength of program effort and level of development of the country, as shown in table 14, as well as UN and World Bank estimates of future levels of TFR, as shown in appendix 4.

Table 13. Annual Percentage Change in Contraceptive Prevalence by Level of Family Planning Program Effort (1982–1989) and Socioeconomic Setting (1985)

Socioeconomic Setting, 1985	Program Effort, 1982–1989							
	Strong		Moderate		Weak		Very Weak	
High	Mexico	3.3	Jamaica	1.0	Jordan	0.7	Iraq	-0.1
	Colombia	0.9	Panama	0.5	Brazil	1.1		
	Korea Rep.	2.0	Trinidad & Tobago	0.1	Costa Rica	0.8		
	Mauritius	-0.8						
	Singapore	1.6						
	Average	**1.4**	**Average**	**0.5**	**Average**	**0.9**		
Upper Middle	Thailand	1.0	Tunisia	1.8	Algeria	1.9		
	Indonesia	1.0	Botswana	1.2	Peru	1.6		
	Sri Lanka	1.0	Ecuador	1.4	Zimbabwe	1.0		
	China	1.3	Dominican Republic	1.3	Syria	1.1		
					Iran	5.8		
			El Salvador	0.6	Turkey	1.2		
			Egypt	1.6	Guatemala	0.5		
			Philippines	1.0	Paraguay	1.3		
			Malaysia	1.1				
	Average	**1.1**	**Average**	**1.3**	**Average**	**1.8**		
Lower Middle	India	0.5	Morocco	2.2	Honduras	1.5	Bolivia	1.8
			Vietnam	1.9	Kenya	1.7	Cote d'Ivoire	0.6
					Zambia	2.1		
					Tanzania	1.7		
					Pakistan	1.0		
					Haiti	1.0		
					Cameroon	1.0		
					Nigeria	0.1		
					Lesotho	1.3		
					Ghana	0.8		
			Average	**2.0**	**Average**	**1.2**	**Average**	**1.2**
Low			Bangladesh	2.3	Rwanda	1.3	Mauritania	0.3
			Nepal	1.4	Senegal	0.1	Sudan (North)	0.3
					Mali	0.2	Malawi	1.2
					Uganda	1.5	Benin	0.5
			Average	**1.8**	**Average**	**0.8**	**Average**	**0.6**

Source: Contraceptive prevalence rate increases are based on data from the UN Department for Economic and Social Affairs, Population Division, *World Contraceptive Use 1998*. The format of table 13 and the categorization of countries is taken from W. Parker Mauldin and John Ross, unpublished analysis (see Spectrum/*FamPlan* manual).

Table 14. Declines in TFR from 1975 to 1990 by Level of Program Effort (1982–1989) and Socioeconomic Setting (1985)

Socioeconomic Setting, 1985	Program Effort, 1982–1989							
	Strong		Moderate		Weak		Very Weak	
High	Mexico	1.7	Jamaica	1.7	Jordan	1.5	Kuwait	2.4
	Taiwan	1.5	Korea PDR	1.4	Brazil	1.2	Iraq	0.7
	Colombia	1.3	Panama	1.1	Lebanon	1.1		
	Korea Rep.	1.3	Trinidad & Tobago	0.8	Venezuela	1.0		
	Mauritius	0.7	Cuba	0.6	Costa Rica	0.7		
	Singapore	0.3	Chile	0.5				
	Average	**1.1**	**Average**	**1.0**	**Average**	**1.1**	**Average**	**1.5**
Upper Middle	Thailand	1.8	Tunisia	2.0	Algeria	2.6	Libya	0.8
	Indonesia	1.5	Botswana	1.8	Peru	1.7	Saudi Arabia	0.7
	Sri Lanka	1.2	Ecuador	1.6	Zimbabwe	1.4		
	China	1.1	Dominican Republic	1.5	Guyana	1.3		
			El Salvador	1.3	Syria	1.2		
			Egypt	1.1	Iran	1.0		
			Philippines	0.9	Turkey	1.0		
			Malaysia	0.6	Guatemala	0.8		
					Paraguay	0.6		
					Congo	0.0		
	Average	**1.4**	**Average**	**1.4**	**Average**	**1.2**	**Average**	**0.7**
Lower Middle	India	1.0	Morocco	2.0	Honduras	1.5	Bolivia	1.2
			Vietnam	1.4	Kenya	1.4	Myanmar	1.0
					Zambia	0.8	Liberia	0.0
					Tanzania	0.7	Cote d'Ivoire	0.0
					Papua New Guinea	0.6	Lao PDR	-0.1
					Pakistan	0.5	Congo	-0.2
					Haiti	0.5	Cambodia	-0.6
					Cameroon	0.5		
					Nigeria	0.5		
					Lesotho	0.4		
					Ghana	0.4		
					Madagascar	0.3		
					CAR	0.2		
			Average	**1.7**	**Average**	**0.6**	**Average**	**0.2**
Low			Bangladesh	2.0	Rwanda	1.7	Mauritania	0.9
			Nepal	0.8	Senegal	0.6	Sudan	0.7
					Afghanistan	0.2	Malawi	0.2
					Mali	0.0	Chad	0.0
					Guinea	0.0	Somalia	0.0
					Burundi	0.0	Benin	0.0
					Togo	0.0	Ethiopia	-0.2
					Mozambique	0.0		
					Sierra Leone	0.0		
					Burkina Faso	0.0		
					Guinea Bissau	-0.2		
					Uganda	-0.4		
					Niger	-0.5		
			Average	**1.4**	**Average**	**0.1**	**Average**	**0.3**

Source: W. Parker Mauldin and John Ross, unpublished analysis (See Spectrum/*FamPlan* manual).

In any case, it is essential that forecasts be prepared using multiple data sources, as discussed in chapter 1. This strategy will highlight excessively optimistic (or excessively pessimistic) assumptions for CPR and other data items.

6.6.3. Estimating Method and Brand Mix for the Final Forecast Year

Unfortunately, few comprehensive studies on trends in method mix have been completed, and most of the rules of thumb on method mix changes apply to long-term changes as a program moves from its initial launch to a more mature stage. This empirical record clearly demonstrates the shift over time from traditional to resupply to more permanent methods, but provides little guidance in estimating short-term method mix changes.

It is best to be conservative when estimating change in method mix over a four- or five-year period. Although method mix can be affected immediately by stockouts of a method, major shifts in the overall method mix have usually progressed more slowly. Without an aggressive program to introduce or expand the use of specific methods (backed by training for service providers and an IEC campaign to orient clients), it is unlikely that there will be significant changes in the method mix during the forecast period. Where proper launch activities were not undertaken, attempts to change even the brand mix for a single method have been unsuccessful. On the other hand, demand for some methods can increase rapidly with only word-of-mouth promotion among clients. This has happened for injectables and Norplant® in countries as different as Tanzania and Haiti. The forecaster should review all program plans to launch or expand the use of particular methods, as well as program budgets for IEC, service delivery training, procurement, and distribution.

If historical logistics or service statistics data (or multiple population surveys) are available, these should be studied to discern trends in method mix. In the absence of quantitative data, knowledgeable service providers should be interviewed, and their best estimates of trends evaluated for reasonableness. If neither of these approaches yields a satisfactory result, it may be best to assume no change in method mix over the short-term forecast period.

These same comments apply to estimation of brand mix. Where these decisions must be made without hard data, the program's information systems should be strengthened quickly.

6.6.4. Estimating the Proportion of National Contraceptive Use Attributable to the Program (Source Mix) for the Final Forecast Year

In the rare cases where two or more successive DHSs are available, and the DHS table "Source of supply for modern contraceptive methods" is sufficiently detailed, the extrapolation techniques shown in chapter 2 can be used to estimate changes in the source mix. Frequently, however, no hard data are available, and the forecaster and program managers will have to use their best judgment in estimating changes in the source mix. As with the other parameters, it is best to be conservative. Unless specific program interventions aimed at changing the market share of individual programs are planned, these percentages are likely to remain relatively constant over the time period of a short-term forecast.

6.7. Estimating Changes in WRA, CPR, Method Mix, and Source Mix over the Forecast Period

Once agreement has been reached on the population parameters for the base year and the final forecast year, values must be computed for each intermediate forecast year. For a base year of 1999 and a final forecast year of 2002, for example, values must be computed for 2000 and 2001.

6.7.1. Estimating Intermediate Values for WRA

The U.S. Bureau of the Census's International Data Base and the UN's *World Population Prospects* provide annual WRA estimates; as discussed above, these should be used where possible. If it is impossible to obtain access to either of these sources, the formula for adjusting WRA data given above can be used. The formula is—

$$\begin{array}{c}\text{Estimated}\\\text{WRA for}\\\text{year } n+1\end{array} = \begin{array}{c}\text{Estimated}\\\text{WRA for}\\\text{year } n\end{array} + \left(\begin{array}{c}\text{Estimated}\\\text{WRA for}\\\text{year } n\end{array} \times \begin{array}{c}\text{Annual rate}\\\text{of population}\\\text{increase}\end{array}\right)$$

Returning to the Anyland example, WRA for 1999 had been estimated to be 5,398,561, and the annual rate of population increase is 3 percent. The estimate for 2000 would be—

$$\begin{array}{c}\text{Estimated}\\\text{WRA for}\\\text{2000}\end{array} = 5{,}398{,}561 + (5{,}398{,}561 \times 0.03)$$

$$= 5{,}560{,}518$$

The 2001 estimate is calculated the same way.

6.7.2. Estimating Intermediate Values for CPR, Method Mix, and the Source Mix

Unless there is good reason to think otherwise, the forecaster should assume that the year-to-year change for each of these parameters is linear, and simply interpolate a line between the first and last values. Interpolation is really the same procedure as the extrapolation technique using linear trends described in chapter 2, except that the points being estimated are *between* the first and last point, rather than *beyond* the last point (hence interpolation instead of extrapolation). The formulas are—

$$\begin{array}{c}\text{Average change}\\\text{over}\\\text{forecast period}\end{array} = \frac{\text{Target value in final period} - \text{Value in base year}}{\text{Number of years in forecast}}$$

And—

$$\begin{array}{c}\text{Estimate for}\\ \text{period } n + 1\end{array} = \begin{array}{c}\text{Estimate for}\\ \text{period } n\end{array} + \begin{array}{c}\text{Average change}\\ \text{over}\\ \text{forecast period}\end{array}$$

In the Anyland example, the CPR in 1999 was 16 percent, and the target CPR for 2002 is 19 percent. So—

$$\begin{array}{c}\text{Average change}\\ \text{over}\\ \text{forecast period}\end{array} = \frac{19\% - 16\%}{3} = 1.0\%$$

And—

$$\begin{array}{c}\text{Estimate for}\\ 2000\end{array} = 16\% + 1.0\% = 17\%$$

Applying the formula again gives a CPR estimate of 18 percent for 2001.

Method mix changes for the interim time periods are calculated similarly. If changes in the brand mix within one or more methods are expected during the time period of the forecast, the same procedure can be used to calculate brand mix values for each interim period. Note that the sum of the method mix percentages for each time period must equal 100 percent, as must the brand mix percentages for each method. It may be necessary to round individual interpolated figures to reach 100 percent.

Finally, if significant changes in the source mix are expected during the forecast period, this same interpolation technique should be used to estimate the intermediate values.

6.8. Calculating Commodity Consumption for Future Time Periods

Once the forecaster and program planners have come to agreement on the above data items and projections, the consumption forecast for each method and brand can be completed.

6.8.1. General Calculation for Population Data Forecasts

The general formula for this calculation is—

$$\begin{array}{c}\text{Estimated}\\\text{consumption}\\\text{of a brand}\\\text{of a method}\\\text{in year } n\end{array} = \begin{array}{c}\text{Estimated}\\\text{WRA for}\\\text{year } n\end{array} \times \begin{array}{c}\text{CPR for}\\\text{Year } n\end{array} \times \begin{array}{c}\text{Method mix}\\\text{for this method}\\\text{for year } n\end{array} \times \begin{array}{c}\text{Brand mix}\\\text{for this brand}\\\text{for year } n\end{array} \times \begin{array}{c}\text{Source mix}\\\text{for this method}\\\text{for year } n\end{array}$$

$$\times \begin{array}{c}\text{CYP}\\\text{conversion}\\\text{factor}\end{array}$$

Although at first glance this formula appears complex, it is straightforward. Multiplying estimated WRA times the CPR, the first two factors, simply gives the total number of women at risk of pregnancy who are estimated to be contracepting. (Again, remember to be consistent in using all women or WRA in union for these factors.) Multiplying this result by the method mix and brand mix percentages, the third and fourth factors, gives the number of users being protected by a particular commodity. Multiplying further by the source mix, the fifth factor, provides an estimate of the number of those users being protected by the program.

With this figure in hand, it is necessary to estimate the quantity of commodities needed to protect those women throughout each time period. This is done using the last factor in the equation, the CYP conversion factor.

6.8.2. Using Couple-Years of Protection Conversion Factors to Estimate Consumption for Short-Term Contraceptive Methods

The quantity of commodities required to protect each user is normally estimated for a one-year period. Again, this quantity is called the *couple-years of protection (CYP) conversion factor*—the amount of a particular contraceptive needed to provide one couple with protection for one year. Table 15 shows the CYP standards established by USAID's EVALUATION Project. Although both the CYP concept and CYP conversion factors have been used for program evaluation for decades, there is still controversy regarding application of the factors for certain purposes. In particular, establishing the exact quantity of a given contraceptive required to protect one couple for one year from an unwanted pregnancy is problematic for many contraceptive methods.

Use of the standard factors from table 15 is likely to be acceptable for orals and injectables, because the CYP factor is very closely associated with the menstrual cycle, and there is little variation from woman to woman or country to country.

Table 15. Couple-years of Protection Conversion Factors[4]

Method	CYP
Oral contraceptives	15 cycles/CYP
Condoms	120 pieces/CYP
CuT 380A IUDs	3.5 CYP/insertion
Injectables	
Depo-Provera®	4 doses/CYP
Noristerat	6 doses/CYP
Cyclofem	12 doses/CYP
Vaginal foaming tablets	120 tablets/CYP
Norplant®	3.5 CYP/implant

For barrier methods, however, there is great variability from person to person and place to place, and few hard data on which to base CYP factors. The standard for condoms and foaming tablets assumes 120 acts of vaginal, protected intercourse per year, and that the two methods are not used together. It further assumes an unspecified level of client wastage. These are difficult assumptions to prove or disprove. It is known that the frequency of sexual relations varies from culture to culture and individual to individual. Moreover, many users combine condoms or spermicides with the rhythm method or withdrawal, or with sexual techniques other than vaginal coitus. Condoms used to prevent HIV/AIDS or other sexually transmitted diseases are often estimated separately. Moreover, more than one method may be used simultaneously, either for backup or, in the case of condoms, for disease prevention. The standard CYP factors do not automatically account for such variations.

For these reasons, the authors of the CYP methodology indicated explicitly the need to conduct country-specific user surveys to establish CYP factors. Use of local data for conversion factors can improve the quality of the forecast for barrier methods. Unfortunately, such data are rarely available, so the forecaster normally has to use the standard factors from table 15. In the Anyland example of table 11, for example, the calculation for condoms for the public sector for the 1999 base year (presuming there is only one brand of condoms in the program) is—

4 Stover, John, Jane T. Bertrand, Susan Smith, Naomi Rutenberg, and Kimberly Meyer-Ramirez. 1997. *Empirically Based Conversion Factors for Calculating Couple-Years of Protection*. Chapel Hill: The EVALUATION Project. Carolina Population Center, Tulane University, and The Futures Group International.

$$\text{Estimated consumption of condoms in 1999} = 5{,}398{,}561 \times 0.16 \times 0.09 \times 1 \times 0.65 \times 120 = 6{,}063{,}664$$

Note that this calculation uses the adjusted WRA estimate for *1999*, not the 1996 survey figure shown in table 11.

6.8.3. Using CYP Factors for Estimating Consumption of Long-Term Contraceptive Methods

CYP conversion factors are even more problematic in forecasting for longer-acting methods (IUD, implants), because these methods provide protection that extends beyond the time period of the forecast. This means that not all of the women being protected by these methods in a particular year need a device that year—many of them will be protected by IUDs or implants received in previous time periods. The CYP factors for IUDs and implants take into account the extended use life of these methods, with an allowance for discontinuation.

Mathematically, the *inverse* of the CYP factor for these methods gives the portion of the program's users who need devices in a given year. If no local data are available, the forecaster can just use the inverse of the factors for IUDs and Norplant from table 15 in the general formula for estimated consumption to obtain quantity estimates for these methods. If Norplant represents 2.0 percent of Anyland's method mix, for example, the required quantity for the public sector is—

$$\text{Estimated consumption of Norplant in 1993} = 5{,}398{,}561 \times 0.16 \times 0.02 \times 1 \times 0.65 \times \frac{1}{3.5} = 3{,}208$$

For IUDs, a more refined estimate is sometimes possible. It is generally true that women continue using the first device for many years or discontinue relatively quickly, switching to another method or discontinuing contraception. For commodity forecasting purposes, the simplest and most accurate assumption for IUDs is that a single device is required for each new user. If program estimates of new users can be obtained or calculated for the forecast period using the extrapolation techniques described in chapter 2, IUD quantities for each time period of the forecast should be estimated by the following formula, rather than the general formula for estimated consumption—

$$\begin{array}{c}\text{Estimated}\\ \text{consumption}\\ \text{of a brand}\\ \text{of IUD}\\ \text{in year } n\end{array} = \begin{array}{c}\text{Estimated}\\ \text{number of new users}\\ \text{of the brand}\\ \text{in year } n\end{array}$$

A complete population data-based forecast for the fictitious country of Anyland, illustrating all the manual techniques described here, is included in appendix 6.

6.9. Using Spectrum/*FamPlan* for Contraceptive Forecasting

Because population-based forecasts require so many demographic and family planning parameters, and because the calculations are long and complicated, it is much easier to use an automated tool to complete the forecast. Spectrum/*FamPlan*, developed by The Futures Group International (TFGI), is the most appropriate tool for this purpose. Appendix 3 describes Spectrum in more depth, and shows the data sources for the most important inputs to the model. Complete documentation of Spectrum/*FamPlan*, available through TFGI, provides step-by-step instructions for installation and operation of the program.

The primary advantages of Spectrum are ease and accuracy. The model requires a number of additional parameters beyond those presented in this chapter, but the program includes a database of many of the most important variables, disaggregated by country and year, which can be selected as defaults. For example, once the country and forecasting years are selected, the software presents the user with complete estimates of WRA, by year; TFR for the initial year; and high, medium, and low assumptions for the ending year. Spectrum/*FamPlan* allows the user to make changes to the default values and then calculates the impact of the changes automatically, freeing the forecaster from hours of manual calculations. This allows the forecaster to focus on verifying the accuracy of the input data.

Because the software performs all the forecasting calculations (using formulas similar to the manual procedures discussed above), potential math errors are eliminated. Moreover, Spectrum takes into account the effects of mortality on the base population and the impact of the proximate determinants of fertility on the numbers of contraceptive users required to achieve the TFR goal. These variables have a major impact on the ultimate accuracy of the forecast, but are too complex to be included in manual calculations.

6.10. Steps in Preparing a Population Data-Based Forecast Using Spectrum/*FamPlan*

The general steps in preparing a Spectrum/*FamPlan* forecast are as follows—

1. Gather the data required for the beginning year of the forecast (WRA, percent in union, TFR, CPR, method mix, source mix, *sterility*, *total abortion rate*, and *post-partum insusceptibility*) from the various sources listed above.

2. Validate the data by checking them against additional data sources where possible, and then input them into Spectrum/*FamPlan* for the base year. Even when default values of the variable are available in the program (e.g., WRA, TFR), it is important to check the defaults and make changes as required.

3. Enter a goal for TFR in the final year of the forecast. This goal should be based on program plans and trends, estimates of future TFR from the data sources listed earlier, and knowledge of historical trends in TFR decline shown in table 14.

4. Input ending year values for any of the other variables that are likely to change over the period of the forecast.

5. Run the model. Spectrum/*FamPlan* calculates the level of contraceptive use that resulted in the base year TFR, given the other demographic and program characteristics entered. It then calculates the number of users and the quantities of contraceptives these users require to achieve the TFR goal in the ending year of the forecast.

6. Use the software to produce output tables on contraceptive commodity needs, by year, for the period of the forecast.

7. Divide the quantities of contraceptives estimated by the software for each method into quantities for each brand using the techniques described earlier in this chapter. (Future versions of the software are expected to calculate brand-level data automatically.)

6.11. Gathering and Adjusting Data for the Spectrum/*FamPlan* Base Year

The data requirements for making a population data forecast with Spectrum/*FamPlan* are detailed in appendix 3, which includes an annotated example taken from actual source data for Kenya. Except for the additional proximate determinants of fertility, these inputs are the same data that were used for making the manual population data-based forecast described earlier in this chapter. With Spectrum, the forecaster is not required to adjust the figures for WRA, or to calculate the source mix or method mix by hand; the software performs this math.

The forecaster *is* required to collect the best data available and to input them accurately into the program. Of the four required proximate determinants, two (postpartum insusceptibility, percentage of WRA in union) are presented clearly in DHS tables. Another (sterility) can be estimated by proxy from the DHS (see appendix 3). The fourth (abortion) is often entered as the default (0) due to lack of credible data.

6.12. Estimating Inputs for the Final Year of the Spectrum Forecast

Spectrum/*FamPlan* requires the user to enter values for all inputs for the ending year of the projection, and then interpolates between the beginning and ending-year values to produce values for the intermediate years. Considerations in selecting the ending values of the most important variables are described in depth earlier in this chapter. Spectrum/*FamPlan* also allows ending-year values to be entered for marital status, age at first use for sterilization, and abortion. Though these are unlikely to change significantly over the time period of a short- or medium-term forecast, the forecaster should also be aware of trends in these parameters.

One parameter that will obviously change during the period of the forecast is the population of women of reproductive age. Fortunately, the *EasyProj* component of Spectrum automatically calculates future estimates of WRA based on assumptions of fertility, mortality, and migration.

The TFR estimate for the final forecast year is the crucial assumption in the automated version of population data-based forecasting. A major advantage of using Spectrum is that the forecaster can set TFR targets, rather than using CPR, as the manual technique requires. There is a good record of historical changes in TFR throughout the world, and there are several credible databases of TFR projections by country and year. Thus, TFR targets are easier to set and defend than CPR targets. The *EasyProj* component of Spectrum/*FamPlan* will automatically produce three scenarios (high, medium, and low variants) for ending-year TFR, using data developed by the UN and reported in *World Population Prospects*. The forecaster might simply choose the medium variant TFR for the projection, but—as with CPR targets—all data sources, as well as the official program goals, should be evaluated carefully before a TFR target is selected.

6.13. Completing the Spectrum/*FamPlan* Forecast

Once all these data are verified and entered, Spectrum/*FamPlan* will produce a wide range of reports. Table 16 is a Spectrum/*FamPlan* “Commodities by Method” report taken from the Kenya example of appendix 3. As mentioned above, future versions of Spectrum/*FamPlan* will disaggregate these data by brand.

Table 16. Spectrum/*FamPlan*, Commodities by Method

	Con	Fst	Inj	IUD	Npl	Pill	Trad	
KENYA98								
1998	6,512,033	48,994	1,970,307	47,803	16,049	5,322,335	0	
1999	7,149,445	51,788	2,142,428	50,702	17,726	5,728,320	0	
2000	7,821,702	54,816	2,322,163	53,737	19,535	6,146,548	0	
2001	8,534,141	57,719	2,510,977	56,743	21,425	6,580,547	0	
2002	9,282,158	60,521	2,707,387	59,713	23,392	7,026,064	0	
2003	10,061,878	63,259	2,910,181	62,653	25,436	7,479,697	0	
2004	10,870,869	66,005	3,118,601	65,589	27,568	7,939,346	0	
2005	11,708,793	68,822	3,332,514	68,548	29,798	8,404,560	0	
2006	12,577,209	71,739	3,552,327	71,550	32,137	8,876,260	0	
2007	13,478,546	74,754	3,778,682	74,595	34,589	9,355,905	0	
2008	14,414,922	77,678	4,012,116	77,601	37,118	9,844,660	0	
2009	15,382,724	80,658	4,251,569	80,623	39,750	10,339,756	0	
2010	16,383,073	84,521	4,497,315	84,058	42,772	10,841,739	0	
	Methods:							
	Condom, Female sterilization, Injectable, IUD, Norplant, Pill, Traditional							
	Sources:							
	Public Sector, Private Medical, Other Private, Mobile Clinic, CBD Worker, Other							
	Projection title = Kenya							
	Projection filename = KENYA98							
	Goal = Reaching a goal for total fertility rate							

7. Estimating Consumption Based on Distribution System Capacity

New family planning or HIV/AIDS prevention programs (and less well-managed older programs) do not have historical data on trends in either contraceptive consumption or services provided, so they will not be able to use these data sources for making projections. Population data-based forecasts may or may not be feasible. Even in programs that have these data, rapid expansion of service delivery or introduction of additional products confuses historical trend analysis. In forecasting commodity requirements for new or rapidly expanding programs, it is essential to consider the capacity of the distribution system to handle the estimated volume of supplies—even if the forecast is accurate, clients will not receive goods unless the program has adequate storage, transport, and staff. In these situations, a forecast based on distribution system capacity should be prepared.

Ideally, such a forecast would take into account three types of programmatic constraints—

- ❒ The realistic level of demand for services in the program's target population.
- ❒ The quantity of services that can realistically be provided by existing staff and facilities.
- ❒ The quantity of contraceptive commodities that can be stored and moved through the distribution system.

This chapter discusses only the third type of constraint—the capacity of the in-country distribution system.

Even where projections using other data sources are feasible, a distribution system capacity forecast may be needed. Forecasts based strictly on historical data (either logistics or service statistics) automatically take into account the capacity limitations of a program's storage and distribution systems, because they reflect rates of growth (or decline) that the program has proven it can achieve. Population data-based forecasts do not. Thus, population data-based forecasts—or logistics- or service-based forecasts that have been adjusted to reflect future program plans—may or may not be consistent with the program's ability to actually deliver the required commodities. In these cases, an explicit review of the program's storage and transport capacity is also in order.

A distribution system capacity forecast can take one of two forms—

1. The forecaster might simply calculate the maximum throughput of the program's *existing* storage and transport systems, using this constraint to set a ceiling for forecasts prepared by the other methods. This approach is appropriate in situations where constraints of time, funding, or human resources make it difficult or impossible for the program to increase its logistics capacity.

2. The forecaster might begin with one or more forecasts prepared by the other methods and calculate the storage and transport capacity required to achieve the projected levels of commodity distribution. This approach is appropriate for longer-term forecasts, because the program's ability to increase its logistics capacity should be greater over the long term. In these cases, the distribution system capacity projection quantifies the program implications of targets set by one of the other forecasting methods.

7.1. Data Sources and Limitations

There are several determinants of distribution system capacity—

- ❒ **Contraceptive requirements.** The quantity of each product needed to achieve a particular level of service.
- ❒ **Method mix.** The actual (or desired) percentage represented by each method in a facility's service output.
- ❒ **Staff time.** The amount of time properly trained procurement, warehouse, and transportation staff are available (or needed).
- ❒ **Storage capacity.** The amount of space available (or required) to store and manage products at each warehouse or storage facility.
- ❒ **Transport capacity.** The amount of space available (or needed) on public or private transport for shipping the required commodities down through the distribution system.
- ❒ **Cost or budget.** Anticipated costs or maximum budget levels available (or needed) for all of these determinants of capacity.

Many family planning programs and almost all HIV/AIDS prevention programs are expanding rapidly. In such situations, the level of *all* program inputs may be changing quickly, and it is important to try to quantify and understand the implications of such changes. Even in mature family planning programs where contraceptive prevalence is no longer growing at a rapid rate, the method mix continues to evolve, following worldwide patterns and trends. Traditional methods gradually are replaced by modern contraceptives, and users of reversible contraceptives gradually switch to permanent methods. These changes have profound implications for the volume of commodities that must be procured, stored, transported, and dispensed.

In theory, data on all the determinants of distribution system capacity are available from a program's administrative management and budgeting systems. In practice, large programs (and less well-managed small programs) may not know the dimensions of every storeroom in the country, or whether all the district trucks are functioning, or the volumes of commodities distributed by different facilities. In such cases, site visits or surveys may be used to obtain the required infrastructure data. It also may be possible to make simplifying assumptions described later in this chapter. Note that the calculations for distribution system capacity-based forecasts are predicated on the assumption that the program has—or can create—a properly functioning distribution system. If this is not the case, a valid distribution system capacity-based forecast cannot be prepared.

Table 17 summarizes some of the advantages and disadvantages of forecasting based on distribution system capacity.

Table 17. Forecasts Using Distribution System Capacity

Advantages	Disadvantages
❑ Closely associated with the idea of a service delivery plan. ❑ Based on very concrete assumptions understandable to program managers. ❑ Essential for determining physical infrastructure and budgetary implications of service or demographic targets. ❑ Usable in new programs with no historical data.	❑ Requires large quantities of local data from all levels of the service delivery system. ❑ Requires properly functioning max-min inventory control system. ❑ Requires tedious and extensive mathematical calculations. ❑ May require drastic simplifying assumptions.

7.2. Completing the Distribution System Capacity-Based Forecast

In preparing the distribution system capacity-based projection, the forecaster and program managers must first decide whether it is possible to change the program's capacity during the time period covered by the forecast. If changes are possible, then the forecaster's task is to quantify the capacity changes required to meet program targets prepared by one of the other forecasting methods. If changes are not possible, then the task is to calculate the maximum throughput of commodities that can be achieved with existing capacity. In either case, it is necessary to calculate capacity requirements for individual transport and storage links at each level in the pipeline and for the pipeline as a whole.

7.2.1. Calculating Storage Capacity Requirements for a Single Facility

To calculate the storage space required at a single facility, the forecaster must know the *maximum quantity* of each commodity to be stored and the *unit volume* that each commodity occupies in storage. Storage volumes per carton for commonly supplied contraceptives are listed in appendix 5.

In a properly functioning distribution system, the *maximum stock level* for each product, stated in terms of *months of supply*, is set by program policy. For example, the policy might be that the maximum stock level at the central store is nine months of supply. These levels, and the quantities of stock they imply, are *not* the same as the consumption estimates produced by the forecasting methods described earlier. This is because storage facilities must also maintain safety stocks as a buffer against uncertainty of demand (or inconsistency of supply), and quantities sufficient to cover distribution during the time between ordering and receiving new supplies. If max-min policies do not exist, they must be created before the distribution system capacity-based forecast can be prepared.[5]

The maximum stock level for each facility (in months of supply) can be converted to *quantities to store* using the following formula—

$$\begin{matrix}\text{Maximum quantity}\\ \text{to store}\\ \text{(in units)}\end{matrix} = \begin{matrix}\text{Maximum}\\ \text{stock level}\\ \text{(in months)}\end{matrix} \times \begin{matrix}\text{Average quantity}\\ \text{dispensed to clients}\\ \text{per month}\end{matrix}$$

The *average quantity dispensed* may be based either on historical logistics data or on projections made by one of the methods described in previous chapters.

After the maximum quantity to store has been calculated, the conversion from quantities to be stored to *volume to be stored* for any product is—

$$\begin{matrix}\text{Cubic meters}\\ \text{of storage space}\end{matrix} = \left(\frac{\text{Maximum quantity to store}}{\text{Quantity per carton}}\right) \times \begin{matrix}\text{Cubic meters}\\ \text{per carton}\end{matrix}$$

[5] For a full discussion of maximum/minimum inventory control systems, see JSI/DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs*. Arlington, Va.: JSI/DELIVER, for the U.S. Agency for International Development.

Few storekeepers or program managers think of their storerooms in terms of cubic meters of usable storage. They are more likely to think in terms of available floor space. Cubic meters of storage space can be converted to square meters of actual floor space by using two common assumptions—

- ❒ The maximum height commodities should be stacked (to prevent damage to the product and injury to the storekeepers) is 2.5 meters (8 feet).
- ❒ In a properly organized storeroom, the floor space needed for aisles, packing and handling areas, ventilation, and so on is equal to at least 100 percent of the floor space actually devoted to product storage.

If these assumptions are accepted, then the floor space needed for commodity storage is—

$$\text{Square meters of storage space} = \frac{\text{Cubic meters of storage space}}{2.5\text{ meters}}$$

And the total area needed for the commodity is—

$$\text{Square meters of storage and handling space} = \text{Square meters of storage space} \times 2$$

Smaller storerooms at lower-level facilities may require less handling space because volumes to be handled are smaller. Managers may decide that 50 percent extra space for handling is sufficient at the clinic level, for example. In this case, the forecaster would multiply by 1.5 instead of 2 in the equation above. On the other hand, large facilities at the central level may require more than 100 percent handling space, particularly if mechanical handling equipment, such as a forklift, is employed. In such cases, a larger multiplier should be used.

As an example, suppose that an HIV/AIDS prevention program intends to rent a new central warehouse for condoms, and that program policy specifies that a maximum of nine months of supply should be maintained at the central level. Also, assume a forecast has been prepared that suggests the average quantity dispensed to clients over the time period of the forecast is one million condoms per month. The product is supplied by USAID, which supplies condoms in cartons of 6,000, each with a volume of 0.11 cubic meters, as indicated in appendix 5. The required storage space is—

$$\text{Maximum quantity to store (in units)} = 9 \times 1{,}000{,}000 = 9{,}000{,}000\text{ units}$$

$$\text{Cubic meters of storage space} = \left(\frac{9{,}000{,}000}{6{,}000}\right) \times 0.11 = 165\text{ m}^3$$

$$\text{Square meters of storage space} = \frac{165\text{ m}^3}{2.5\text{ meters}} = 66\text{ m}^2$$

And, finally—

$$\text{Square meters of storage and handling space} = 66\,m^2 \times 2 = 132\,m^2$$

These calculations should be repeated for each product to be stored, and the answers summed to obtain the total required size of the warehouse or storeroom.

If the grand total is greater than the storage space actually available, several options can be considered—

- Alternatives for increasing storage capacity can be examined. In many places, it is possible to rent additional temporary or permanent space instead of building new stores. In most programs, significant additional storage capacity can be gained by simply reorganizing existing space and disposing of unusable commodities.
- The maximum quantity to store can be lowered if the delivery schedule into and out of the facility can be changed. The more frequently deliveries are made, the lower the stock levels can be. It may also be possible to reduce safety stock levels by changing the type of max-min inventory control procedures used.[6]
- The projected quantities to be distributed can be lowered by reducing the projection for one or more products, repeating the previous calculations until the forecasted amounts fit within the storage constraints.

A decision to reduce projected distribution because of storage capacity constraints must be made in close cooperation with program managers. From a logistics viewpoint, the easiest way to reduce storage (or transportation) volumes in a family planning program is to reduce projected quantities of condoms, because these are the bulkiest contraceptive commodities. However, in a country with a serious HIV/AIDS problem, this strategy would be absolutely wrong.

7.2.2. Calculating Transport Capacity for a Single Transportation Link

In distribution systems that have policies for maximum and minimum stock levels at each facility or each type of facility, stock balances vary between the max and min, and each facility generally needs to be resupplied with the amount of product issued or dispensed in the previous period. To ensure that the system stays in balance, however, resupply decisions should not be made on the basis of quantities issued from higher-level storage facilities to lower-level facilities, but rather on the basis of quantities dispensed to clients at the service level of the system. Thus, for any higher-level storage facility, the monthly quantity that needs to be issued is calculated as—

[6] See JSI/DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs*. Arlington, Va.: JSI/DELIVER, for the U.S. Agency for International Development.

$$\text{Average quantity to issue per month} = \text{Average quantity dispensed to clients per month at an SDP} \times \text{Number of SDPs served}$$

Thus a regional medical store that serves 30 SDPs which each dispense an average of 6,000 condoms per month should expect to issue—

$$\text{Average quantity to issue per month} = 6{,}000 \times 30 = 180{,}000 \text{ pieces}$$

The volume that this amount of product will occupy is calculated using the formula shown previously. If the 180,000 condoms are USAID product, for example—

$$\text{Cubic meters of storage space} = \left(\frac{180{,}000}{6{,}000}\right) \times 0.11 = 3.3\text{ m}^3$$

This is the amount of space in the vehicle that will be needed for condoms for a regular replenishment trip if all 30 service delivery points (SDP) are to be restocked in a single monthly trip from the regional medical store.

Of course, the calculation illustrated here is based on *average* quantity dispensed. In actual practice, individual SDPs will need amounts above or below the average, and there are likely to be significant differences in service volumes between SDPs. In such cases, it may be necessary to calculate quantity requirements for each SDP individually.

This example assumes that delivery is made by the higher-level storage facility to the SDPs in a single monthly trip. If multiple trips are made (or if lower-level facilities are responsible for picking up supplies from the higher-level facility), the volume that must be transported on a single trip is correspondingly reduced. Also, the calculation shown is for *monthly* distribution; if the delivery schedule were quarterly, for example, the volume estimate must be multiplied by three.

As with the storage capacity calculation, this procedure must be repeated for each commodity to be transported, with the results summed to obtain the total shipping volume for a single trip.

Note that this calculation computes the regular *replenishment* quantity for a facility. For new programs or facilities, initial stocks equal to the maximum quantity to store must be provided, because the facilities will have no stock on hand at the outset. That is—

$$\text{Initial quantity} = \text{Maximum quantity to store (in units)}$$

If the stock policy at the SDP specifies a maximum stock level of three months and a minimum stock level of two months, for example, then a new clinic initially needs a three-month supply—18,000 condoms in the previous example.

Analogous calculations can be made to determine the weight of commodities that must be transported. Appendix 5 provides product weights needed to make the computation. Contraceptives are light relative to their volume, so weight is rarely the limiting factor, except where products must be carried by porters or animals. In cases where transport is by air, both weight and volume may need to be considered because of the cost.

If these calculations show that existing transport capacity is insufficient, three options are available—

- ❒ Alternatives for increasing transport capacity can be examined. These include using commercial transport (which may be less expensive than program-owned transport) and procurement of additional program-owned vehicles.
- ❒ The projected quantities to be distributed can be lowered by reducing the projection for one or more products. As with storage space constraints, such decisions must be made in close cooperation with program managers.
- ❒ The frequency of deliveries can be increased.

Obviously, if it is possible to deliver monthly instead of quarterly, three times as much product can be transported. But a more frequent delivery schedule is feasible only if vehicles and drivers are available and if fuel, per diem, and other added expenses can be covered.

Note that maximum and minimum levels and delivery schedules are interrelated. Specifically, deliveries must be made at least as frequently as the difference between max and min. That is—

$$\begin{array}{c}\text{Resupply}\\\text{interval}\end{array} \leq \text{Max stock level} - \text{Min stock level}$$

where the max stock level and min stock level are expressed in months. In the example above, SDPs must be resupplied on a monthly basis (because 3 – 2 = 1). Thus, decisions to change delivery schedules may also require changes to max and min levels, which affect the amounts that the facilities themselves must store.[7]

7.2.3. Preparing the Aggregate Delivery Capacity Forecast

The above calculations produce the capacity requirements (or limitations) for a single facility or a single transportation link. Ideally, this analysis should be performed for each facility and transportation link in the distribution system to identify individual bottlenecks in the various supply chains.

[7] To understand the reasons for this interrelationship, see JSI/DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs*. Arlington, Va.: JSI/DELIVER, for the U.S. Agency for International Development.

The total capacity of the existing distribution system can be computed as the sum of the maximum quantities that can be moved through all of the individual supply chains. Of course, each supply chain is only as strong as its weakest link—lower-level facilities cannot move more product than higher-level facilities in the supply chain can provide, even if the lower-level capacity is greater. If the forecasting exercise is undertaken with the assumption that the program's logistics capacity can be increased during the forecast period, this constraint does not apply.

These calculations can only be completed manually in very small distribution systems that manage a small number of products and a few facilities. In larger systems, it may be possible to use standard max and min levels and averages for transport capacity, storage space, and consumption to perform the analysis for each *type* of facility rather than for each individual facility. This approach is dangerous in programs where facilities of each type vary greatly in size, because a distribution system may have enough capacity to serve the average facility, but not enough to serve the largest facilities. In such cases, automated techniques for calculating service capacity must be used to produce a more refined projection.

This analysis may produce several alternative strategies for meeting the program's commodity throughput requirements. For example, capacity can be increased by obtaining additional storage space and more vehicles; changing max-min policies and increasing the frequency of resupply with existing vehicles might accomplish the same thing. These two strategies have different cost implications and different staffing and management implications. The forecaster should be prepared to assist program managers in quantifying these implications.

A complete example of a service distribution system capacity-based forecast for the fictitious country of Anyland is included in appendix 6.

8. Estimating Consumption for New Programs

Because new programs lack historical data, they cannot use the logistics data-based forecasting method to produce a forecast. However, it should be possible to prepare forecasts using some or all of the other methods, depending on the external data available and the planning process used in establishing the program. In any event, the program's development plan must be the basis for any new program's forecast.

8.1. Characteristics of an Acceptable Program Plan

When new programs are established, they tend to plan based on serving a certain percentage of some target population. The population data-based forecasting method can be applied directly to such goals. Some program plans include expected numbers of acceptors, perhaps from a well-defined population subgroup such as factory workers, or from the general population of a limited area of the country. In such cases, the service statistics data-based forecasting technique can be used to obtain consumption estimates.

A complete discussion of program planning is beyond the scope of this handbook. For logistics management purposes, however, a new program plan must include at least the following elements—

- ❒ Estimates of the target population to be served, preferably based on an analysis of unmet need and services already provided by other programs.
- ❒ A realistic, phased schedule for increased acceptance in the target population (which does *not* assume that the entire population will be served in the first year of the program).
- ❒ A specific list of where and when the service delivery outlets will be established.
- ❒ Numbers of trained service delivery staff now available.

- Projections of when and how many staff will be trained to provide services in the future.
- Details of the distribution system to be established, including numbers and capacities of warehouses and storerooms, types and capacities of transportation links between facilities, and inventory management policies and procedures.
- Details of the number and types of personnel available for logistics management activities and the training they already have or will require.
- An explanation of how well equipped the program is and/or when needed equipment will be available, as well as details of other resources available for logistics management.
- A detailed plan for instituting the data collection and reporting mechanisms required for obtaining logistics and service statistics data for future use in commodity forecasting and other program management activities.

8.2. Evaluating the Validity of the Program Plan

As mentioned earlier, new programs tend to be overly optimistic. Though the new program has no historical data of its own, it is possible to compare program plans and targets with the experience of similar programs operating in similar environments. The literature on evaluation of family planning programs is filled with information on what can be expected from a given level of program effort. Table 13 on page 56 and table 14 on page 57 provide just two examples of the data available on rates of program growth. Though HIV/AIDS prevention programs are far younger than family planning programs, research efforts are underway to gather similar data on program expansion.

Forecasting supply needs for new programs is frequently complicated by incomplete program plans. While most new programs establish service delivery targets by year, few actually detail their current service delivery and logistical capacities or plans for future expansion. To make a distribution system capacity-based forecast, the forecaster has to gather these data.

Table 18 summarizes additional points to consider when evaluating a program's development plan. A common approach in setting or evaluating a program's targets is to gather a group of experts with experience in the field, and ask them—in either a structured or unstructured format—to assess the program's prospects based on the likely evolution of the external environment, political events, economic changes, and so forth. This qualitative method of forecasting is commonly used in many fields, and may be a useful adjunct to the more quantitative methods described in this handbook.

When a new program plans to offer all methods, the proposed method mix should be compared with other programs serving the same or similar target populations and, if possible, with the method mix and prevalence achieved by the private sector. When they are available, historical trend data from such programs also should be examined and used as a basis for further quantifying the new program's likely pattern of growth.

Table 18. New Program Planning: Issues to Consider

The most successful national family planning programs have increased contraceptive prevalence one to two percentage points per year between 0 percent and 20 percent prevalence, and two to three percentage points per year between 20 percent and 50 percent prevalence. These are national averages, so annual growth rates that are twice as high may be found in urban areas. Very successful clinics may experience even more rapid growth over some period of time.
A good estimate of potential demand for contraception can be made from rates of *unmet need* if a recent contraceptive prevalence survey is available.
Major concentrations of actual or potential clients will likely be located in areas with the *lowest* fertility rates. It is here that the highest rates of knowledge, positive attitude, and current use almost certainly will be found.
Sectors of the population or regions of the country with high rates of prevalence of traditional family planning methods or high abortion rates are more likely to be ready to adopt family planning on a large scale.
Programs with strong private sector components tend to grow faster than programs based purely in the public sector.
Single-purpose family planning programs tend to grow faster than integrated programs, especially if the single-purpose program is market oriented.
Programs that concentrate a smaller number of service points in areas of high demand tend to grow faster than comprehensive programs that have many diverse or dispersed facilities.
An effective CBD distributor should produce a minimum of 1.5 CYP per month at the beginning of the program and between 3 and 10 CYP per month when the program is mature.
A successful, mature social marketing project that distributes only condoms should generate 0.5 percentage point of additional prevalence per year. If multiple contraceptives are distributed, one percentage point is not unrealistic.
It is doubtful that HIV/AIDS prevention programs can develop new markets for condoms faster than the most successful social marketing projects, at least in the general population.

8.3. Completing the Forecast(s)

In short, estimated demand must be considered, along with the program's budget, capacity to deliver family planning services, and anticipated performance of other programs serving all or part of the same population group. Ideally, all these issues will be reflected in the program plan.

If the plan has been prepared properly, projected service levels should be stated either in population coverage terms or more specifically in terms of new acceptors and revisits. If the appropriate population data are available, a population data-based forecast based on program goals should be prepared, using the methodology described earlier. In addition to consumption estimates, such a forecast can be used to assess the reasonableness of population coverage targets included in the plan (or to generate them if they do not exist).

If the planning process has produced new acceptor and revisit targets, these can be used instead of actual historical data to prepare a service statistics data-based forecast, again using the methodology described earlier. Because such a forecast is not based on historical reality, it is very important to compare it to forecasts made by other methods. In particular, it is essential to compare forecasts with commodity budgets set forth in the program plan or elsewhere, and to highlight discrepancies between the two for consideration by program managers.

A distribution system capacity-based forecast should always be completed for new programs, using either actual or planned facility and transport information, if only to force quantification of the program's logistics management capabilities. If program planners are unable to produce the necessary data for completing a distribution system capacity-based forecast, it is very unlikely that the program can be implemented successfully. When it is impossible to obtain details of storage, transport, and service delivery capacities at lower levels, projected supply quantities should be compared at least against central-level storage and transport capacities, which are easily assessed.

Although the forecaster's mandate is to look at the situation realistically, care must be taken to avoid discouraging those who are establishing the new program. When in doubt, the forecaster should err on the high side, to ensure that the forecast itself does not become the limiting factor in the program's expansion.

9. Estimating Consumption for HIV/AIDS Prevention Programs

HIV/AIDS prevention programs are generally younger than family planning programs, so they lack the wealth of historical data on program growth and commodity consumption that family planning programs enjoy. Of the data that do exist—whether for family planning or HIV/AIDS—condom consumption figures are frequently the least reliable, because survey questions often are not comprehensive. However, the severity of the epidemic requires an urgent response, even if historical data for program planning are not available.

In spite of these constraints, all of the forecasting methods discussed earlier, with some modifications, are applicable to HIV/AIDS prevention efforts. The forecasting strategies for new programs outlined in chapter 8 are appropriate for new HIV/AIDS programs as well. In all cases, the forecaster should prepare projections using as many data sources as possible, for the same reasons that multiple data sources should be used for family planning program forecasts.

9.1. Estimating Consumption Using Logistics Data

HIV/AIDS prevention programs fortunate enough to have historical data on quantities dispensed to clients should prepare a logistics data-based forecast using exactly the same methods described in chapter 4.

For most HIV/AIDS prevention programs, it is even more important that logistics data from the lowest possible level of the distribution system be used for the projection, because distribution system malfunction is more likely in newer programs. It is essential to avoid basing forecasts and subsequent shipments only on previous shipment histories, since many national and local HIV/AIDS prevention programs are stocked initially on an emergency basis, with little or no analysis of actual consumption patterns. Such a strategy is essential for getting distribution systems up and running. In subsequent resupply periods, however, program managers must ensure that shortages due to underestimation of demand do not occur. They must also ensure that condoms do not expire unused at SDPs or remain in intermediate storage facilities until they deteriorate, lest increased condom breakage rates threaten clients' health and destroy the program's credibility.

To prevent such supply imbalances, HIV/AIDS prevention programs should move quickly to establish LMISs that gather lowest-level consumption data. Many HIV/AIDS programs dispense condoms in non-clinical settings, in which gathering data on individual clients is neither desirable nor feasible. Nonetheless, it should always be possible to gather data on quantities dispensed in aggregate from service delivery points by comparing stock balances at the beginning and end of each resupply period.

9.2. Estimating Consumption Based on Service Statistics

The service statistics data-based forecasting method is most applicable to clinic-based HIV/AIDS prevention programs, though the technique can be applied in any setting in which clients are counted and dispensing protocols are standardized.

As with family planning programs, separate estimates must be prepared for each different dispensing protocol used by the program. In the family planning example in chapter 5, commodities for new visits and revisits were computed separately, because quantities dispensed to a new client differed from quantities dispensed to old clients. HIV/AIDS prevention programs might or might not have different protocols for new and old clients, but probably will have separate protocols for different target population segments. A program that dispenses to commercial sex workers, military recruits, and sexually transmitted infection (STI) clinics, for example, may need to prepare separate projections for each group, because each group's usage pattern is likely to be quite different.

9.3. Estimating Consumption Using Population Data

All HIV/AIDS prevention programs, new or old, should be able to prepare forecasts based on data about the population(s) to be served. However, population data-based estimates must *not* be made using overall population size or seroprevalence in the general population, as some forecasting methods recommend. These data can be used to determine the severity of the epidemic and the total potential *need* for condom protection. However, need is not the same as *demand* for condoms. Even in countries where the scope of the epidemic is well understood, clients' demand is usually substantially less than the actual need. Though individuals may know they are at risk of contracting HIV or other STIs, they may not use condoms consistently (or at all) to prevent infection. This gap between knowledge and attitudes, and between attitudes and practice, has been well documented in family planning and other health programs. HIV/AIDS programs face the same issues. Though the consequences of becoming infected with HIV far outweigh the consequences of pregnancy, experience with other STIs indicates that fear of adverse consequences rarely causes sustained behavior change among members of high-risk groups.

Table 19 shows condom-specific prevalence rates found in selected developed and developing countries. These figures are taken from the UN's *World Contraceptive Use 1998* wall chart. Unfortunately, these sources have traditionally interviewed only women. When couples were interviewed, partners' reports of condom use frequently differed from one another. For this reason, condom prevalence figures must be interpreted with caution. Nonetheless, in these surveys only a few countries—developing or developed—have reached a condom prevalence rate of 10 percent or higher, and the majority have rates of less than 5 percent. Thus forecasts based on an assumption of 20 percent prevalence of condom use in the general population—or even on 10 percent or 5 percent—may vastly overstate likely condom consumption.

Instead of assuming that the entire general population will be reached, the forecaster should prepare projections for the specific high-risk groups to be served. Forecasts prepared in this manner require separate estimates for segments of the target population that differ in their sexual behavior—including frequency of sexual relations, coital frequency, sexual practices, and prevalence of condom use. For example, condom use rates vary drastically between monogamous married couples and commercial sex workers.

The first step in preparing a population data-based projection for HIV/AIDS programs should be to define the target segments and estimate the size of each segment. For example, the target population might be commercial sex workers. One segment might be female brothel workers in a lower-income group, working in the hotel district of a capital city. Another might be women between the ages of 15 and 20 who work for escort services that cater to clientele staying in higher-priced hotels in the tourist area of the capital.

After the target population has been segmented into appropriate risk/practice groups, it is necessary to establish quantities of condoms that are required to protect a member of each group over a specific time period. It is usually a dangerous simplification to apply the standard CYP factor from table 15 to an HIV/AIDS prevention program, because HIV/AIDS programs are rarely designed to serve the same general population as family planning programs. Rather, it is necessary to define separate consumption factors, here called *segment member-year of protection* or SYP factors, for each different target population segment. The definition of SYP is the functional equivalent of CYP—the number of condoms required to protect a *full time user of condoms* for one year.

Few data upon which to base SYP factors for particular target segments are actually available. Initially, programs may have to choose SYPs on the basis of local experts' estimates, or on interviews with small samples of clients from each segment. For some segments, the standard CYP factor may be sufficient. Whatever factors are chosen initially, the program should move swiftly to design and implement small client surveys to establish more accurate figures.

Table 19. Condom–Specific Prevalence Rates

Country	Rate	Country	Rate	Country	Rate
WORLD	4	Paraguay	6.0	Nepal	2.0
AFRICA	1	Portugal	6.0	Zimbabwe	2.0
ASIA (excl. Japan)	3	St. Lucia	6.0	Thailand	2.0
OCEANIA	1	Venezuela	5.0	Oman	2.0
LATIN AMERICA	4	Belgium	5.0	Botswana	1.0
MORE DEVELOPED	14	Martinique	5.0	Bolivia	1.0
		Puerto Rico	4.0	Dominican Republic	1.0
Japan	46.0	Germany	4.0	Swaziland	1.0
Hong Kong	35.0	Australia	4.0	Philippines	1.0
Finland	32.0	Austria	4.0	South Africa	1.0
Sweden	25.0	France	4.0	Iraq	1.0
Singapore	24.0	Romania	4.0	Lesotho	1.0
Denmark	22.0	Bangladesh	4.0	Benin	1.0
Grenada	22.0	Colombia	4.0	Cameroon	1.0
Slovakia	21.0	Peru	4.0	Morocco	1.0
Czech Republic	19.0	Pakistan	4.0	Burkina Faso	1.0
United Kingdom	18.0	Mexico	4.0	Indonesia	1.0
Jamaica	17.0	Vietnam	4.0	Kenya	1.0
Costa Rica	16.0	Zambia	4.0	Jordan	1.0
Poland	14.0	Brazil	4.0	Tanzania	1.0
Norway	13.0	Guyana	3.0	Algeria	1.0
Mauritius	13.0	Montserrat	3.0	Egypt	1.0
Italy	13.0	Reunion	3.0	Senegal	1.0
Spain	12.0	Honduras	3.0	Côte d'Ivoire	1.0
Trinidad & Tobago	12.0	Nicaragua	3.0	Uganda	1.0
New Zealand	12.0	Ecuador	3.0	Madagascar	0.5
Canada	10.0	Haiti	3.0	DR of Congo	0.5
USA	10.0	Sri Lanka	3.0	Gambia	0.4
Republic of Korea	10.0	El Salvador	2.0	Nigeria	0.4
Bahrain	10.0	Bahamas	2.0	Togo	0.4
Switzerland	8.0	Panama	2.0	Mali	0.4
Netherlands	8.0	Cuba	2.0	Syria	0.3
Barbados	7.0	Yugoslavia SFR	2.0	Namibia	0.3
Hungary	7.0	Kuwait	2.0	Yemen	0.3
St. Vincent	7.0	Qatar	2.0	Rwanda	0.2
Turkey	7.0	Bulgaria	2.0	Mauritania	0.1
St. Kitts & Nevis	6.0	Ghana	2.0	Burundi	0.1
Guadeloupe	6.0	Malawi	2.0	Ethiopia	0.1
Iran	6.0	India	2.0	Sudan	--
Antigua	6.0	Tunisia	2.0	Liberia	--
Malaysia	6.0	Guatemala	2.0	Niger	--
Dominica	6.0	Belize	2.0		

Source: United Nations. *World Contraceptive Use, 1998.* 1999.

Once SYP factors have been selected, the *total need* for condoms by a segment for any year of the forecast can be calculated simply as—

$$\text{Total need} = \text{Population segment size} \times \text{SYP}$$

For example, assume that the population of commercial sex workers is estimated to be 10,000, and 2,000 are found to be in the first segment (brothel workers). It is estimated that each of these brothel workers has sexual encounters in which a condom should be used, on average, six times a night, five nights a week, 50 weeks of the year. This gives a total of 1,500 sexual encounters that require a condom. Thus, the number of condoms to protect a user in this segment—the SYP—is 1,500.

The total need is then simply—

$$\text{Total need} = 2{,}000 \times 1{,}500$$
$$= 3{,}000{,}000$$

As mentioned earlier, need does not equal either demand or consumption. The total need is the maximum number of condoms that would be used if every member of the segment used a condom with every sexual encounter. However, not all members of a population segment do so. *Total current need*, defined as the quantity needed to fully protect those members of the segment who are actually using condoms, can be calculated as—

$$\text{Total current need} = \text{Total need} \times \text{Percent of segment using condoms}$$

For example, if 40 percent of the population segment members report that they are current users of condoms, then—

$$\text{Total current need} = 3{,}000{,}000 \times 0.40$$
$$= 1{,}200{,}000$$

This figure represents the quantity of condoms required to protect the members of the segment *if members of the segment who report using condoms use them consistently in all sexual encounters*. No country boasts a 100 percent usage rate of condoms, even among current users. Therefore, the consumption estimate for each population segment should be further adjusted by the condom consistency of use rate reported by current users—

$$\text{Total current demand} = \text{Total current need} \times \text{Consistency of use rate}$$

If, on average, self-reported current users of condoms state that they use condoms about 50 percent of the time, then—

$$\begin{aligned}\text{Total current demand} &= 1{,}200{,}000 \times 0.50 \\ &= 600{,}000\end{aligned}$$

Most countries lack data on consistency of use rates for specific target segments. In the short term, the best guesses of local experts can be used to make the projections, but operations research studies should be instituted quickly to obtain more objective data.

It may be necessary or appropriate simply to use this total current demand as the estimate of condom consumption. However, not all condoms dispensed to clients are used for disease or pregnancy prevention. Some may be lost, given to friends, used to practice or familiarize oneself with condoms, or simply not used. If the forecaster believes that these quantities are significant, the estimate should be adjusted *upward*, using the following formula—

$$\text{Total current consumption} = \text{Total current demand} + \left(\text{Total current demand} \times \text{User wastage rate}\right)$$

For example, if current clients report that they only use about 8 out of every 10 condoms they are given, corresponding to a user wastage rate of 20 percent, then—

$$\begin{aligned}\text{Total current consumption} &= 600{,}000 + (600{,}000 \times 0.20) \\ &= 720{,}000\end{aligned}$$

An HIV/AIDS prevention program that serves the general population can use this same methodology for estimating consumption. In this case, the population segment to be targeted is *all* males of reproductive age, and the SYP factor is just the CYP estimate for the general population. The formula for total need is—

$$\text{Total need} = \text{Males of reproductive age} \times \text{CYP}$$

In this case, the forecaster should use the CYP factor from table 15 or, preferably, local data. The other formulas are the same as shown earlier.

9.4. Estimating HIV/AIDS Condom Consumption Based on Demographic Surveys

Some recent DHSs (primarily in Africa) have consistently asked males about their contraceptive behavior, though the male samples are smaller than the female samples. One of the findings of these newer surveys is that males consistently report higher condom use than females, sometimes by a factor of 10 or more. When such surveys are available, their results can be used to generate a population data-based consumption estimate for condoms for HIV/AIDS prevention. This methodology can be used either in addition to or instead of the technique described immediately above; as always, it is better to do both.

To prepare a forecast based on DHS sample results for condom use, the number of females in union using condoms is subtracted from the number of males who report using condoms. The difference is taken to be the number of males using condoms with a partner other than their regular partner, and it is assumed that they use these extra condoms primarily for HIV/AIDS prevention (though obviously they may be using them primarily or solely for family planning). This group is considered to be the target population for the HIV/AIDS condom projection.

The required data items are—

1. Number of women of reproductive age (WRA) in union.
2. Family planning condom prevalence for WRA in union.
3. Number of men of reproductive age (MRA)—usually age 15–59 years.
4. Reported condom prevalence for MRA.

Again, these data are available only in countries where a recent DHS has included a male component. In other countries, this methodology cannot be used.

The number of women using condoms is calculated as—

$$\begin{array}{c} \text{Women} \\ \text{using} \\ \text{condoms} \end{array} = \begin{array}{c} \text{Women of} \\ \text{reproductive age} \\ \text{in union} \end{array} \times \begin{array}{c} \text{Condom} \\ \text{prevalence reported} \\ \text{by women} \end{array}$$

Thus if there are 1,000,000 women of reproductive age in union (15–49), and the prevalence rate for women in union using condoms from the DHS is 1.0 percent—

$$\begin{array}{c} \text{Women} \\ \text{using} \\ \text{condoms} \end{array} = 1{,}000{,}000 \times 0.01 = 10{,}000$$

The number of men using condoms is estimated similarly—

$$\begin{array}{c} \text{Men} \\ \text{using} \\ \text{condoms} \end{array} = \begin{array}{c} \text{Men of} \\ \text{reproductive age} \end{array} \times \begin{array}{c} \text{Condom} \\ \text{prevalence reported} \\ \text{by men} \end{array}$$

For example, if there are 1,100,000 men between the ages of 15 and 59, and 5.0 percent respond that they are condom users—

$$\text{Men using condoms} = 1{,}100{,}000 \times 0.05 = 55{,}000$$

The difference between these figures provides an estimate of the number of men using condoms with women other their regular partners. As stated above, this methodology assumes these condoms are used mainly for HIV/AIDS prevention. Thus—

$$\text{Men using condoms for HIV/AIDS} = \text{Men using condoms} - \text{Women using condoms}$$

In this example—

$$\text{Men using condoms for HIV/AIDS} = 55{,}000 - 10{,}000 = 45{,}000$$

An SYP factor is needed to convert the number of men using condoms into estimated consumption. The factor depends on the frequency of extramarital sexual liaisons, premarital activity for younger men, and the frequency of visits to commercial sex workers. There are still few data on which to base this judgment. When local data are lacking, local experts should be consulted to establish a consensus on the SYP factor to use. If, for example, an SYP factor of 50 seems reasonable, assuming that men who have stated they use a condom have a sexual liaison with someone other than their regular partner about once per week, then the calculation is—

$$\text{Total current need} = \text{Men using condoms for HIV/AIDS} \times \text{SYP}$$

$$= 45{,}000 \times 50$$

$$= 2{,}250{,}000 \text{ condoms}$$

This figure represents the number of condoms required for HIV/AIDS prevention for all men who have stated that they use condoms, *if they used condoms at every encounter.* However, in many countries extramarital sexual liaisons are reported by up to 80 percent of men, but nowhere near that many use condoms consistently to prevent HIV/AIDS or pregnancy. As in the earlier methodology, this figure must be reduced by a consistency of use rate (and perhaps also inflated by a user wastage rate) to obtain a final estimate.

For each successive year of the projection, an estimate may be made for the percentage of males using condoms. For example, if there is a vigorous IEC campaign in the country, then the level of male use can be expected to increase. The SYP factor may change as well. Table 20 is an example of such a projection from Kenya, based on an estimated SYP of 50, and showing both family planning and HIV/AIDS forecasts.

Table 20. Condom Requirements: Kenya 1998–2010

Year	Males Age 15-59 (Spectrum)	Male Condom Prevalence Rate (DHS)	Condom-using Males Age 15-59 (B*C)	Females in Union Age 15-49 (Spectrum)	Female F/P Condom Prevalence Rate (Spectrum)	Condom-using Females Age 15-49 (E*F)	Males Using for HIV/AIDS Prevention (D-G)	Condoms/ Male/Year for HIV/AIDS Prevention	Condoms for Male HIV/AIDS Prevention (H*I)	Condoms for Contraception (Spectrum)	Total Condom Requirements (J+K)
A	B	C	D	E	F	G	H	I	J	K	L
1998	7,422,400	15.90%	1,180,162	4,152,973	1.31%	54,404	1,125,758	50	56,287,883	6,512,032	62,799,915
1999	7,713,312	16.00%	1,234,130	4,317,242	1.38%	59,578	1,174,552	50	58,727,599	7,149,446	65,877,045
2000	8,010,228	16.10%	1,289,647	4,484,794	1.45%	65,030	1,224,617	50	61,230,860	7,821,702	69,052,562
2001	8,309,647	16.20%	1,346,163	4,653,338	1.53%	71,196	1,274,967	50	63,748,337	8,534,141	72,282,478
2002	8,607,146	16.30%	1,402,965	4,819,940	1.60%	77,119	1,325,846	50	66,292,288	9,282,158	75,574,446
2003	8,899,566	16.40%	1,459,529	4,982,526	1.68%	83,706	1,375,822	50	68,791,119	10,061,879	78,852,998
2004	9,185,357	16.50%	1,515,584	5,140,094	1.76%	90,466	1,425,118	50	71,255,913	10,870,869	82,126,782
2005	9,464,918	16.60%	1,571,176	5,292,791	1.84%	97,387	1,473,789	50	73,689,452	11,708,793	85,398,245
2006	9,739,829	16.70%	1,626,551	5,441,585	1.93%	105,023	1,521,529	50	76,076,443	12,577,209	88,653,652
2007	10,011,961	16.80%	1,682,009	5,587,669	2.01%	112,312	1,569,697	50	78,484,865	13,478,545	91,963,410
2008	10,282,832	16.90%	1,737,799	5,731,939	2.10%	120,371	1,617,428	50	80,871,394	14,414,922	95,286,316
2009	10,550,115	17.00%	1,793,520	5,872,971	2.18%	128,031	1,665,489	50	83,274,439	15,382,724	98,657,163
2010	10,815,090	17.10%	1,849,380	6,011,312	2.27%	136,457	1,712,924	50	85,646,180	16,383,073	102,029,253

Source: Starting data from the Kenya DHS for 1998.

This example draws on a Spectrum-based forecast for condoms used for contraceptive purposes. The increase in prevalence for condoms used by women is taken from the Spectrum projection, and the increase in the prevalence for condoms used by men assumes that increasingly more men use condoms in successive years.

9.5. Estimating Consumption Based on Distribution System Capacity

All HIV/AIDS prevention programs should be able to prepare estimates of consumption based on distribution system capacity, using the methods described in chapter 7. As with other new programs, any HIV/AIDS prevention program that lacks the data necessary to make a distribution system capacity-based forecast has not been sufficiently well planned.

9.6. Maximum Rates of Growth for HIV/AIDS Prevention Programs

Because HIV/AIDS prevention programs are relatively new, worldwide data are insufficient to establish rules of thumb for rates of program growth. However, there are many parallels between the HIV/AIDS prevention effort and family planning. Pregnancy (always) and HIV/AIDS (usually) originate in sexual activity. The prevention of both requires voluntary and sustained cooperation of both male and female members of the couple and changes in their most intimate behaviors. From a programmatic viewpoint, both HIV/AIDS prevention and family planning require preventive and curative interventions, sustained in both the public and private sectors.

In many cases, there is already extensive collaboration between HIV/AIDS and family planning programs. Moreover, family planning programs in general, and contraceptive social marketing and community-based distribution programs in particular, have included condom distribution as a major component of their services for many years. This distribution has taken many forms, including public and private networks, and has used many types of commercial distributors and local people.

It is reasonable to presume, then, that the experience of family planning programs—their limitations, their achievements, and the speed with which they have developed—can be taken at least as a rough guide to the likely potential for expansion of HIV/AIDS prevention programs. In particular, it will be very difficult for HIV/AIDS prevention programs to achieve more rapid increases in consumption than the best social marketing programs have accomplished.

10. Validating and Reconciling the Forecast(s)

At this point in the process, the forecaster has prepared (or will have been given) forecasts based on all available data sources. The next step is to validate and reconcile the forecast(s), working with program managers to complete a best forecast of commodity consumption. This process involves—

- Examining the different individual projections to identify the weaknesses of the various data sources and assumptions used.
- Comparing and contrasting the acceptable forecasts.
- Using good judgment to select a final answer.

10.1. The Need for Forecast Validation

A perfect forecast would be one based on complete, accurate, and relevant trend data that exactly predict future behavior. In such circumstances, the forecaster's projection should be exactly correct. Its validity would be proven by data gathered as the future unfolds.

Unfortunately, family planning and HIV/AIDS prevention programs do not operate in such a perfect world; data are almost never complete or completely accurate. Future consumption patterns may be related only loosely to the past. The assumptions that must be made to convert population and service data to consumption estimates are questionable, and frequently these assumptions must be made on the basis of managers' best judgments rather than hard data. Data gathered subsequently to judge forecast accuracy are also likely to be incomplete, making it more difficult for forecasters to learn from their mistakes.

Yet, forecasts must be made, and commodities must be purchased at substantial and ever-increasing cost. When donors are involved, the local organization may not be aware of the purchase price, even though the expenditure is great. USAID alone, for example, spends approximately U.S.$50 million annually on contraceptive shipments. Even more important than these cash outlays are the program costs in credibility and wasted time when supply imbalances occur, and the cost to clients—measured in pregnancies, illness, or death—when there are stockouts.

For both human and financial reasons, the forecaster should spare no effort to produce the most accurate forecast possible. However, it is important to understand that in the environment in which family planning and HIV/AIDS prevention programs operate, the forecast always will be wrong. The forecaster can only hope to reduce the forecast error to a level that will not have severe programmatic or cost implications for the organization or its clients.

For these reasons, this handbook recommends preparation and comparison of multiple forecasts from independent data sources. This strategy highlights the strengths and weaknesses of each data source and mathematical assumption, and demonstrates the consistency (or inconsistency) of the resulting forecasts, allowing program managers to make an informed judgment in selecting the best projection. Increased accuracy—and defensibility—of the final forecast always justifies the extra labor. Even when data limitations prevent preparation of multiple forecasts, the quality of the single forecast should be judged explicitly.

10.2. Evaluation of Individual Forecast Quality

Evaluating the quality of an individual forecast involves at least the following—

- ❒ **Assessment of source data strengths and weaknesses.** Completeness, accuracy, and timeliness of the data determine—at least in part—the accuracy of the forecast. A logistics data-based forecast made using an LMIS that has 90 percent reporting through the most recent quarter is likely to be much better than one made using an LMIS that is nine months behind in data processing and has only 50 percent reporting.
- ❒ **Assessment of the reliability of forecast assumptions.** Because of the mathematics, a small error in assumptions used for calculating estimated consumption (e.g., CYP, prescribing protocols) could make a very large difference in total quantities projected. The reliability of these conversion factors must be judged carefully.
- ❒ **Assessment of external or programmatic events that may affect either the historical data or the forecast.** Local political and economic events, such as strikes, civil unrest, or famine, may have reduced past demand for services (or may affect future demand). Similarly, programmatic events, such as stockouts or introduction of a new method, may mean that future consumption cannot be modeled by previous patterns.
- ❒ **Assessment of the methodologies used in completing the forecast calculations.** The forecasting methodologies presented in previous chapters of this hand-

book are theoretically simple and mathematically sound. However, the total number of calculations required for any but the smallest programs is very large. Especially where the forecasts are prepared manually, the math should be verified, preferably by someone other than the original forecaster. Where forecasts have been prepared by different methodologies from those suggested here, both theoretical and mathematical soundness should be checked.

All of these assessments, except perhaps the last, can best be made by program managers themselves, and it is essential that they be involved in the forecasting and validation process from the outset, particularly if the forecaster is an external consultant.

Table 21 through table 24 present the minimum list of questions that should be asked and answered in evaluating forecasts based on logistics data, service statistics, population data, and service delivery capacity. After the forecaster and program managers have completed this analysis for all the available projections, the final forecast of consumption can be prepared.

10.3. Forecast Reconciliation

Evaluation of the individual forecasts reveals whether they are technically and methodologically sound. Any forecast that is not should be discarded. The remaining forecasts should then be compared and reconciled to produce the *best* consumption estimate.

This comparison is the essence of the validation process; as with the basic projection techniques described in previous chapters, the comparison is accomplished most easily by graphing all the projections for a product on a single graph. If forecasts prepared from several separate data sources have produced substantially congruent results (say, within 10 percent of each other), the forecaster can be confident that all the data and assumptions used in the process are at least consistent; it is probably not possible to produce a better forecast.

Table 21. Evaluating Logistics Data-Based Forecasts

Question	Assessment
1. Were dispensed-to-client data used to make the forecast? If not, what level issues data were used?	Dispensed-to-client data provide by far the best estimate. The higher the level from which issues data are used, the less reliable the projection; service delivery site visits should have been made to determine whether issues data are an adequate substitute for dispensed-to-client data. Except in the smallest distribution systems, projections based solely on central-level issues data are unacceptable.
2. What percentage of reports from SDPs or warehouses were missing over the period covered by historical data? What adjustments were made for incomplete reporting?	The higher the percentage of facilities not reporting, the less reliable the projection. The greater the variability in data that *were* available, the more uncertainty the adjustments for missing data introduce.
3. How many time periods of data were used for the projection? What percentage of reporting periods were missing from the period covered by historical data? What adjustments were made for missing time periods?	The more historical data used for the extrapolation, the more reliable the forecast. For an annual projection, a minimum of two to three years of quarterly data (i.e., 8 to 12 data points) should be used. The higher the number of missing reporting periods, the less reliable the projection. The greater the variability in data among time periods that *were* available, the more uncertainty the adjustments for missing time periods introduce.
4. Were losses reported separately from consumption or issues data? If not, what adjustments were made to account for system losses?	All logistics systems have product loss in storage and transit, and any LMIS that reports zero losses is immediately suspect. Adjustments for losses should be made based at least on surveys of a sample of storage facilities at all levels, but this is very difficult to accomplish in practice.
5. Were there stockouts during the time period covered by the data? If so, what adjustments were made to estimate true demand?	The greater the percentage of time when one or more products were stocked out, the less reliable the forecast. The greater the variability in data among time periods when stocks *were* available, the more uncertainty the adjustments introduce.
6. Were there special circumstances affecting past demand that no longer affect the program? If so, what adjustments were made to consumption estimates?	Political, economic, or other external circumstances may have affected historical consumption trends either positively or negatively, and may affect future consumption similarly. If the projection has been adjusted to account for changes in such external circumstances, a rational justification for both direction and size of the adjustments should be given.
7. What was the basis for projection of future consumption? What adjustments, if any, were made to the extrapolation of historical data?	*Simple extrapolation* of historical data may not be appropriate, depending on the answer to the above questions. If based on *program plans*, significant differences from the historical pattern must be explained satisfactorily. If based on *government or donor targets or policies*, projections that differ from historical patterns are very suspect. If based on *funding or other resource constraints*, justification for anticipated consumption levels should be given, along with an explanation of plans to cover demand that cannot be met by currently available resources.

Table 22. Evaluating Service Statistics Data-Based Forecasts

Question	Assessment
1. Were visits (either in total or broken down by visit or client type) used to make the forecast? If not, what service statistics were used? Are service data definitions written down? Do service delivery staff understand them?	If any data other than visits/revisits were used (for example, new/continuing users), the conversion from service statistics to consumption estimates is very difficult, and the conversion process must be documented completely. In any case, data definitions must be absolutely clear to staff who record and report services data. If definitions are not well documented and understood, recording inconsistencies should be suspected that will make the forecast less reliable.
2. Are prescribing protocols documented and understood by service delivery staff? What evidence is there that such protocols are routinely followed?	The assumption regarding quantities of each product dispensed at each visit critically affects forecast accuracy. If the protocol specifies that 10 condoms should be dispensed to each client, but staff give 12, the forecast will be off by 20 percent. If protocols are not written and disseminated to staff, the basis for the conversion factor should be investigated carefully. If there has been a history of shortages or oversupply in the program, the likelihood is higher that prescribing protocols are not strictly followed.
3. What percentage of reports from SDPs were missing during the period covered by historical data? What adjustments were made for incomplete reporting?	The higher the percentage of facilities not reporting, the less reliable the projection. The greater the variability in data that *were* available, the more uncertainty the adjustments for missing data introduce.
4. How many time periods of data were used for the projection? What percentage of reporting periods were missing from the period covered by historical data? What adjustments were made for missing time periods?	The more historical data used for the extrapolation, the more reliable the forecast. For an annual projection, a minimum of two to three years of quarterly data (i.e., 8 to 12 data points) should be used. The higher the number of missing reporting periods, the less reliable the projection. The greater the variability in data among time periods that *were* available, the more uncertainty the adjustments for missing time periods introduce.
5. Were there special circumstances affecting past service levels that no longer affect the program? If so, what adjustments were made to service activity estimates?	Political, economic, or other external circumstances may have affected historical service levels either positively or negatively, and may affect future service levels similarly. If the projection has been adjusted to account for changes in such external circumstances, a rational justification for both direction and size of the adjustments should be given.
6. What was the basis for projection of future service levels? What adjustments, if any, were made to the extrapolation of historical data?	*Simple extrapolation* of historical data may not be appropriate, depending on the answer to the above questions. If based on *program plans*, significant differences from the historical pattern must be explained satisfactorily. If based on *government or donor targets or policies*, projections that differ from historical patterns are very suspect. If based on *funding or other resource constraints*, justification for anticipated service levels should be given.

Table 23. Evaluating Population Data-Based Forecasts

Question	Assessment
1. What source(s) were used for total population, WRA, percent in union/sexually active, total fertility rate (if used in the projection), CPR, method mix, brand mix, source mix? Are there known problems with or biases in these surveys?	DHSs and Reproductive Health and Family Planning Surveys are the most carefully designed and executed demographic surveys, though local surveys may also contain data appropriate for local program forecasts. Local surveys may be especially useful for programs that do not provide nationwide coverage. When local surveys are used, survey instruments, sampling plans, and data processing protocols should be examined for appropriateness, with the help of demographers or survey researchers as needed. Condom prevalence figures are likely to be problematic, because most surveys target female rather than male respondents and concentrate on family planning activity, in some cases missing or underestimating non-family planning use of condoms. Survey figures for other contraceptive methods are likely to be more accurate.
2. How old were these demographic data? If adjustments were made to older data to obtain base-year estimates for the forecasts, what methodologies were used?	The older the data, the less reliable the forecast. Ideally, the date of the primary survey source will have been used as the base year for the survey. If adjustments to survey data were required to obtain base-year figures, WRA estimates preferably should be taken from the U.S. Census Bureau's *International Data Base* or from the UN's *World Population Prospects*. CPR adjustments preferably should be taken from the UN's *Levels and Trends of Contraceptive Use*, or computed from TFR estimates using Spectrum. Other methodologies and assumptions should be fully explained.
3. What was the basis for the estimate of the source mix?	Population data-based surveys rarely cover exactly the same target population as a service program. Few surveys other than the DHSs provide source breakdowns, and the DHS source breakdowns may not relate directly to particular service programs. This assumption is critical, and its basis should be examined carefully. The forecast will be in error by the same percentage that this figure is in error.
4. What CYP/SYP factors were used to calculate commodity requirements?	Most programs will have no choice other than the worldwide average estimates. These are reasonably reliable for orals, IUDs, injectables, and Norplant®, but more problematic for condoms and vaginal foaming tablets (VFT). Accordingly, forecasts for these latter methods are less reliable. SYP assumptions should be examined closely for forecasts of HIV/AIDS prevention programs that serve specific target populations; there are currently few hard data on which to base SYP estimates.
5. If brand-specific projections were made, what was the basis for disaggregating method-specific data into individual brands?	Brand-specific projections are always needed for forecasts made for procurement purposes. If logistics data on brand-specific distribution are available, they should be used as the basis for disaggregating by brands (and they should also be used to prepare a logistics data-based forecast). If such data are not available, brand-specific estimates are less reliable, though method-specific aggregates may still be acceptable.
6. How were population data changes over the forecast period estimated?	WRA estimates preferably should be taken from the U.S. Census Bureau's *International Data Base*, or the UN's *World Population Prospects*. If these sources were not available, the methodology used to estimate WRA should be explained fully. CPR should preferably be taken from the UN's *Levels and Trends of Contraceptive Use*, or computed from TFR estimates using Spectrum. Projected changes in nationwide CPR of more than one percentage point per year (for CPR $\leq$ 20 percent), or more than two percentage points per year (for CPR between 20 percent and 50 percent) should be reviewed carefully and compared to the appropriate estimates in *Levels and Trends of Contraceptive Use*. These ranges may not apply to HIV/AIDS prevention programs serving particular target populations, but strong justification for higher estimates should be given. Projections based on *government or donor targets or policies* that differ from historical patterns are very suspect.

Table 24. Evaluating Distribution System Capacity-Based Forecasts

Question	Assessment
1. Does the program have a properly designed and functioning max-min inventory control system at every program level and facility?	If max-min policies are not set and followed, a distribution system capacity-based forecast cannot be made easily.
2. What simplifying assumptions were made about stock level policies in preparing the projection?	Max and min policies may be different at different levels or at individual facilities in the same distribution system. If averages or other simplifying assumptions were used in preparing the forecast, these should be examined to determine their likely effect on forecast accuracy. The more variability from place to place, the more uncertain the forecast.
3. What simplifying assumptions were made about storage capacity?	Storage capacity is likely to be different for different facilities, and averages or other simplifying assumptions may be necessary to reduce required calculations to a manageable level. These should be examined to determine their likely effect on forecast accuracy. The more variability from place to place, the more uncertain the forecast.
4. What simplifying assumptions were made about transportation capacity?	Transport capacity is likely to be different for individual links in the distribution pipeline, and averages or other simplifying assumptions may be necessary to reduce required calculations to a manageable level. These should be examined to determine their likely effect on forecast accuracy. The more variability from place to place, the more uncertain the forecast.
5. What simplifying assumptions were made about quantities dispensed to clients at the service level of the distribution system?	Quantities to be transported are calculated based on the average quantity dispensed to clients for resupply, or on the maximum stock quantity for initial supply for a new service delivery point. If these consumption data are estimates, or averages used for simplicity of calculation, the forecast is more uncertain.

If the forecasts differ substantially—which is more common—then some or all data and assumptions are incorrect. At this point the forecasting process becomes more art than science, and program knowledge becomes more important than mathematics. The forecaster and program managers have three choices—

1. **Average the acceptable forecasts.** If all forecasts are judged to be equally good (or equally bad), a simple average might be used as the final forecast.

2. **Weight the acceptable forecasts according to their perceived accuracy.** If one or two forecasts are judged superior to the others, a weighted average might be used as the final forecast.

3. **Choose the strongest forecast and discard the rest.** If one forecast seems clearly superior to all the others, it could be accepted as final. If two forecasts seem clearly superior, they could be averaged and the weaker forecasts discarded.

In making these choices, it is necessary to consider whether the data sources from which the various projections were made are truly independent. For example, logistics data and service statistics often come from the same MIS, and might suffer from similar data errors and biases. In such cases, a comparison of forecasts from these two sources may not be reassuring.

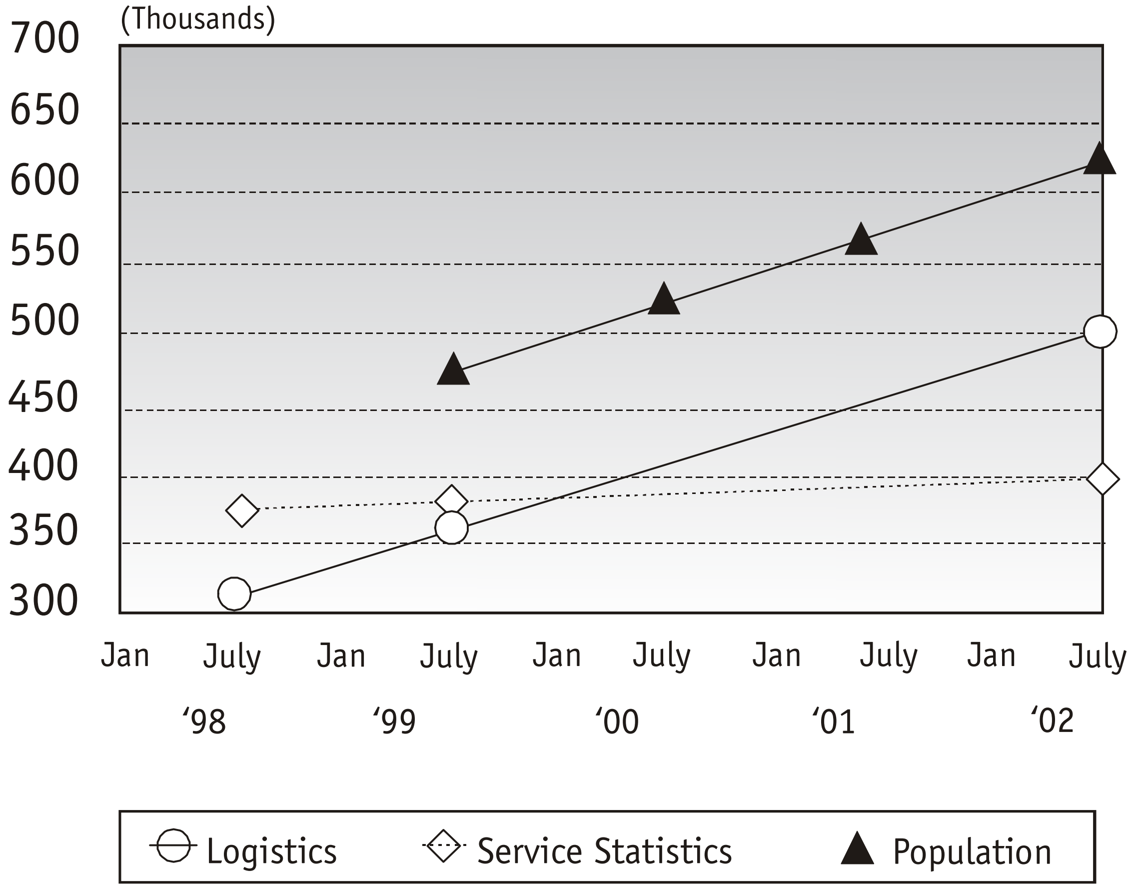
Since population data-based forecasts are completely independent of program data, and since demographic data are frequently available, a comparison between a population data-based forecast and forecasts made by any of the other methods should be made whenever possible. If consumption estimates have been prepared for all projections, a direct comparison can be made. Alternatively, CYP factors can be used to convert consumption forecasts to an estimate of contraceptive prevalence rate (CPR) for comparison to demographic projections.

Appendix 6 contains a completed example forecast for one brand of orals—Lo-Femenal—for the fictitious country of Anyland, made using all four data sources discussed previously. To reconcile these forecasts, it may be desirable to display alternate projections in tabular form for discussion with program managers, particularly when forecasts for several products are being prepared simultaneously. Table 25 shows an example of such a forecast for the year 2000, with the Lo-Femenal figures completed; subsequent years' forecasts should be displayed in the same format. Figure 6 displays the projections for Lo-Femenal for *all* forecast years in graphical form, which is easier to understand. Of course, separate graphs are required for each method and brand.

Table 25. Alternate Forecasts of Contraceptive Needs: 2000

Method	Logistics Data Forecast	Service Statistics Forecast	Population Data Forecast	Distribution System Capacity Forecast	Final Forecast
Family Planning Condoms					
HIV/AIDS Prevention Condoms					
Lo-Femenal	1,646,000	1,560,000	2,092,159	Feasible	1,646,000
Microgynon					
Depo-Provera®					
Norplant®					

Figure 6. Comparison of Three Alternative Projections for Lo-Femenal for Anyland



The forecaster and program managers in this case chose to use the logistics data-based forecast as the best estimate of future consumption (see appendix 6), for the following reasons—

1. The logistics data for 1998 and 1999 were more complete than the service statistics data. For this reason, the forecaster had more confidence in the logistics data-based forecast, even though adjustments both for under-reporting and missing data were required in each case.

2. The trend in consumption shown by the demographic data-based forecast parallels the estimates made from logistics data. This fact further strengthened program managers' confidence in both of the forecasts. The absolute values of the demographic data forecast are higher than those included in the logistics data-based forecast. However, the demographic data-based consumption figures are calculated based on both source mix and CYP conversion factors, which are not known with certainty. Since the logistics data-based forecast does not require such assumptions, it seemed more reasonable to use the logistics figures than, for example, to average logistics and demographic estimates.

3. The distribution system capacity-based forecast indicated that the current distribution system can adequately handle the volume of commodities implied by the other forecasts, with a few exceptions that program managers felt could be remedied with available resources. Thus, it was not necessary to adjust the forecast downward based on distribution system capacity.

Again, these deliberations must be undertaken in collaboration with program managers. Many judgments had to be made even in this simplified, hypothetical example. It should be clear just from the above list that the forecaster cannot make such judgments alone.

11. Requirements Estimation

After the quantities of contraceptives or HIV/AIDS condoms to be dispensed to clients are estimated, the next step is to determine the quantities that must be procured or requested from donors to ensure a continuous supply. Note that the amounts to be procured are *not* the same as the amounts projected to be dispensed to clients; quantities already in the distribution system and desired stock levels must be considered as well.

11.1. The Basic Calculation for Requirements Estimation

Four data items are needed for estimating the quantity of any commodity to be procured or requested from donors—

- **Stock on hand**. The quantity of stock on hand *at all levels of the distribution system* at the beginning of the time period of the forecast. For an annual requirements estimation, this is called *beginning of year stock*.
- **Shipments received/on order**. Shipments that have arrived and are available for distribution since the date of the stock on hand/beginning of year stock figures, plus any quantities already on order but not yet received.
- **Estimated consumption**. The quantity expected to be dispensed or sold to clients as projected by the forecasting methods described in this handbook.
- **Adjustments.** Actual or projected quantities lost or disposed of due to damage, expiry, or any other reason, and quantities transferred into or out of the distribution system for any reason other than being dispensed to clients.

In a well-functioning distribution system, these data are recorded and reported routinely in the program's LMIS; in practice, some or all may be unavailable.

In addition to these data, one further figure is required, which should be a part of the program's logistics management policies—

- ❒ **Desired stock at end of period**. The desired stock balance at the end of the period, including safety stocks and lead-time stocks at *all* levels in the distribution system, and working stocks as appropriate.[8] For an annual requirements estimation, this is called *desired end of year stock*.

After these figures are obtained or estimated, the quantity that should be procured or requested from donors can be calculated as—

$$\text{Net supply requirement} = \text{Stock on hand} + \text{Shipments already ordered/received} - \text{Estimated consumption} - \text{Losses/adjustments} - \text{Desired stock at end of period}$$

That is, the net supply requirement is just the sum of the quantities already available or known to be entering the distribution system (stock on hand and shipments already ordered/received), minus the quantities expected to leave the system during the time period in question (estimated consumption and losses/adjustments), minus the quantity program managers want to have left at the end of the period (desired stock at end of period).

If the net supply requirement resulting from this calculation is a negative number, then the calculated amount must be procured or obtained from donors for the program to satisfy estimated demand and still maintain the desired stock at end of period. A positive net supply requirement indicates a possible oversupply situation; in such cases, no procurement is needed for the period.

In programs that use multiple products, it may be helpful to present these requirements data in tabular form. Table 26 displays a 2000 forecast, using the figures for Lo-Femenal for the fictitious country of Anyland estimated in the example in appendix 6. Subsequent years' forecasts could be displayed in the same format.

Of course, estimated consumption figures should be produced using the forecasting methodologies described in previous chapters of this handbook. Issues and considerations in obtaining the rest of the data are discussed below. Data sources, problems, and possible solutions are summarized in table 27.

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8 Safety stock, lead time stock, and working stock requirements are described in JSI/DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs*. Arlington, Va.: JSI/DELIVER, for the U.S. Agency for International Development.

Table 26. Net Supply Requirements for CY2000 (1,000s)

Method	Beginning of Year Stock CY 2000	(+) Shipments Received/ On Order	(-) Est'd Consumption 2000	(-) Losses/ Adjustments	(-) Desired End of Year Stock	(=) Net Supply Requirement
Family Planning Condoms						
HIV/AIDS Prevention Condoms						
Lo-Femenal	1,283.4	562.8	1,646.0	12.0	2,149.7	-1,961.5
Microgynon						
Depo-Provera®						
Norplant®						

Table 27. Data Sources, Problems, and Solutions

Beginning of Year Stock

Sources	Problems	Solutions
❑ Stock cards ❑ LMIS ❑ Physical inventory	❑ Under-reporting ❑ Incomplete records ❑ Out of date records ❑ Inconsistent records ❑ No records	❑ Do physical inventory. ❑ Estimate based on data from a higher level. ❑ Average data from multiple sources.

Adjustments

Sources	Problems	Solutions
❑ Stock cards ❑ LMIS ❑ Destruction reports ❑ Physical inventory ❑ Shipping or receiving records	❑ Under-reporting ❑ Lack of reporting ❑ Inability to record or report adjustments ❑ Lack of policies for dealing with losses, destruction	❑ Check inventory records and stocks at clinics and warehouses. ❑ Check available shipping and receiving reports.

Shipments

Sources	Problems	Solutions
❑ Stock cards ❑ LMIS ❑ Donor records ❑ Customs or port records ❑ Bills of lading or receiving reports	❑ Lack of records or improper recording ❑ Lack of information from donors	❑ Seek records of next level up. ❑ Seek donor/supplier records.

11.2. Determining Current Stock on Hand

Again, the beginning of year stock figure that should be used for requirements estimation for each product should include stocks *at all levels of the distribution system* as of the *beginning of the time period of the forecast*. Either of these requirements can be problematic.

11.2.1. Estimating Stock on Hand at All Program Locations

If the LMIS is fully functional, stock on hand figures should be available for all program locations. A physical inventory conducted at all levels of the distribution system will also provide correct figures.[9] In other situations, stock balances must be estimated.

Where LMIS reporting is inadequate, the only available data might be the inventory in the central warehouse and, perhaps, the next level down the system. It is tempting to base stock on hand estimates on these data. However, this strategy is equivalent to assuming that there are *no* stocks available at lower levels of the distribution system. The resulting requirements estimate would cause program managers to over order by whatever amounts are actually in inventory at these facilities. Over ordering leads to overstocking and perhaps to wastage through product expiration; in the worst case it can clog the pipeline so that products cannot be moved.

Thus, lower-level stocks should never be ignored. In programs that have some LMIS data available for these levels, adjustments for incomplete reporting or missing time periods (or both) can be made using the procedures described in chapter 3. This approach has the same pitfalls as estimating consumption on this basis, as described in chapters 3 and 10.

When such information is not centrally available, an effort must be made to gather hard data on which to base estimates of lower-level balances. At a minimum, field visits to all levels of the distribution system must be made to count commodities at selected facilities of each type. If such field visits were needed in preparation for making a logistics data-based forecast, data on stock balances should be collected simultaneously. If possible, a more formal mini-physical inventory should be undertaken, including a representative sample of facilities and SDPs at lower levels and all significant warehouses at higher levels. In either case, stock on hand counts should be disaggregated by product expiration or manufacture date, to facilitate estimation of current and future product losses.

If the program has established max-min inventory control procedures, the field review should determine whether SDPs and warehouses are operating within their prescribed

9 Procedures for conducting physical inventories are described in JSI/DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs*. Arlington, Va.: JSI/DELIVER, for the U.S. Agency for International Development.

maximum and minimum levels.[10] If the locations are found to be in compliance, field stock on hand can be assumed to be at a level halfway between max and min.

In large programs with multilevel distribution systems, significant quantities of product may be in transit in the country between one level and the next at any point in time. When field visits, mini-physical inventories, or complete physical inventories are taken, information on stocks in transit should be gathered; if appropriate, a percentage should be added to stock balance data gathered from warehouses and SDPs to account for these products.

11.2.2. Estimating Stock on Hand at the Beginning of the Forecast Period

Requirements estimates are rarely prepared exactly at the beginning of the forecast period. For a calendar year estimate beginning in January, for example, the forecast might be prepared in November or December of the previous year. Even if the forecast is prepared in January, it is likely that LMIS reporting will be current only through the previous month or quarter, so January data will not be available at the time the requirements estimate is made.

In the case of a requirements estimate prepared *after* the beginning of the forecast period, it is more likely that stock balance data as of the beginning of the forecast period will be available. If so, balances on the first day of the forecast period should be used for the requirements calculation, even though more current information may have been reported already.

If the requirements estimate is being prepared *before* the beginning of the forecast period (or if LMIS reporting and processing is delayed), it is necessary to project the stock on hand balance as of the beginning of the forecast period. This is done by adding any shipments expected to be received before the forecast period begins to the current inventory level and subtracting estimated use and anticipated losses for this same period. That is—

$$\begin{matrix}\text{Stock on hand}\\ \text{at beginning}\\ \text{of forecast}\\ \text{period}\end{matrix} = \begin{matrix}\text{Current}\\ \text{stock on}\\ \text{hand}\end{matrix} + \begin{matrix}\text{Anticipated}\\ \text{shipments}\end{matrix} - \begin{matrix}\text{Estimated}\\ \text{consumption}\end{matrix} - \begin{matrix}\text{Losses/}\\ \text{adjustments}\end{matrix}$$

In any case, stock on hand data and assumptions used for the requirements estimate should be documented completely. One easy way to display such information is shown in table 28, which shows estimated stock balances by distribution system level, along with details of assumptions that were made in arriving at the balances, again using the hypothetical figures for Lo-Femenal from the Anyland example in appendix 6.

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10 Max-min inventory control procedures are described in JSI/DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs*. Arlington, Va.: JSI/DELIVER, for the U.S. Agency for International Development.

Table 28. Estimated Stock on Hand at All Levels as of January 1, 2000

Method	Central Medical Store	Regional Stores	District Stores	Service Delivery Points	Total Stock on Hand
Family Planning Condoms					
HIV/AIDS Prevention condoms					
Lo-Femenal	746,600*	417,950	N/A	118,889	1,283,439
Microgynon					
Depo-Provera®					
Norplant®					

* Includes 12,000 cycles expiring April 2000.

Note 1: Central and regional balances are actual figures reported by each store, based on 1999 year-end physical inventory.

Note 2: SDP balances are based on LMIS reports, adjusted for missing data. Region 2 year-end figures were unavailable; SDP figures for Region 2 were calculated on the assumption that all facilities had an average of 1.5 months of supply on hand, using the nationwide average quantity dispensed to clients per month.

11.3. Determining Shipments Already Received/on Order

It is essential that the calculation of contraceptive requirements account for shipments already in process. The forecaster must ensure that such shipments are neither omitted from consideration nor double-counted.

After the beginning date of the requirements estimate is set and the stock on hand is calculated, *any* shipments that are not included in the stock on hand figures but are known to be in process should be counted as shipments already ordered/received. These include—

- ❒ Commodities already procured by the program (or committed to by donors) that have not yet been received.
- ❒ Product already received but not yet cleared through customs that is not included in the central warehouse stock balance.
- ❒ For requirements estimates prepared after the beginning of the forecast period, shipments received, cleared, and possibly distributed that were omitted from the stock on hand balance because they occurred between the beginning of the forecast period and the time the requirements estimate was prepared.

Where promises of donated commodities have been made, but the commodities have not actually been shipped, program managers must evaluate the strength of each commitment and decide whether to include the promised quantities as shipments already ordered/received. If commitments have not been made in writing, or if history suggests the likelihood of significant schedule slippage, a more conservative approach is to omit such quantities from the calculation.

11.4. Estimating Current and Future Losses

In making allowances for existing stocks, the requirements estimate should consider only currently usable stocks that are likely to remain usable throughout the forecast period.

Commodities that have expired or are unusable due to damage in transit or storage should be removed from the distribution system promptly and destroyed in accordance with local laws and any applicable donor guidelines for disposal. Unfortunately, many programs find disposal procedures difficult to implement; in the worst cases, storekeepers may be financially liable for damaged product. In such situations, unusable commodities are likely to remain in the distribution system and be included in stock balances reported by the program's LMIS. If the LMIS routinely reports zero losses, or does not report losses at all, this problem should be suspected.

In these cases, a physical inventory is the only way to obtain information on current stocks and future losses. Field visits should be made or a mini-physical inventory taken, as described earlier, and stocks should be counted by age of the product—i.e., by manufacturing or expiration dates found on shipping cartons.

After these investigations are complete, the forecaster and program managers should agree on the percentage of stocks for each product that is currently estimated to be unusable. In addition, they should determine how many, if any, will expire before they can be used, and estimate other losses that might occur during the time period of the requirements estimate. These quantities should be included in the losses/adjustments figure.

11.5. Identifying Other Adjustments to Inventory

Besides actual and anticipated losses, other types of adjustments to inventory levels may be needed. There are normally two types of adjustments—

- ❒ **transfers of product** into or out of the system; and
- ❒ **adjustments for data errors,** such as the difference between stock balances found through a physical inventory and balances reported by the LMIS.

The most common reason for transfers is loans of product (or repayment of loans) to another program in the country, or in rare cases, to another country. It is important that such transfers not be included with consumption data. Such an error overestimates program consumption by the amount of the transfer, perhaps introducing significant additional error into future forecasts and causing program managers to over order and overstock.

Note that adjustments can be either positive (product entering the distribution system) or negative (product leaving). However, because losses/adjustments are *subtracted* in the requirements estimation formula, the signs are reversed—transfers out of the program, negative adjustments to inventory, and losses should be recorded as *positive* numbers; transfers into the program and positive adjustments to inventory should be recorded as *negative* numbers.

11.6. Determining Desired Inventory Levels

The desired stock at end of period should be set high enough to ensure continuous availability of products at all program levels, but not so high that they regularly expire. In setting this policy, program managers should take into account the length of the pipeline to and within the country, storage capacity at all levels of the distribution system, normal and maximum lead times for ordering and receiving supplies, and volatility of consumption.

Most contraceptive and HIV/AIDS prevention program logistics systems operate on variations of the max-min inventory control system, in which each storage facility is supposed to maintain stock balances between preset maximum and minimum levels, expressed in terms of number of months of supply on hand. The minimum stock levels include not only quantities sufficient to cover demand during the time it takes to replenish supplies, but also a safety stock. The purpose of safety stock is to avoid stockouts when shipments are late, when consumption or losses are higher than anticipated, or when breakdowns occur in the distribution system. In setting these levels, managers must judge the reliability of—

- ❒ the distribution system,
- ❒ the forecast of consumption and losses, and
- ❒ the suppliers.

The less reliable any of these components is, the higher the safety stock (and maximum and minimum stock levels) needed.

Selecting the level of safety stock need not be a purely subjective decision. Data should be available on timing and reliability of both in-country and international shipments. Comparisons of past forecasts to actual performance can provide a quantitative measure of forecast reliability. Generally, safety stock and minimum and maximum policies are set initially at relatively high levels, and then increased or decreased as experience dictates.

Because stock balances are intended to fluctuate between the maximum and minimum, desired stock at the end of the period ideally is calculated by summing the maximum and minimum months' supply at each level of the distribution system and dividing by two. This calculation yields a desired stock at end of period (measured in months of supply) equal to the average of maximum and minimum, which is appropriate for stable, mature distribution systems. In a less reliable system, managers should adopt the more conservative approach of setting desired stock at end of period equal to the *maximum* stock level, so that all facilities are topped up completely at the end of the period. In this case, desired stock at end of period, again measured in months, is equal to the sum of the maximum months of supply at each level of the distribution system. These calculations are illustrated in table 29.

Table 29. Calculating Desired Stock at End of Period (In Months of Supply)

Program Level	Maximum Stock Level (months)	Minimum Stock Level (months)
Central	6	3
District	3	2
SDP	3	1
Total	**12**	**6**

Normal Calculation:

$$\text{Desired stock at end of period (months)} = \frac{\text{Total max stock level} + \text{Total min stock level}}{2}$$

$$= \frac{12 + 6}{2}$$

$$= \text{9 months of supply}$$

Conservative Calculation:

$$\text{Desired stock at end of period (months)} = \text{Total max stock level}$$

$$= \text{12 months of supply}$$

In either case, the desired stock at end of period (in months) is converted to an actual quantity of product for use in the requirements estimation formula by multiplying by the projected average *monthly* consumption in the *following* time period. The following time period's forecast is used instead of the current time period's projection because the end of period balance for each period should be sufficient to cover demand during the subsequent time period. Where usage of a commodity is growing or shrinking rapidly, it is especially important to use the following period's forecast in this calculation.

In distribution systems with multiple levels or long lead times for procurement, the forecaster and program managers must also be concerned about the total length of the pipeline implied by these calculations. All contraceptives, particularly condoms, have limited shelf lives and are susceptible to deterioration in storage. A program never wants to run short of commodities, but neither does it want to destroy contraceptives because of expiration or quality problems. For these reasons, every effort should be made to limit the length of the in-country pipeline, and, therefore, the desired stock at end of period, to no more than 12 months. A longer pipeline increases the risk that contraceptives will expire before they can be distributed.

11.7. Determining Desired Shipment Frequency

If the time period covered by the requirements estimate is very short, or if the program is small, a single shipment from each supplier may be sufficient to provide the required commodities. At the national level, requirements estimates normally are made annually, and, at least in programs that receive product from USAID, for multi-year periods. In these cases—and always for larger programs—multiple shipments are required to meet the program's commodity needs. Determining the desired shipment schedule should be part of the requirements estimation process.

Several factors should be considered in determining an appropriate shipment schedule, including at least the following—

- ❐ **Ability to store product in country.** Basic storage capacity calculations are described in chapter 7. If storage space is at a premium, smaller, more frequent shipments can be scheduled; if there is a surplus of storage space, larger, less frequent shipments can be scheduled.
- ❐ **Undesirable seasons for product receipt.** Some countries are subject to a monsoon season, typhoons, hurricanes, or other weather problems that make it undesirable to receive shipments during certain time periods. Also, there may be times when the port is busier, making it difficult to clear shipments through customs. These factors may necessitate less frequent, larger shipments, or irregular shipping schedules.
- ❐ **Economies of scale in shipment costs.** Most ports are equipped to handle containerized freight. Containerized freight is usually less costly and easier to manage than bulk shipments, and the containers protect against product loss and damage. Minimizing the cost, however, requires that full containers be used. Maximum savings are obtained if shipments can be scheduled in quantities that completely fill containers.
- ❐ **Product shelf life.** Less frequent shipments imply higher stock levels and a longer pipeline. Where product shelf lives are short, procurement lead times are long, or product storage conditions are severe, shipments should be scheduled more frequently. Family planning and HIV/AIDS prevention programs clearly fall into this category.
- ❐ **In-country resupply schedules.** It is very desirable to coordinate shipments from suppliers with the in-country distribution schedule. For example, some programs operate on a quarterly resupply system. If central storage capacity is limited, program managers will want to receive quarterly shipments into the central warehouse after the outgoing shipments to lower program levels have been completed.

All of these factors should be discussed with logistics system managers and central warehouse staff to determine the most desirable shipment schedules. The shipping schedule at the central level is constrained by the central maximum and minimum stock level policies, just as the in-country resupply schedules at lower levels of the distribution system are constrained. As described in chapter 7—

$$\text{Resupply interval} \leq \text{Max stock level} - \text{Min stock level}$$

Thus, in the example in table 29, shipments must be scheduled at least quarterly.[11]

11.8. Preparing Multi-Year Requirements Estimates

Donor procurement cycles are very long, and lead times even for commercial procurement of large quantities of contraceptives or HIV/AIDS prevention condoms may be measured in years. USAID, for example, begins procurement planning as much as three years in advance of production of commodities. For these reasons, most programs need to calculate requirements estimates for two to three years into the future.

Multi-year estimates are made simply by repeating the net supply requirement calculation for as many years as necessary, using the desired stock at end of period as the opening stock on hand figure for the following period, and substituting the appropriate projections for estimated consumption and losses/adjustments. The calculations for each year might be presented to program managers in the form of multiple copies of the format shown in table 26.

As an alternative, a single table can be prepared for each *product*, showing estimated consumption and requirement estimates year by year. Table 30 portrays such a chart, completed using the projection for Anyland.

Note that in this example, the table includes historical data for two years prior to the forecast year, thus showing, at least in part, the basis for consumption and loss projections. Requirements estimates are produced for two forecast years, and consumption and loss projections are shown for three years. This corresponds to the procurement process used by USAID for commodities it supplies; similar contraceptive procurement tables, supported by desired shipping schedules and documentation of assumptions, are required of programs to which USAID donates contraceptives.[12]

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[11] To understand the reasons for this interrelationship, see JSI/DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs*. Arlington, Va.: JSI/DELIVER, for the U.S. Agency for International Development.

[12] For a complete description of these tables and instructions for their completion, see the *USAID Contraceptive Procurement Tables (CPT) Guidance*, published annually by USAID/G/PHN/POP/CLM.

Table 30. 2000 Contraceptive Procurement Table

Country: Anyland		Prepared by: Richard C. Owens, Jr.			
Program: MOH/Dept. of Family Planning		Prepared on: January 28, 2000			
Contraceptive: Lo-Femenal					
All Numbers in 1,000s					
	1998	1999	2000	2001	2002
1. Beginning of year stock	1,419.9	1,146.2	1,283.4	2,149.7	2,357.3
MINUS					
2. Estimated consumption					
a) Sales or distribution	1,273.7	1,460.6	1,646.0	1,834.0	2,012.0
b) Loss or disposal	0	0	12	10	10
c) Transfer or adjustment	0	0	0	0	0
PLUS					
3. Additional contraceptives received or scheduled					
a) Received	1,000.0	1,597.8	186.0		
b) Scheduled			376.8		
EQUALS					
4. End of year stock	1,146.2	1,283.4	188.2	305.7	
MINUS					
5. Desired end of year stock: 14 months			2,149.7	2,357.3	
EQUALS					
6. Net supply situation					
a) Surplus **OR**					
b) Quantity needed			1,961.5	2,051.6	

12. Monitoring the Forecast and the Distribution Cycle

The forecaster's job does not end when the requirements estimation is completed. Whether or not the needed commodities are procured locally, the entire process of obtaining, distributing, and dispensing products should be monitored continuously, so the quantities to be procured and/or desired shipping schedules can be adjusted to ensure that the program's needs are continuously met.[13]

12.1. Monitoring the Distribution Cycle

The data items that should be monitored throughout the forecast period track the actions that obtain and move supplies to the clients who need them. In particular, the forecaster and program managers should regularly assess quantities of product—

- Needed by the program as calculated in the requirements estimate.
- Purchased by the program and/or promised by donors.
- Planned to be shipped by commercial suppliers or donors.
- Actually shipped by commercial suppliers or donors.
- Received by the program.
- Dispensed or sold to clients, or lost due to expiry, damage or other reasons.

In a perfect logistics system supported by perfect forecasts, these numbers all would be the same. In practice, of course, they are not. Safety stocks should be built into maximum and

[13] For additional information on local procurement, see UNFPA. 1993. *Contraceptive Procurement: Options for Programme Managers*; and PATH. May 1993. *Competitive Procurement of Public Sector Contraceptive Commodities: A Reference Manual*.

minimum stock policies to provide short-term protection against stockouts when the logistics system and the forecast are *not* perfect. If differences between the original forecast and actual consumption are significant, however, program managers must take corrective action swiftly to avoid interruption of supply. The two basic corrective actions available to program managers are—

1. **Increasing or decreasing the amount of product to be purchased or requested**. Because of contractual arrangements, it may be impossible or very expensive to change the total quantity to be purchased or requested. Logistics system managers must know how much lead time is required for making adjustments in quantities that have been ordered. This lead time may be very long.

2. **Changing the shipment schedule to speed up or delay delivery of particular shipments**. In most cases it is easier to change shipment schedules than to change total quantities ordered. However, such changes may also be very expensive (for example, if it is necessary to ship by air instead of by sea), and the lead time to make such changes may also be long.

In cases where consumption or loss is less than originally forecast, the relatively long shelf life of contraceptives adds some flexibility. If storage space is available, in-country stock balances can be allowed to rise above the desired maximum level, and procurement in subsequent time periods can be reduced to compensate for the excess in the current period. Because condoms may deteriorate rapidly in poor storage conditions, it is more difficult to make such adjustments for this product.

The amount by which stock balances can be allowed to fall *below* desired minimums depends on the amount of safety stock built into the system and the length of time needed for corrections to take effect. Increasing safety stock levels can help compensate for inflexibility in the procurement and shipping processes, but such a strategy lengthens the pipeline, increases inventory costs, and requires additional storage space at some or all levels of the distribution system.

For all of these reasons, it is very important for the initial forecast to be as accurate as possible. One way to monitor the distribution cycle is to set up stock balance records for each commodity, entering estimated consumption and losses for each month (or quarter) of the forecast period. Stock on hand at the beginning of the period should be entered as well. Quantities expected to be received according to the projected shipping schedule should be recorded in the appropriate month. After this balance record is set up, projections of consumption, losses, and receipts can be replaced by actual figures on a monthly or quarterly basis, and stock balances can be recalculated. If the new projected balances vary significantly from established maximum and minimum stock levels, shipment quantities or schedules can be changed.

For a program that manages a small number of products coming from a few suppliers, this monitoring can be done manually or with a simple spreadsheet. However, many programs now manage large numbers of products obtained from multiple suppliers and donors. In these cases, monitoring the distribution system manually is very time-consuming. To assist managers of such programs, USAID's Family Planning Logistics Management project has developed a software tool, the *Pipeline Monitoring and Procurement Planning System (PipeLine)*. The rest of this chapter uses PipeLine examples to illustrate the essential principles that apply to any monitoring strategy, manual or automated.[14]

12.2. PipeLine

PipeLine is a software tool designed to help program managers and policymakers monitor the status of their distribution systems regularly. PipeLine provides the information logisticians need to initiate and follow up actions that ensure consistent availability of all products at *the program or national level*. For each product, PipeLine tracks—

- ❒ **Rate of consumption.** The quantity dispensed or sold to clients by month, either actual or forecasted.
- ❒ **Shipments of new products.** Planned, ordered, shipped, or received quantities and their value, either actual or estimated.
- ❒ **Inventory levels.** Total quantity available in the entire program for dispensing or selling to clients each month, and the maximum and minimum total quantity desired.
- ❒ **Inventory changes.** Losses, adjustments, or transfers into or out of the program that change the inventory level.

Again, these are the basic data that any manual or automated monitoring system must gather. With these data and an understanding of the lead time required for each step in the procurement process, PipeLine identifies actions needed for each proposed shipment and when those actions should be taken; highlights pipeline problems (shortfalls, surpluses, or stockouts) before they occur; and calculates procurement quantities and estimated costs.

Table 31 is an example of a PipeLine Stock Status Report. This hypothetical example displays nationwide balances of Depo-Provera® for the Ministry of Health. The most important information for program managers is *stock in months*, which is found in the 9th column. PipeLine compares the months of stock on hand with the desired maximum and minimum stock levels and then calculates whether the program is oversupplied or undersupplied, and by how much. These data are easier to understand when displayed as a graph, also a standard output of PipeLine, as shown in figure 7.

[14] PipeLine is available free from the JSI/DELIVER project (see appendix 1 for details).

Table 31. Procurement and Pipeline, Directorate of Family Planning

Ministry of Health, RHU

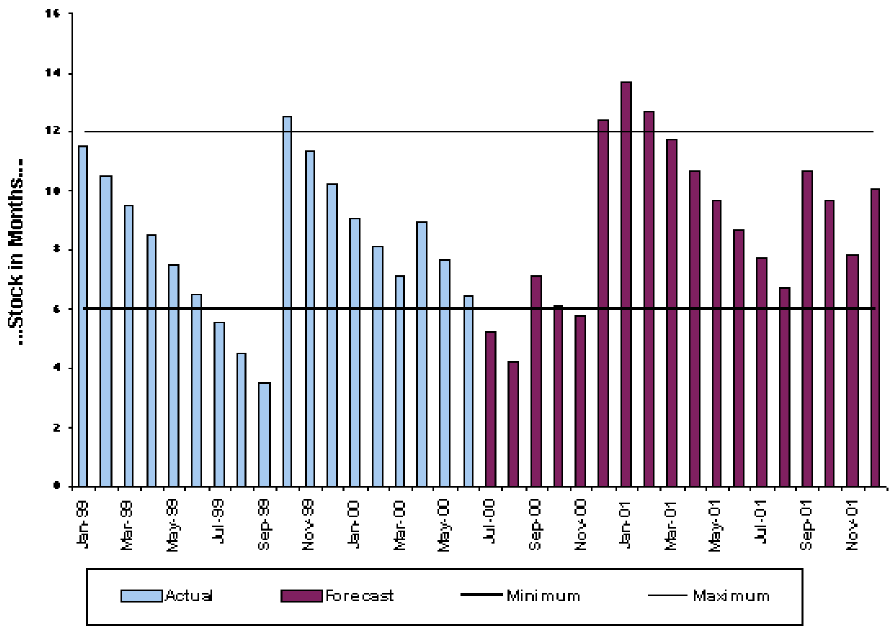
Stock Status By Month

Depo-Provera

Desired months of stock = ***12***
Minimum = ***6*** **Maximum =** ***12***

		----------Shipments ----------			-----Consumption----					
Month	**Beginning Balance**	**Quantity**	**Status**	**Supplier**	**- Amount**	**Stock Adjustment**	**Ending Balance**	**Stock in Months**	**Shortfall / Surplus**	**Desired Stock**
Jan-99	340,156	160,000	Received	USAID	40,000		460,156	11.5		19,844
Feb-99	460,156				40,000		420,156	10.5		59,844
Mar-99	420,156				40,000		380,156	9.5		99,844
Apr-99	380,156				40,000		340,156	8.5		139,844
May-99	340,156				40,000		300,156	7.5		179,844
Jun-99	300,156				40,000		260,156	6.5		219,844
Jul-99	260,156				40,000		220,156	5.5	-19,844	259,844
Aug-99	220,156				40,000		180,156	4.5	-59,844	299,844
Sep-99	180,156				40,000		140,156	3.5	-99,844	339,844
Oct-99	140,156	400,000	Received	USAID	40,000		500,156	12.5	20,156	
Nov-99	500,156				40,000		460,156	11.3	26,504	
Dec-99	460,156				40,000		420,156	10.2	73,176	
Jan-00	420,156				41,667		378,489	9.1	121,515	
Feb-00	378,489				41,667		336,822	8.1	163,182	
Mar-00	336,822				41,667		295,155	7.1	204,849	
Apr-00	295,155	120,000	Received	USAID	41,667		373,488	9.0		126,504
May-00	373,488				41,667		331,821	7.7		188,175
Jun-00	331,821				41,665		290,156	6.4		249,832
Jul-00	290,156				46,667		243,489	5.2	-36,513	316,515
Aug-00	243,489				46,667		196,822	4.2	-83,180	363,182
Sep-00	196,822	180,000	Ordered	USAID	46,667		330,155	7.1		229,849
Oct-00	330,155				46,667		283,488	6.1		276,492
Nov-00	283,488				46,667		236,821	5.8	-9,839	256,499
Dec-00	236,821	250,000	Ordered	USAID	46,663		440,158	12.4	13,510	
Jan-01	440,158				30,000		410,158	13.7	50,158	
Feb-01	410,158				30,000		380,158	12.7	20,158	
Mar-01	380,158				30,000		350,158	11.7		9,842
Apr-01	350,158				30,000		320,158	10.7		39,842
May-01	320,158				30,000		290,158	9.7		69,842
Jun-01	290,158				30,000		260,158	8.7		99,842
Jul-01	260,158				30,000		230,158	7.7		129,842
Aug-01	230,158				30,000		200,158	6.7		159,842
Sep-01	200,158	150,000	Planned	USAID	30,000		320,158	10.7		39,842
Oct-01	320,158				30,000		290,158	9.7		69,842
Nov-01	290,158				30,000		260,158	7.8		139,838
Dec-01	260,158	140,000	Planned	USAID	30,000		370,158	10.1		69,834

Figure 7. Depo-Provera Stock Status



PipeLine does *not* take the place of a program's LMIS, which should provide data for stock management at every level and facility in the program. Rather, PipeLine provides the overall program-wide monitoring capability that some LMISs lack. In addition, the entire in-country distribution system should be monitored to detect and correct local supply imbalances.[15]

12.3. Monitoring the Forecast

The final step is monitoring the accuracy of the forecast itself by comparing projected consumption and losses to actual consumption and losses. Through this process, the forecaster and program managers gain the program-specific knowledge and experience to improve their subsequent forecasts.

Actual consumption is *always* different from projected consumption. If the differences are significant, the reasons should be investigated. It is useful to categorize these reasons into predictable causes and unpredictable causes.

Predictable causes are those that the forecaster would have taken into consideration if they had been known at the time of the forecast. For example, actual consumption of one or more methods might exceed projections if the program mounted a significant promotion halfway through the year. If IEC staff knew of plans for the promotion at the beginning of the forecast period, but the forecaster did not, then steps should be taken to ensure that future forecasts adequately account for program plans.

[15] See JSI/DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs*. Arlington, Va.: JSI/DELIVER, for the U.S. Agency for International Development.

Program performance is also affected by causes that cannot be predicted in advance. For example, a rumor that oral contraceptives cause cancer might cause clients to switch to another method or drop out of the program altogether, thus decreasing demand for orals and perhaps increasing demand for other products. Improving the forecasting process cannot eliminate these differences. However, other changes that improve the logistics system's capacity to respond to such variability (for example, increasing safety stocks or negotiating more flexible contracts with suppliers) may be appropriate.

Above all, the forecaster should not be discouraged by such differences. Forecasting for family planning and HIV/AIDS prevention programs, as for any human service program, remains as much an art as a science. If the science described in this handbook is applied, if the art is honest, and if every effort is made to ensure a continuous supply of products to the clients who need them, then the job will be done well.

Appendix 1
Related Publications

1.1. Forecasting and Forecasting Tools

Business Forecast Systems. *Forecast Pro*, Version 4.01. Business Forecast Systems, Inc., 68 Leonard Street, Belmont, MA 02478 USA. Phone: 617-484-5050. Fax: 617-484-9219. Web: forecastpro.com.

Jain, Chaman L., and Al Migliaro. 1988. *Understanding Business Forecasting*. Flushing, New York: Graceway Publishing Company, Inc. (ISBN: 9932126154).

John Snow, Inc./DELIVER. 2004. *USAID Contraceptive Procurement Guide and Product Catalog. 2005* . Arlington, Va.: John Snow, Inc. /DELIVER, for the U.S. Agency for International Development.

USAID Contraceptive Procurement Guide and Product Catalog. 2004. is also available from Project Officer, Commodities Security and Logistics Division (CSL), Office of Population and Reproductive Health (PRN), Bureau for Global Health (GH), U.S. Agency for International Development (USAID), 1300 Pennsylvania Avenue, NW, Washington, DC 20523 USA, Phone: 202-212-4539, Fax: 202-216-3404, Internet: usaid.gov.

John Snow, Inc./DELIVER. 2004. *PipeLine User's Guide*. Arlington, Va.: John Snow, Inc./DELIVER, for the U.S. Agency for International Development.

Makridakis, Spyros, and Steven C. Wheelwright. 1985. *Forecasting Methods for Management*, 4th Edition. John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012 USA. Phone: 212-850-6000. Fax: 212-850-6088. (ISBN: 0471816876)

The Futures Group International. December 1999. *SPECTRUM: A Set of Computer Programs for Population, Family Planning, HIV/AIDS, and Reproductive Health Analyses and Projections*. The Futures Group International, 1050 17th Street, NW, Suite 1000, Washington, DC 20036 USA. Phone: 202-775-9680. Fax: 202-775-9694. Web: www.tfgi.com.

1.2. Demographic Data

Bongaarts, John, W. Parker Mauldin, and James F. Phillips. “The Demographic Impact of Family Planning Programs.” *Studies in Family Planning.* 21, 6 (1990): 299–310.

Centers for Disease Control and Prevention (CDC), National Center for Chronic Disease Prevention and Health Promotion, U.S. Department of Health and Human Services. *Reproductive Health and Family Planning Surveys*. CDC Division of Reproductive Health, Behavioral Epidemiology and Demographic Research Branch, Mail Stop K-35, 4770 Buford Highway, NE, Atlanta, GA 30341 USA. Phone: 770-488-5260. Fax: 770-488-5666. Web: www.cdc.gov.

Macro International, Inc. *Demographic and Health Surveys*. Macro International Inc., 11785 Beltsville Drive, Calverton, MD 20705-3119 USA. Phone: 301-572-0200. Fax: 301-572-0999. Web: www.measuredhs.com.

National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development) [Kenya], and Macro International Inc. (MI). 1999. *Kenya Demographic and Health Survey 1998*. Calverton, Maryland: NDPD, CBS, and MI.

Population Reference Bureau. *World Population Data Sheet*. Population Reference Bureau, Inc., 1875 Connecticut Avenue NW, Suite 520, Washington, DC 20009-5728 USA. Phone: 202-483-1100. Fax: 202-328-3937. Web: www.prb.org. Published annually.

Stover, John, Jane T. Bertrand, Susan Smith, Naomi Rutenberg, and Kimberly Meyer-Ramirez. 1997. *Empirically Based Conversion Factors for Calculating Couple-Years of Protection*. The EVALUATION Project. Carolina Population Center, Tulane University, and The Futures Group International, Chapel Hill, NC USA.

United Nations, Department of Economic and Social Affairs, Population Division. *Levels and Trends of Contraceptive Use as Assessed in 1998*. 1999. United Nations, Department of Economic and Social Affairs, Population Division, United Nations Plaza, New York, NY 10017 USA. Phone: 212-963-4996. Fax: 212-963-2147. Web: www.un.org. (ISBN: 9211513103). Published every four years.

United Nations, Department of Economic and Social Affairs, Population Division. *World Contraceptive Use, 1998*. 1999. United Nations, Department of Economic and Social Affairs, Population Division, United Nations Plaza, New York, NY 10017 USA. Phone: 212-963-4996. Fax: 212-963-2147. Web: www.un.org. Published annually.

United Nations, Department of Economic and Social Affairs, Population Division. *World Population Prospects: The 1996 Revision*. 1997. United Nations, Department of Economic and Social Affairs, Population Division, United Nations Plaza, New York, NY 10017 USA. Phone: 212-963-4996. Fax: 212-963-2147. Web: www.un.org. Published every two years.

United States Bureau of the Census. *The International Data Base*. Center for International Programs, Room 207, Washington Plaza 2, Bureau of the Census, Washington, DC 20233-8860 USA. Phone: 301-763-4811. Fax: 301-763-7610.
Web: www.census.gov/ipc/www.

1.3. Statistical Reference Texts

Sage Publications, Inc. 1976–2000. *Quantitative Applications in the Social Sciences: A Sage University Paper Series*. Sage Publications, C-23 Defence Colony, New Delhi 110 024, India; 28 Banner Street, London EC1Y 8QE, England.
(A series of more than 40 monographs designed for readers with limited background in statistics or mathematics on various data analysis techniques applicable to the social sciences.)

Zar, Jerrold H. 1984. *Biostatistical Analysis*, 2nd Edition. Prentice Hall, Inc.: Upper Saddle River, NJ 07458 USA. Phone: 1-800-282-0693. Fax: 1-800-835-5327. (ISBN: 0130779253)

1.4. Logistics Management

Centers for Disease Control and Prevention (CDC), National Center for Chronic Disease Prevention and Health Promotion, U.S. Department of Health and Human Services. 2000. *Pocket Guide to Managing Contraceptive Supplies.* CDC Division of Reproductive Health, Mail Stop K-22, 4770 Buford Highway, NE, Atlanta, GA 30341-3724 USA. Phone: 770-488-5612 or 1-800-311-3435. Fax: 770-488-5240. Web: www.cdc.gov.

John Snow, Inc./DELIVER. 2004. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs.* Arlington, Va.: John Snow, Inc. /DELIVER, for the U.S. Agency for International Development.

John Snow, Inc./DELIVER. 2004. *Supply Chain Manager User's Manual.* Arlington, Va.: John Snow, Inc. /DELIVER, for the U.S. Agency for International Development.

Program for Appropriate Technology in Health (PATH). Draft, May 1993. *Competitive Procurement of Public Sector Contraceptive Commodities: A Reference Manual*. PATH, 4 Nickerson Street, Seattle, WA 98109-1699 USA. Phone: 206-285-3500. Fax: 206-285-6619. Web: www.path.org/resources.

United Nations Fund for Population Activities. 1993. *Contraceptive Procurement: Options for Programme Managers*. UNFPA, 220 East 42nd Street, New York, NY 10017 USA. Phone: 212-297-5226. Fax: 212-297-4915. Document Number E/2,250/1993. (French and English) Web: www.unfpa.org.

United States Agency for International Development. *Contraceptive Procurement Tables (CPT) Guidance*. Contraceptives and Logistics Management Division, Office of Population, G/PHN/POP/CLM, 1300 Pennsylvania Ave., Washington, DC 20523 USA. Phone: 202-712-0876. Fax: 202-216-3404. Web: www.usaid.gov. Published annually.

1.5. Other Related Publications and References

Bertrand, Jane T., Robert J. Magnani, and James C. Knowles. 1994. *Handbook of Indicators for Family Planning Program Evaluation*. The EVALUATION Project, Carolina Population Center of the University of North Carolina, University Square East, 123 W. Franklin Street, Suite 304, Chapel Hill, NC 27516-3997 USA. Phone: 919-966-7482. Fax: 919-966-2391.

Family Planning Logistics Management (FPLM). 2000. *Programs That Deliver: Logistics' Contributions to Better Health in Developing Countries.* FPLM/John Snow, Inc. 1616 North Fort Myer Drive, 11th Floor, Arlington, VA 22209 USA, for the U.S. Agency for International Development. Phone: 703-528-7474. Fax: 703-528-7480. Web: deliver.jsi.com.

Appendix 2
Logistics Management Information System Assessment Guidelines

Purpose

A logistics management information system (LMIS) assessment identifies differences between the way a program's LMIS should work and how it actually works. Problems and their possible causes are analyzed to distinguish those related to LMIS from other issues. Once the causes of LMIS problems are identified, solutions can be recommended.

These guidelines are intended as a comprehensive general reference for field advisors conducting LMIS assessments. In some instances, the advisor will be familiar with the system being assessed and may already know the answers to many of the questions. The questions and checklists presented here should be condensed or adapted based on what is and is not known and on the scope of the assessment trip.

Use of these guidelines should not be limited to formal LMIS assessment visits. Most logistics technical assistance—commodity requirements estimation, distribution systems design, performance improvement assessment, or any other intervention—requires an understanding of the design and functioning of the LMIS.

Strategy

The job of the advisor is to assess the functionality of the LMIS, identify the problems in its operations, and propose solutions. LMIS problems can be divided into three basic types—

Design	Does the LMIS collect and report the essential data items for logistics management?
Operation	Are reporting procedures followed; do the data flow in a timely fashion?
Use	Are managers throughout the program actually using LMIS data for decision making?

Using the framework in this guideline, you work through five steps to answer these questions—

- ❐ What are the logistics system's problems?
- ❐ Which of the logistics problems are caused by the LMIS?
- ❐ Are the LMIS problems *design* problems, *operation* problems, or *use* problems?
- ❐ What are the solutions to the identified LMIS problems?

The steps are—

1. Outline the logistics system.
2. Outline the design of the current LMIS as it exists on paper.
3. Identify design problems.
4. Assess functionality of the logistics system and the actual LMIS in the field.
5. Identify logistics system problems with LMIS causes and recommend solutions.

The tasks involved in completing the first three steps typically can be accomplished in the national capital. The fourth step requires travel outside the capital city. The last step is analytical (based on the first four) and can be completed anywhere.

Steps

1. Outline the Logistics System

To assess an LMIS, you first must understand the logistics system it serves. For example, you cannot evaluate the reporting feedback loop without knowing whether the distribution system is a "push" or a "pull" system. Other elements of the logistics system essential to understanding the LMIS include—

- ❒ Whether the distribution system is vertical (i.e., responsible only for family planning commodities) or integrated (i.e., responsible for other primary health care commodities as well).
- ❒ Sources of supply.
- ❒ Products distributed.
- ❒ Number of levels in the system.
- ❒ Number and types of facilities at each level.
- ❒ Types of service delivery points—clinic, community-based distribution (CBD), others.
- ❒ Storage capacities and constraints.
- ❒ Type of inventory control system.
- ❒ Maximum and minimum stock levels.
- ❒ Periodicity of orders and deliveries.
- ❒ Lead times.
- ❒ Transport modes/mechanisms (how products are moved between facilities).
- ❒ Management/supervision structure of the distribution system.

2. Outline the Current LMIS Design As It Exists on Paper

In many cases, the LMIS design is very good on paper, but the official procedures are not followed (or not followed uniformly) in the field. Step 2 requires you to interview central-level logistics managers and review all forms, manuals, and guidelines to ascertain what the *de jure* LMIS looks like and how it is supposed to work. If this information is not available at the central level, you may be able to infer the intended LMIS design from observations at lower levels. This step helps you determine whether the LMIS suffers from *design* problems, as opposed to *operation* or *use* problems.

At minimum, you need to determine the following—

- ❒ Is there more than one LMIS design for the same program?
- ❒ Is the LMIS supposed to be for family planning only, or is it integrated with LMIS for other primary health care supplies?
- ❒ Is the LMIS intended to stand alone, or is it integrated with other program reporting, such as service statistics or health management information systems (HMIS)?
- ❒ What logistics data are supposed to be collected?
- ❒ What LMIS forms are supposed to be used?
- ❒ How is the reporting cycle supposed to work (reporting interval, data flow, levels at which data are aggregated)?
- ❒ Who is supposed to be responsible for collecting, reporting, and processing the data? Who is supposed to be responsible for overseeing these activities?
- ❒ Are the commodity reordering and data reporting systems the same or different (i.e., are the people who collect, report, and process LMIS data the same staff who actually order and issue supplies)?
- ❒ What logistics management decisions are supposed to be made with the LMIS data, and who is supposed to make them? How often, and when, are these decisions supposed to be made?

3. Identify Design Problems

After outlining the design of the current LMIS, you should be able to identify obvious/serious design constraints. Areas to consider include—

- ❒ Are the essential logistics data being collected (beginning and ending balances, quantities received, quantities issued, quantities distributed to clients, consumption, lead time, losses and adjustments, quantities needed)?
- ❒ Are data that do not serve any management purpose being collected?
- ❒ Is the reporting cycle consistent with timing of decisions that need to be made?
- ❒ Are the forms for collecting and reporting the data well designed, easy to fill out, and easy to aggregate?
- ❒ Do the forms and data collection procedures actually reflect the service delivery and management structures?
- ❒ Are the data being reported consistent with the data being recorded on the primary collection forms?
- ❒ Are there guidelines, systems manuals, and job aids that specify system parameters, such as definition of terms, standard quantities for distribution to clients,

reporting periods, report flow, supervision procedures, feedback reports, staff responsibilities, and so forth?

4. Assess the Functionality of the Logistics System and the Actual LMIS in the Field

It is essential that you obtain systematic, firsthand knowledge of the functioning of the LMIS and the logistics system in the field. This is *the* key step in the assessment; it requires you to make site visits to a representative sample of facilities at all levels in the system. The primary goals of the field assessment are to—

- ❐ Identify the nature and extent of logistics system problems.
- ❐ Assess the design, operation, and use of the LMIS as it is actually implemented in the field.

As a rule of thumb, approximately half of an assessment visit should be spent in the field.

Sample selection. It is important that the sites selected be representative. The sample should be as diverse as possible, including good and bad, urban and rural, accessible and remote, and large and small facilities. The goal is to visit as many different facilities as possible in the allotted time, following each supply chain along its entire length. For example, in a supply chain with central, regional, district, and service delivery point (SDP) levels, you might select two of the regions to investigate, at least two districts in both of the selected regions, and two SDPs in each of the selected districts.

Methodology. Although you can begin at SDPs and track logistics information as it flows up from level to level, protocol usually requires you to begin at the central level and work your way down to SDPs. At each level there are eight steps to be completed—

1. **Records and forms check:** Which LMIS records and forms are being used?

2. **Records and forms review:** Are the records and forms properly maintained and kept up to date?

3. **Crosscheck for data consistency within facilities:** Are the records within this facility consistent with each other? That is, do shipping/receiving records match stock cards? Do stock records match a physical inventory taken at the time of the assessment?

4. **Crosscheck for data consistency between levels:** Do the records in this facility match the corresponding records from the facilities above and below? That is, were shipments sent here from the higher level received and recorded properly? Are shipments from this facility to lower-level facilities it serves recorded properly both here and at the lower-level facilities?

5. **Logistics system performance:** Are the right quantities of the right contraceptives going to the right places at the right time?

6. **Management and supervision structure:** What are the supervision protocols and actual practices at this facility?

7. **Operation:** Do staff understand and follow LMIS guidelines?

8. **Use:** Do managers use the LMIS data to manage the logistics system?

The crosschecks are particularly important. Visiting facilities throughout the length of a single reporting chain will enable you to follow specific logistics data as they move up the system and supplies as they move down. The crosschecks of data between levels, and between the logistics information and the flow of supplies, will highlight shortcomings in operation and use of the LMIS. For example, if you crosscheck the quantities ordered, received, and dispensed to clients at the SDP level against the data the SDP reports up to the next level, and against the quantity issued from the higher level to the SDP, you will be able to evaluate—

- ❒ How order quantities are determined at the SDP.
- ❒ Whether the link between recording and reporting data is functioning.
- ❒ Whether commodity loss/wastage is significant.
- ❒ How orders are verified at the next higher level.
- ❒ Whether there were enough supplies at the next level to fill the orders.

To organize your field assessment findings, you might rate the LMIS from 1 to 4 (where 1 = best performance) at each facility and for the system overall, regarding—

Design

___ Collects only essential data.

___ Forms and reports are easy to understand and use.

___ LMIS structure and parameters support the logistics system design.

Operation

___ Knowledge and use of system standards and reporting procedures.

___ Completeness of data recording and reporting.

___ Timeliness of data recording and reporting.

___ Quality and accuracy of reported data.

Use

___ Use of data for determining and validating order quantities.

___ Use of data for managing and troubleshooting the logistics system.

Such rankings can be used to identify problem facilities and problem components within the logistics system, providing a partial baseline assessment of the distribution system and a focus for future assistance.

5. Identify Logistics System Problems with LMIS Causes and Recommend Solutions

Having completed the first four steps, you should be able to—

- ❒ Assess any differences between the *de jure* LMIS identified in the capital city and the *de facto* LMIS found in the field.
- ❒ Identify the nature and extent of logistics system problems found at different levels in the pipeline (i.e., overstocking, stockouts, bottlenecks, expired stock).
- ❒ Identify and distinguish among problems with the design, operation, and use of the LMIS, and assess the impact of these problems on the functioning of the logistics system.
- ❒ Recommend solutions to problems with the LMIS design, operation, and use.

Distinguishing between the *de jure* and the *de facto* LMISs not only facilitates your understanding of system problems and interventions required, but also makes it easier to communicate with policymakers who may be unaware of the situation in the field. Going beyond identifying LMIS problems to identify the logistics system consequences of LMIS problems gives weight to your recommendations—information system problems are intangible, but stockouts are not. It is easier for decision makers to commit resources to LMIS interventions when they know that improvements can resolve high-profile problems, such as undersupply or expired stocks. Moreover, putting the LMIS problems in context will help you develop and prioritize strategies for improving the LMIS.

Some problems require design interventions and others require performance improvement interventions. Most require both. Whatever the problem, fixing it will involve not only developing recommendations, but also building a consensus in support of the recommendations among decision makers before attempting to implement them.

Field Assessment Tool

Facility level/type____________________

Facility name/location____________________

1. Records/Forms Check

Identify LMIS forms and records used—

- ❒ daily activity records
- ❒ inventory control records
- ❒ order forms
- ❒ requisition/issue vouchers
- ❒ stock reports (i.e., quarterly report forms)
- ❒ other types of forms and reports.

Are the forms—

- ❒ well designed and easy to fill out?
- ❒ easy to aggregate to produce reports?
- ❒ available and used uniformly across time and at all facilities?

2. Records/Forms Review

Review all forms to determine—

- ❒ Are the essential data collected (beginning and ending balances, quantities received, quantities issued, quantities distributed to clients, consumption, lead time, losses and adjustments, quantities needed)?
- ❒ Are the forms filled out properly?
- ❒ Is the math correct?
- ❒ Are the records up to date and complete?

3. Logistics System Assessment

- ❒ Are contraceptives being supplied at regular intervals?
- ❒ Are facilities receiving the correct mix of contraceptives in the right quantities?
- ❒ Have there been stockouts in the last six months?

- ❒ Have supplies expired in the pipeline?

4. Management/Supervision Structure

- ❒ Who is responsible for recording, reporting, and processing data?
- ❒ Who is responsible, at each level, for overseeing the recording, processing, and reporting of data?
- ❒ What LMIS supervision takes place? How often?
- ❒ What kind of feedback do they give staff?

5. Operation

Interview staff responsible for data collection, reporting, and supplies management to determine their knowledge of—

- ❒ data definitions
- ❒ standard quantities to dispense to clients (new versus continuing)
- ❒ how to maintain and fill out records and forms
- ❒ how to aggregate data
- ❒ when to update records
- ❒ when and where to forward reports to and receive reports from.

6. Use

Interview supervisory/management staff to assess their knowledge of—

- ❒ how to calculate an order quantity
- ❒ how to verify an order
- ❒ how to process an order
- ❒ how to use the data to forecast program needs
- ❒ how to use the data to set and adjust minimum and maximum stock levels
- ❒ how to identify undersupply and oversupply situations and their causes
- ❒ how to identify and rectify incomplete, poor-quality, or slow reporting.

7. Crosschecks (at one facility)

Compare for data consistency—

- ❒ between inventory record and physical inventory (balance on hand)

- ❒ between inventory record and daily activity register (quantity dispensed to clients)
- ❒ between daily activity register and stock report (quantity dispensed to clients)
- ❒ between inventory record and receipt voucher (quantity received)
- ❒ between quantity ordered and quantity received.

8. Crosschecks (between levels)

Compare for data consistency—

- ❒ between quantity ordered from the lower level and quantity issued from the higher level
- ❒ between quantity issued from the higher level and quantity received at the lower level
- ❒ between quantity dispensed to clients at the SDP and quantity reported to the higher level as having been dispensed to clients from that SDP.

Appendix 3
JSI/FPLM Spectrum Projection Preparation Guidelines

As discussed in chapter 6, the Spectrum System is an automated tool that can be used to forecast contraceptive demand for reproductive health programs. The Futures Group International developed the software and an excellent reference manual to accompany it. The Spectrum/*FamPlan* manual is the primary reference for the use of this tool, providing a step-by-step tutorial for installing the software and completing projections.

These guidelines, developed to supplement the manual, help you understand the required inputs to Spectrum and provide guidance on which data source(s) and data items to select for each input. The following pages show how to develop a basic forecast, assuming that the forecaster will rely on Spectrum defaults for some of the demographic inputs. When time and data permit, you should check the default data against additional data sources presented in the Spectrum manuals.

The principal inputs are organized according to the Spectrum model headings and various windows (shown in italics) under which they appear in the software. Table number(s) cited in each section refer to the attached sample tables, which show preferred data sources and indicate which measurement of the input variable should be used. Kenya is the country used in this example, and the 1998 DHS is the primary data source. For countries where there is no DHS, a relatively current Reproductive Health and Family Planning survey or other reliable prevalence survey should be used.

Note that the Spectrum/*FamPlan* model enables you to select from five possible reproductive health goals—

1. Reducing unmet need for contraception.

2. Total wanted fertility.

3. Reaching a goal for contraceptive prevalence.

4. Reaching a goal for total fertility rate.

5. Specified expenditure levels.

Any of these five goals could be used to prepare a contraceptive forecast. Because good historical trend data and future estimates of TFR are available for most countries, JSI/FPLM uses TFR goals, as described below. Forecasters who want to use the other goals should refer to the Spectrum/*FamPlan* manual.

In addition, Spectrum/*FamPlan* allows forecasters to include available cost data in their analyses. Those who want to use this feature should also refer to the Spectrum/*FamPlan* manual.

3.1. *EasyProj*

To begin the Spectrum/*FamPlan* forecast, open the window for making a new demographic projection (*EasyProj*) and select the country, base year, and number of years to project, as well as TFR and life expectancy in the ending year of the projection. The *EasyProj* model will present base-year and future assumptions for TFR and life expectancy. Also, select *Family Planning* (*FamPlan*) from the *Active Modules* menu.

First Year The beginning year of the forecast should correspond to the year of the main source material for data inputs—typically the most recent Demographic and Health Survey (DHS) for the country.

Ending Year This establishes the number of years to project, for example, through 2010 A.D. We recommend no more than a 15-year projection.

Total Fertility Rate The *EasyProj* model assigns a default total fertility rate (TFR) for the base year, and offers high, medium, and low assumptions for TFR in the ending year of the forecast. At this point, select the default (medium) assumption.

Please note: If the TFR for the base or ending years does not agree with your primary data sources, you can change it later in the *Goal* window under the *FamPlan* model (see TFR in section 3.3).

Life Expectancy

Life expectancy, like TFR, is assigned for the base year, and high, medium, and low assumptions are provided for the ending year. Refer to table A.27, "Life Expectancy at Birth," from the UN's *World Population Prospects*, for country-specific estimates of life expectancy projected to 2050 (see table 32). Select the life expectancy option closest to the source data for the ending year of the projection.

Please note: You can change this later in the *Demographic Data* window under the *DemProj* model.

Number of WRA

The *EasyProj* model will automatically load the population data, by age and sex, for the country selected. To view and edit these data, select the *Demography* (*DemProj)* model from the *Edit* menu, followed by *Demographic Data* and *First Year Population*. The population data for women age 15–49 (number of women of reproductive age—WRA) should be checked against the U.S. Bureau of the Census, Center for International Research's International Data Base (IDB). This data source is Internet accessible at the following web site: www.census.gov. From the home page, under "*People*," select "*Projections*," and then "*International Demographic Data*" which takes you to the IDB. From there, select "*Online Demographic Aggregation*" and then "*Table 094*" for your country. The UN's *World Population Prospects* is also an acceptable data source (see tables 33 and 34).

3.2. *DemProj*

After setting up your demographic projection, you will be able to *Open* and *Edit* the country file you created under the *EasyProj* model.

1. Open the *Demography* (*DemProj)* model.
2. Select *Projection Parameters* and enter the currency to be used if cost projections will be included. You can use the default scale (thousands) and no urban/rural projection.
3. Select the *Demographic Data* window to review the demographic assumptions. At this point you are able to review and modify life expectancy and first year population figures.
4. Review and select your projection figures for the other variables under the *Demographic Data* window.

3.3. *FamPlan*

You can continue to edit your projection in the *FamPlan* model.

1. Return to *Edit* and select *Family Planning* (*FamPlan*) and the *Configuration* window.

2. In the *Configuration* window, select the contraceptive methods and the source of supply. Refer to the descriptions of method mix and source of supply below (see tables 35 and 36).

3. Select "Reaching a Goal for Total Fertility Rate" from the *Goal options*; "Single Age Group, 15–49" from the *Age group options*; and "Specify Total Abortion Rate" from the *Abortion options*.

4. After closing the *Configuration* window, select the *Goal* window to adjust the TFR data and to enter the first year CPR (see table 35).

5. Finally, select the *Family Planning* window. Here is where you must enter most of the data required for the Spectrum/*FamPlan* forecast (see tables 35, 36, 38, 39, 40 and 41).

Method Mix

Calculate the beginning year method mix from the DHS table on "Current use of contraception: women" (see table 35). Estimate method mix for the ending year based on trends evidenced by local surveys (e.g., where there are two DHSs), program plans, logistics data, or other knowledge of trends in method mix. Please note that none of the available international survey data sources (DHS, UN) provide brand-specific data, and that the Spectrum/*FamPlan* model does not yet accept brand data. Consequently, forecasts of oral contraceptives, for example, must be disaggregated into brand estimates using demand patterns demonstrated by logistics data.

Source Mix

This is the source of contraceptives dispensed to clients (e.g., the percentage of all condoms that were dispensed by public-sector facilities). Source mix allows you to prepare sector-specific estimates of contraceptive need (e.g., for the public sector only). The DHS table, "Source of supply for modern contraceptive methods" may or may not provide enough detail to allow you to make program-specific estimates (see table 36).

TFR

The *EasyProj* model automatically provides a base year TFR, and high/medium/low assumptions for TFR in the ending year. Under *Edit*, you can review and edit the TFR by selecting the *Family Planning* model and the *Goal* window. TFR for the base year of the projection should be taken directly from the DHS, when available. Check the estimates of ending year TFR against estimates listed in the UN's *World Population Prospects,* medium variant (see table 34), and edit if necessary.

For historical trends in TFR decline, refer to the DHS (see table 37) or the Spectrum/*FamPlan* manual's table on historical trends in TFR. For additional estimates of future levels of TFR by country, refer to USAID's Center for International Health Information (CIHI) database at www.cihi.com.

CPR

Take the contraceptive prevalence rate (C1PR) for the beginning year from the DHS table "Current use of contraception: women" (see table 35). Do not enter an ending year value for CPR because that is the value that the system will determine to meet the TFR goal.

The DHS table "Current use of contraception: women" provides CPR data for all women/any method and also for currently married women/any method (see table 35). Use the CPR for currently married women/any method. The CPR for any method—rather than any *modern* method—should be used, so that the traditional methods component of CPR can be included in the "Other" category in the *FamPlan* input. This strategy allows you to analyze the substitution effect of gradually replacing traditional methods with modern methods, a common program goal.

CYP Factors

The *Method Attributes* window allows you to enter couple-years of protection (CYP) factors for resupply methods, average age at sterilization, and duration of use for IUDs and Norplant®. The USAID standard factors are displayed as defaults under *Family Planning/Method Attributes*. Use these unless good local data are available.

Effectiveness

Use the Spectrum/*FamPlan* model's default variables unless you have good program- or country-specific data. These defaults were established by USAID's EVALUATION Project.

Percent of Women Age 15–49 in Union

This input variable attempts to estimate the proportion of the population at risk of unwanted pregnancy. Traditionally, married women of reproductive age (MWRA) have been used to define the at-risk population, but, for many reasons, MWRA often underestimates the number at risk. A better estimate is provided by "percentage in union," which can be calculated by summing the percentage of WRA married and the percentage of WRA "living together" as reported by DHS and other surveys (see table 38). The percentage of WRA in union should always be used instead of MWRA when data are available. Use WRA in union in conjunction with the CPR for currently married women, because this CPR includes both married women and those reported in the DHS as living together.

However, the percentage of WRA in union will also underestimate the proportion of the population at risk in countries where significant numbers of people are sexually active outside of any formal or informal union. In these cases, this figure should be adjusted to represent the percentage of women who are sexually active in order to avoid underestimating the quantity of supplies needed to protect the population at risk. In countries with stricter cultural parameters regarding sexual activity, such adjustments may not be necessary.

PPI

Postpartum insusceptibility (PPI) should be taken from the DHS table entitled “Postpartum Amenorrhea, Abstinence and Insusceptibility.” The median duration (months) of postpartum insusceptibility (composed of amenorrhea and abstinence components) should be used (see table 39).

Total Abortion Rate

When a reputable data source reports the total abortion rate (as opposed to crude rates or other rates of abortions per pregnancy), and when it is politically feasible, the country-specific estimate should be entered. In other cases, use the Spectrum/*FamPlan* default of zero (see table 40).

Sterility

This variable includes both natural and pathological sterility. Although pathological sterility can be quite significant in countries with a high incidence of sexually transmitted infections (STIs), there are few good country-specific sources for estimates of sterility. As an approximation, use the percentage of all women age 45–49 with zero children from the DHS table “Children ever born and living” (see table 41). When neither sterility data nor DHS data are available, use 3 percent as the estimate.

Total Fecundity

Total fecundity is an output, rather than a system input. It can be used as a quick check on the proximate determinants you have entered. After completing the *FamPlan* projection, select *Display* and choose *Total Fecundity* from the *Family Planning* menu. Based on the inputs described above, *FamPlan* will calculate total fecundity. The result should be a number between 13 and 17. If total fecundity is outside these limits, then you need to review and modify one or more of the proximate determinants (PPI, sterility, percent of WRA in union, or abortion rate).

To request more information or a copy of the Spectrum software and manual, please contact—

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Data Source Tables

Table 32. Life Expectancy, Kenya

Table A.27. Life expectancy at birth, by major area, region and country, 1995-2050

No.	Major area, region and country	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020	2020-2025
		Life expectancy at birth (in years)					
1	World total						
	Both sexes	65.6	66.9	68.3	69.7	70.9	72.1
	Males	63.4	64.7	66.1	67.4	68.6	69.7
	Females	67.7	69.2	70.6	72.0	73.3	74.5
2	More developed regions (*)						
	Both sexes	74.5	75.3	76.1	76.9	77.7	78.3
	Males	70.6	71.6	72.5	73.5	74.3	75.1
	Females	78.4	79.1	79.7	80.4	81.0	81.6
3	Less developed regions (+)						
	Both sexes	63.6	65.1	66.7	68.2	69.5	70.8
	Males	62.1	63.5	65.0	66.3	67.6	68.8
	Females	65.2	66.9	68.6	70.1	71.6	72.9
4	Least developed countries						
	Both sexes	52.0	54.2	56.7	59.1	61.3	63.3
	Males	50.9	53.1	55.6	57.9	60.0	62.0
	Females	53.0	55.3	57.8	60.4	62.6	64.7
5	Africa						
	Both sexes	53.8	55.9	58.2	60.4	62.5	64.4
	Males	52.3	54.4	56.6	58.8	60.9	62.8
	Females	55.3	57.4	59.7	62.0	64.2	66.1
6	Eastern Africa (1)						
	Both sexes	49.0	51.4	54.4	57.3	59.8	62.0
	Males	47.8	50.1	53.1	55.9	58.4	60.6
	Females	50.3	52.7	55.7	58.7	61.3	63.5
7	Burundi						
	Both sexes	47.2	49.3	51.8	54.1	56.3	58.5
	Males	45.5	47.6	50.1	52.4	54.7	56.8
	Females	48.8	51.0	53.4	55.8	58.0	60.1
8	Comoros						
	Both sexes	57.5	59.5	61.5	63.5	65.5	67.5
	Males	57.0	59.0	61.0	63.0	65.0	67.0
	Females	58.0	60.0	62.0	64.0	66.0	68.0
9	Djibouti						
	Both sexes	50.3	52.3	54.3	56.3	58.4	60.4
	Males	48.7	50.7	52.7	54.7	56.7	58.7
	Females	52.0	54.0	56.0	58.0	60.0	62.0
10	Eritrea						
	Both sexes	50.6	52.1	54.7	57.7	60.8	63.7
	Males	49.1	50.8	53.3	56.3	59.4	62.2
	Females	52.1	53.5	56.1	59.1	62.3	65.2
11	Ethiopia						
	Both sexes	49.9	52.4	54.9	57.4	60.0	62.5
	Males	48.4	50.9	53.4	55.9	58.4	60.9
	Females	51.6	54.1	56.6	59.1	61.6	64.1
12	Kenya						
	Both sexes	54.5	57.4	61.0	64.4	66.7	68.3
	Males	52.3	56.1	59.6	62.6	64.9	66.4
	Females	55.7	58.6	62.4	66.1	68.4	70.2
13	Madagascar						
	Both sexes	58.5	60.5	62.5	64.5	66.5	68.0
	Males	57.0	59.0	61.0	63.0	65.0	66.5
	Females	60.0	62.0	64.0	66.0	68.0	69.5
14	Malawi						
	Both sexes	40.7	42.5	46.1	50.0	53.3	56.0
	Males	40.3	42.2	45.7	49.6	52.9	55.5
	Females	41.1	42.8	46.4	50.4	53.8	56.4
15	Mauritius (2)						
	Both sexes	71.6	72.7	73.8	74.9	75.8	76.6
	Males	68.3	69.5	70.6	71.8	72.7	73.5
	Females	75.0	76.1	77.1	78.0	78.9	79.7
16	Mozambique						
	Both sexes	46.9	48.9	51.4	54.0	56.4	58.7
	Males	45.5	47.5	49.9	52.5	54.9	57.1
	Females	48.4	50.4	52.9	55.6	58.0	60.2
17	Reunion						
	Both sexes	75.3	76.5	77.5	78.4	79.3	80.0
	Males	70.9	72.1	73.3	74.2	75.3	76.1
	Females	79.8	80.8	81.6	82.4	83.2	83.7

Source: United Nations. *World Population Prospects: The 1996 Revision*. 1997.

Table 33. Number of Women of Reproductive Age, Kenya

Table 094. Midyear Population, by Age and Sex

Country/ Year/ Age	Population both sexes	Population male	Population female	Sex ratio
Kenya/1998				
Total, all ages	28,337,071	14,191,772	14,145,299	100.3
0- 4	4,186,197	2,118,316	2,067,881	102.4
5- 9	4,082,596	2,065,174	2,017,422	102.4
10- 14	4,088,910	2,064,770	2,024,140	102.0
15- 19	3,620,673	1,829,607	1,791,066	102.2
20- 24	2,996,530	1,522,644	1,473,886	103.3
25- 29	2,309,603	1,171,705	1,137,898	103.0
30- 34	1,727,467	874,576	852,891	102.5
35- 39	1,235,730	620,594	615,136	100.9
40- 44	966,529	476,704	489,825	97.3
45- 49	778,203	375,059	403,144	93.0
50- 54	644,108	306,083	338,025	90.6
55- 59	525,347	245,417	279,930	87.7
60- 64	413,251	187,242	226,009	82.8
65- 69	312,396	136,702	175,694	77.8
70- 74	215,923	95,523	120,400	79.3
75- 79	134,389	59,140	75,249	78.6
80+	99,219	42,516	56,703	75.0
15- 49	13,634,735	6,870,889	6,763,846	101.6
Kenya/2010				
Total, all ages	32,442,774	16,351,950	16,090,824	101.6
0- 4	3,766,690	1,906,693	1,859,997	102.5
5- 9	3,814,803	1,928,804	1,885,999	102.3
10- 14	3,967,083	2,005,077	1,962,006	102.2
15- 19	3,963,514	2,006,397	1,957,117	102.5
20- 24	3,915,358	1,995,338	1,920,020	103.9
25- 29	3,352,153	1,725,043	1,627,110	106.0
30- 34	2,579,596	1,352,144	1,227,452	110.2
35- 39	1,845,072	969,464	875,608	110.7
40- 44	1,326,840	689,462	637,378	108.2
45- 49	950,432	478,032	472,400	101.2
50- 54	749,105	357,597	391,508	91.3
55- 59	620,596	279,820	340,776	82.1
60- 64	512,008	221,228	290,780	76.1
65- 69	404,902	168,224	236,678	71.1
70- 74	298,948	120,250	178,698	67.3
75- 79	202,150	79,050	123,100	64.2
80+	173,524	69,327	104,197	66.5

Source: U.S. Bureau of the Census.

Table 34. Number of Women of Reproductive Age and Total Fertility Rate, Kenya

KENYA

A. ESTIMATES

Indicator	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995
Population (thousands)										
Total	6265	7190	8332	9749	11498	13741	16632	19872	23475	27150
Males	3159	3612	4176	4880	5750	6870	8315	9937	11746	13595
Females	3105	3577	4156	4870	5748	6872	8317	9936	11729	13555
Sex ratio (per 100 females)	101.7	101.0	100.5	100.2	100.0	100.0	100.0	100.0	100.1	100.3
Age distribution:										
Percentage aged 0-4	17.4	19.1	19.6	19.9	20.1	20.7	21.3	20.0	19.0	16.1
Percentage aged 5-14	22.4	23.1	26.0	27.5	28.1	28.4	28.8	30.0	30.1	29.9
Percentage aged 15-24	18.9	17.8	15.8	16.1	17.9	18.6	18.6	18.9	19.6	21.5
Percentage aged 60 or over	6.3	6.4	6.4	6.2	5.9	5.5	5.0	4.7	4.5	4.5
Percentage aged 65 or over	3.9	4.1	4.1	4.1	3.9	3.7	3.4	3.1	3.0	2.9
Percentage of women aged 15-49	45.6	43.7	41.3	40.5	40.6	40.7	40.5	40.9	42.3	45.8
Median age (years)	20.0	19.2	17.7	16.4	15.9	15.4	15.0	15.0	15.4	16.6
Population density (per sq km)	11	12	14	17	20	24	29	34	40	47

Indicator	1950-1955	1955-1960	1960-1965	1965-1970	1970-1975	1975-1980	1980-1985	1985-1990	1990-1995
Population change per year (thousands)	185	228	284	350	449	578	648	721	735
Births per year (thousands)	355	411	477	555	668	814	890	988	954
Deaths per year (thousands)	170	182	194	205	219	236	242	267	299
Population growth rate (percentage)	2.75	2.95	3.14	3.30	3.56	3.82	3.56	3.33	2.91
Crude birth rate (per 1,000 population)	52.8	52.9	52.8	52.2	52.9	53.6	48.7	45.6	37.7
Crude death rate (per 1,000 population)	25.3	23.5	21.4	19.3	17.3	15.5	13.2	12.3	11.8
Total fertility rate (per woman)	7.51	7.82	8.12	8.12	8.12	8.12	7.50	6.80	5.40
Gross reproduction rate (per woman)	3.70	3.85	4.00	4.00	4.00	4.00	3.70	3.35	2.66
Net reproduction rate (per woman)	2.23	2.43	2.65	2.77	2.90	3.02	2.86	2.64	2.10
Infant mortality rate (per 1,000 births)	150	130	118	108	98	88	81	75	71
Life expectancy at birth (years)									
Males	39.0	41.5	44.0	46.5	49.0	51.5	53.8	54.0	52.7
Females	43.0	45.4	48.0	50.5	53.0	55.5	58.0	57.5	55.4
Both sexes combined	40.9	43.4	45.9	48.4	51.0	53.4	55.8	55.7	54.1

B. MEDIUM-VARIANT PROJECTIONS

Indicator	1995	2000	2005	2010	2015	2020	2025	2030	2040	2050
Population (thousands)										
Total	27150	30340	34469	38869	43170	47029	50202	53632	60534	66054
Males	13595	15206	17288	19507	21663	23595	25168	26859	30243	32902
Females	13555	15134	17181	19362	21507	23434	25034	26773	30291	33152
Sex ratio (per 100 females)	100.3	100.5	100.6	100.7	100.7	100.7	100.5	100.3	99.8	99.2
Age distribution:										
Percentage aged 0-4	16.1	15.9	15.4	14.3	12.6	10.7	8.8	8.9	8.4	7.2
Percentage aged 5-14	29.9	27.5	25.5	25.3	24.6	23.0	20.5	17.3	16.0	15.0
Percentage aged 15-24	21.5	22.5	22.5	21.0	19.9	20.6	20.9	19.9	15.2	14.6
Percentage aged 60 or over	4.5	4.3	4.0	4.1	4.5	5.2	6.2	7.4	11.0	15.7
Percentage aged 65 or over	2.9	2.9	2.8	2.7	2.8	3.3	3.9	4.7	7.0	10.6
Percentage in school ages 6-11	18.5	16.5	15.6	15.6	15.0	13.8	12.2	10.1	9.8	8.9
Percentage in school ages 12-14	8.1	8.3	7.0	7.0	7.0	6.9	6.4	5.7	4.6	4.6
Percentage in school ages 15-17	7.5	7.5	7.3	6.3	6.6	6.7	6.5	5.9	4.2	4.5
Percentage in school ages 18-23	12.3	13.2	13.2	12.7	11.5	12.1	12.4	12.0	9.3	8.7
Percentage of women aged 15-49	45.8	48.5	50.7	51.4	52.8	54.9	57.1	57.4	53.2	50.3
Median age (years)	16.6	17.7	18.8	20.0	21.1	22.8	24.9	27.1	31.0	34.7
Population density (per sq km)	47	52	59	67	74	81	87	92	104	114

Indicator	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030	2030-2040	2040-2050
Population change per year (thousands)	638	826	880	860	772	635	686	690	552
Births per year (thousands)	1062	1144	1182	1145	1050	918	994	1045	992
Deaths per year (thousands)	324	318	302	285	278	283	308	355	440
Net migration per year (thousands)	-100	0	0	0	0	0	0	0	0
Population growth rate (percentage)	2.22	2.55	2.40	2.10	1.71	1.31	1.32	1.21	0.87
Crude birth rate (per 1,000 population)	36.9	35.3	32.2	27.9	23.3	18.9	19.2	18.3	15.7
Crude death rate (per 1,000 population)	11.3	9.8	8.2	7.0	6.2	5.8	5.9	6.2	6.9
Net migration rate (per 1,000 population)	-3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total fertility rate (per woman)	4.85	4.30	3.75	3.20	2.65	2.10	2.10	2.10	2.10
Gross reproduction rate (per woman)	2.39	2.12	1.85	1.58	1.30	1.03	1.03	1.03	1.03
Net reproduction rate (per woman)	1.93	1.77	1.60	1.41	1.19	0.96	0.96	0.97	0.98
Infant mortality rate (per 1,000 births)	65	57	48	41	37	33	30	25	21
Life expectancy at birth (years)									
Males	52.3	56.1	59.6	62.6	64.9	66.4	67.3	69.2	70.8
Females	55.7	58.6	62.4	66.1	68.4	70.2	71.5	73.4	75.3
Both sexes combined	54.5	57.4	61.0	64.4	66.7	68.3	69.4	71.3	73.1

Source: United Nations. *World Population Prospects: The 1996 Revision*. 1997.

Table 35. Contraceptive Prevalence Rate and Method Mix, Kenya

Table 4.4 Current use of contraception: women

Percentage of all women, of currently married women, and of sexually active unmarried women who are currently using a contraceptive method, by method and age, Kenya 1998

Age	Any method	Modern method: Any modern method	Pill	IUD	Inject-ables	Con-dom	Female sterili-sation	Im-plants	Other modern	Traditional method: Any trad. method	Periodic absti-nence	With-drawal	Other	Not currently using	Total	Number of women
ALL WOMEN																
15-19	7.6	4.2	1.7	0.0	1.0	1.6	0.0	0.0	0.0	3.3	3.0	0.1	0.2	92.4	100.0	1,851
20-24	27.0	19.9	7.9	0.8	8.9	1.6	0.0	0.7	0.0	7.1	6.4	0.3	0.4	73.0	100.0	1,548
25-29	38.7	31.1	10.3	2.1	14.6	1.6	1.2	1.4	0.0	7.6	6.5	0.5	0.6	61.3	100.0	1,371
30-34	43.8	34.9	11.4	2.6	12.9	1.8	5.2	1.0	0.0	8.8	7.3	0.9	0.6	56.2	100.0	986
35-39	44.0	37.7	5.7	2.7	15.1	1.3	11.7	1.2	0.0	6.3	4.9	0.5	0.9	56.0	100.0	991
40-44	40.8	33.3	5.2	5.8	5.7	0.6	15.2	0.4	0.3	7.5	5.6	0.5	1.5	59.2	100.0	637
45-49	28.0	23.6	2.6	3.1	5.3	1.7	10.9	0.0	0.0	4.4	3.0	0.1	1.3	72.0	100.0	497
Total	29.9	23.6	6.5	1.9	8.8	1.5	4.2	0.7	0.0	6.3	5.3	0.4	0.6	70.1	100.0	7,881
CURRENTLY MARRIED WOMEN																
15-19	18.0	10.1	3.8	0.0	4.1	2.3	0.0	0.0	0.0	7.9	6.7	0.1	1.2	82.0	100.0	285
20-24	31.2	24.8	10.0	1.3	11.1	1.6	0.0	0.7	0.0	6.4	5.3	0.5	0.7	68.8	100.0	948
25-29	40.1	32.2	10.6	2.5	15.4	1.2	1.4	1.2	0.0	8.0	6.7	0.6	0.6	59.9	100.0	1,069
30-34	45.6	35.9	11.9	2.8	13.2	1.4	5.7	0.9	0.0	9.7	8.1	1.1	0.5	54.4	100.0	822
35-39	47.2	40.4	6.1	3.1	15.6	1.2	12.9	1.4	0.0	6.8	5.2	0.6	1.0	52.8	100.0	832
40-44	44.3	36.5	6.1	6.2	6.0	0.4	16.8	0.5	0.4	7.8	5.9	0.4	1.6	55.7	100.0	511
45-49	31.1	26.1	3.3	3.2	5.9	1.9	11.9	0.0	0.0	5.0	3.9	0.1	1.0	68.9	100.0	365
Total	39.0	31.5	8.5	2.7	11.8	1.3	6.2	0.8	0.0	7.5	6.1	0.6	0.8	61.0	100.0	4,834
SEXUALLY ACTIVE, UNMARRIED WOMEN																
15-19	30.4	20.4	6.9	0.0	2.2	11.3	0.0	0.0	0.0	9.9	9.0	1.0	0.0	69.6	100.0	149
20-24	50.7	35.0	11.8	0.0	17.3	4.1	0.0	1.8	0.0	15.7	15.7	0.0	0.0	49.3	100.0	98
25+	57.1	49.5	13.1	3.2	17.5	7.6	5.7	2.3	0.0	7.6	7.6	0.0	0.0	42.9	100.0	187
Total	46.5	36.2	10.7	1.4	12.2	8.1	2.5	1.4	0.0	10.2	9.9	0.3	0.0	53.5	100.0	434

Source: National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development) [Kenya], and Macro International Inc. (MI). 1999.

Table 36. Contraceptive Source Mix, Kenya

Table 4.12 Source of supply for modern contraceptive methods

Percent distribution of current users of modern contraceptive methods by most recent source of supply, according to specific methods, Kenya 1998

Source of supply	Pill	IUD	Inject-ables	Con-dom	Female sterili-sation	Im-plants	All modern methods[1]
Public sector	52.8	66.7	64.0	21.2	63.8	51.6	58.0
Government hospital	18.0	46.2	24.5	5.9	56.1	47.1	29.5
Government health centre	19.7	16.3	21.3	6.7	5.3	4.1	16.1
Government dispensary	15.1	4.2	18.3	8.7	2.4	0.4	12.3
Private medical	30.0	32.6	35.0	24.8	36.2	47.3	33.4
Mission church hospital/centre	3.8	3.3	9.6	1.5	15.4	13.7	8.1
FPAK health centre/clinic	3.6	7.4	2.4	7.6	6.4	13.2	4.5
Other private service	0.9	0.5	0.5	0.4	1.5	0.0	0.8
Private hospital/clinic	9.1	17.2	19.2	2.3	11.2	16.8	13.8
Pharmacy	8.5	0.0	0.1	13.0	0.0	0.0	3.2
Private doctor	4.2	4.0	3.2	0.0	1.7	3.6	3.0
Other private	5.3	0.0	0.3	46.3	0.0	0.0	4.5
Shop	1.7	0.0	0.0	33.2	0.0	0.0	2.6
Friends, relatives	3.6	0.0	0.3	13.1	0.0	0.0	1.9
Mobile clinic	0.4	0.2	0.4	1.5	0.0	1.1	0.4
CBD worker	10.9	0.6	0.2	3.9	0.0	0.0	3.4
Other	0.4	0.0	0.0	2.0	0.0	0.0	0.2
Don't know/missing	0.2	0.0	0.2	0.3	0.0	0.0	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number	510	146	695	119	335	53	1,860

CBD = Community-based distribution
[1] Total includes 2 users of diaphragm, foams, and jellies

Source: National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development) [Kenya], and Macro International Inc. (MI). 1999.

Table 37. Total Fertility Rate, Kenya

Table 3.3 Trends in fertility

Age-specific fertility rates (per 1,000 women) and total fertility rates for selected surveys, 1997/78/KFS, 1989 KDHS, 1993 KDHS, and 1998 KDHS

Age group	1977/78 KFS 1975-78[a]	1989 KDHS 1984-89[b]	1993 KDHS 1990-93[c]	1998 KDHS 1995-98
15-19	168	152	110	111
20-24	342	314	257	248
25-29	357	303	241	218
30-34	293	255	197	188
35-39	239	183	154	109
40-44	145	99	70	51
45-49	59	35	50	16
TFR women age 15-49	8.1	6.7	5.4	4.7

Note: Rates refer to the three-year period preceding the survey except for the 1989 KDHS (five-year period before survey).
[a] CBS, 1980
[b] NCPD, 1989
[c] NCPD, 1994

Source: National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development) [Kenya], and Macro International Inc. (MI). 1999.

Table 38. Percent of Women of Reproductive Age in Union, Kenya

Table 5.1 Current marital status

Percent distribution of women and men by current marital status, according to age, Kenya 1998

Age	Current marital status: Never married	Married	Living together	Widowed	Divorced	Not living together	Total	Number of women/ men
WOMEN								
15-19	83.3	14.5	0.9	0.1	0.4	0.7	100.0	1,851
20-24	34.9	58.4	2.9	0.4	0.9	2.5	100.0	1,548
25-29	12.7	74.3	3.6	1.9	1.9	5.5	100.0	1,371
30-34	6.1	79.9	3.5	3.7	2.6	4.2	100.0	986
35-39	2.8	81.2	2.8	5.9	3.3	4.0	100.0	991
40-44	2.8	77.8	2.5	10.1	3.2	3.5	100.0	637
45-49	1.7	70.6	2.8	19.0	2.8	3.1	100.0	497
Total	30.1	58.8	2.6	3.7	1.8	3.1	100.0	7,881
MEN								
15-19	99.2	0.7	0.0	0.0	0.0	0.0	100.0	811
20-24	77.4	15.5	0.6	0.0	1.3	5.2	100.0	589
25-29	35.1	59.5	1.7	1.3	0.2	2.2	100.0	463
30-34	9.4	85.6	1.3	0.4	0.4	2.9	100.0	418
35-39	3.4	89.0	2.0	0.0	1.5	4.2	100.0	375
40-44	3.7	90.3	0.9	2.7	0.7	1.6	100.0	291
45-49	1.2	93.7	0.8	0.7	0.9	2.6	100.0	278
50-54	0.3	92.7	2.9	1.9	0.0	2.3	100.0	183
Total	43.7	51.5	1.0	0.6	0.6	2.5	100.0	3,407

Source: National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development) [Kenya], and Macro International Inc. (MI). 1999.

Table 39. Postpartum Insusceptibility, Kenya

Table 5.9 Postpartum amenorrhoea, abstinence and insusceptibility

Percentage of births in the three years preceding the survey for which mothers are postpartum amenorrhoeic, abstaining and insusceptible, by number of months since birth, and median durations, Kenya 1998

Months since birth	Amenor-rhoeic	Abstaining	Insus-ceptible	Number of births
<2	97.6	90.2	98.9	156
2-3	82.9	55.1	92.8	206
4-5	64.2	29.7	72.7	178
6-7	54.9	18.7	61.2	205
8-9	49.4	22.9	59.0	201
10-11	48.8	14.1	53.7	193
12-13	37.7	14.1	42.5	199
14-15	33.7	8.6	40.8	199
16-17	25.6	9.7	32.5	204
18-19	17.8	6.9	23.6	191
20-21	14.2	6.9	19.7	186
22-23	11.0	8.8	18.2	207
24-25	10.9	6.2	16.2	215
26-27	5.1	7.4	10.5	201
28-29	5.3	3.6	7.9	156
30-31	3.7	3.7	6.4	188
32-33	1.0	4.9	5.9	159
34-35	1.4	3.4	4.8	170
Total	31.5	17.1	37.3	3,414
Median	8.9	3.1	11.1	-

Source: National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development) [Kenya], and Macro International Inc. (MI). 1999.

Table 40. Induced Abortion Rate

Table 22: Total Abortion Rates in Selected Countries

Country	Source	Year	Total Abortion Rate*
Albania	-	1993	1.353
Australia	-	1988	0.498
Bangladesh	-	1993	0.114
Brazil	-	1991	1.333
Bulgaria	-	1994	1.572
Canada	-	1993	0.459
Chile	-	1990	1.589
China	-	1992	1.074
Colombia	-	1989	1.180
Cuba	-	1990	1.635
Czech Republic	-	1994	0.714
Denmark	-	1994	0.477
Dominican Republic	-	1992	1.530
England/Wales	-	1993	0.441
Finland	-	1994	0.282
France	-	1993	0.396
Hong Kong	-	1987	0.381
Hungary	-	1995	1.041
Iceland	-	1994	0.381
India	-	1991	1.059
Israel	-	1992	0.465
Italy	-	1994	0.330
Japan	-	1994	0.423
Kazakhstan	2	1995	1.75
Kyrgyzstan	3	1993	1.3-1.6
Mexico	-	1990	0.816
Mongolia	4	1990	2.1
Netherlands	-	1994	0.180
New Zealand	-	1994	0.471
Norway	-	1993	0.483
Peru	-	1989	1.813
Romania	5	1990	1.70
Romania	5	1993	3.39
Russia	6	1994	2.04
Russia **	7	1996	2.28-2.80
Singapore	-	1993	0.681
Slovak Republic	-	1995	0.714
South Korea	-	1990	1.092
Spain	-	1993	0.228
Sweden	-	1995	0.546
Switzerland	-	1990	0.255
Tajikistan	3	1993	1.0-1.4
Tunisia	-	1988	0.408
Turkey	-	1992	0.798
Turkmenistan	3	1993	1.0-1.2
USA	-	1992	0.777
Uzbekistan	8	1996	0.668
Vietnam	-	1993	3.00

* The total abortion rate was estimated from data on abortion rate per 1,000 women aged 15–44 for those data from unpublished tables prepared by Stanley Henshaw of the Alan Guttmacher Institute, 1997.

Source: Spectrum System of Policy Models, FamPlan, Version 4, The Futures Group International, 1997.

Table 41. Sterility Rate, Kenya

Table 3.7 Children ever born and living

Percent distribution of all women and of currently married women by number of children ever born and mean number of children ever born (CEB) and mean number of living children, according to five-year age groups, Kenya 1998

Age group	Number of children ever born: 0	1	2	3	4	5	6	7	8	9	10+	Total	Number of women	Mean number of CEB	Mean number of living children
ALL WOMEN															
15-19	82.7	14.1	3.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	1,851	0.21	0.18
20-24	30.8	31.7	22.4	11.0	2.7	1.3	0.2	0.0	0.0	0.0	0.0	100.0	1,548	1.28	1.15
25-29	7.4	16.9	26.2	19.8	15.2	9.1	3.5	1.6	0.2	0.1	0.0	100.0	1,371	2.70	2.43
30-34	2.7	6.6	15.9	17.8	17.2	15.1	12.8	7.4	3.0	1.1	0.4	100.0	986	4.03	3.59
35-39	2.4	2.9	7.0	10.1	17.3	12.9	16.3	12.2	9.1	6.0	3.8	100.0	991	5.32	4.83
40-44	1.7	2.1	3.5	8.9	10.8	9.5	13.8	14.8	11.2	11.0	12.7	100.0	637	6.37	5.59
45-49	2.6	2.2	4.1	4.7	7.1	8.6	13.3	10.4	14.3	12.5	20.1	100.0	497	6.94	5.81
Total	27.7	14.0	13.1	10.2	8.8	6.7	6.3	4.6	3.4	2.6	2.8	100.0	7,881	2.89	2.57
CURRENTLY MARRIED WOMEN															
15-19	34.9	47.9	15.9	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	100.0	285	0.84	0.73
20-24	12.3	33.1	31.8	16.5	4.3	1.7	0.3	0.0	0.0	0.0	0.0	100.0	948	1.74	1.57
25-29	3.4	12.0	26.7	22.4	17.7	10.9	4.4	2.0	0.2	0.1	0.0	100.0	1,069	3.02	2.72
30-34	1.5	4.5	14.7	17.6	18.0	16.2	13.7	8.7	3.4	1.2	0.5	100.0	822	4.27	3.81
35-39	1.7	2.2	6.2	10.0	16.8	12.9	17.5	12.1	9.8	6.6	4.2	100.0	832	5.49	5.03
40-44	1.5	1.3	1.8	7.9	12.0	8.7	14.2	14.7	11.9	12.3	13.7	100.0	511	6.60	5.82
45-49	2.7	1.6	3.6	4.6	4.9	7.1	13.8	10.7	14.6	12.8	23.6	100.0	365	7.23	6.11
Total	6.1	13.4	17.1	14.1	12.4	9.2	8.9	6.4	4.7	3.6	4.0	100.0	4,834	3.97	3.54

Source: National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development) [Kenya], and Macro International Inc. (MI). 1999.

Appendix 4
Levels and Trends of Contraceptive Use as Assessed in 1998

The following pages reproduce table 4, “Trends in the percentage of married women currently using contraception, by country” from the United Nations’ publication *Levels and Trends of Contraceptive Use as Assessed in 1998*. The complete document may be obtained from the United Nations Department of Economic and Social Affairs, Population Division, United Nations, United Nations Plaza, New York, NY 10017 USA. Phone: 212-963-0422. Fax: 212-963-2147.

Current estimates of contraceptive prevalence rate increases also may be obtained from the *World Contraceptive Use 1998* wall chart, available from the United Nations Department of Economic and Social Affairs, Population Division, United Nations, United Nations Plaza, New York, NY 10017 USA. Phone: 212-963-3179. Fax: 212-963-2147.

Table 42. Trends in the Percentage of Married Women Currently Using Contraception, by Country

TABLE 4. TRENDS IN THE PERCENTAGE OF MARRIED WOMEN[a] CURRENTLY USING CONTRACEPTION, BY COUNTRY

Major area, region and country	Age range	Most recent survey: Year	Most recent survey: Percentage using: any method	Most recent survey: Percentage using: modern method[b]	Earlier survey: Year	Earlier survey: Percentage using: any method	Earlier survey: Percentage using: modern method[b]	Annual change (percentage points): Any method	Annual change (percentage points): Modern method[b]
A. Developing countries									
Africa									
Eastern Africa									
Kenya	15-49	1993	32.7	27.3	1984	17.0	9.6	1.7	1.9
Malawi	15-49	1996	21.9	14.4	1984	6.9	1.1	1.2	1.1
Mauritius	15-44	1991	74.7	48.9	1985	79.5	48.5	-0.8	0.1
Rwanda	15-49	1992	21.2	12.9	1983	10.1	0.8	1.3	1.4
Uganda	15-49	1995	14.8	7.8	1988/89	4.9	2.5	1.5	0.8
United Rep. of Tanzania	15-49	1996	18.4	13.3	1991	10.4	6.6	1.7	1.4
Zambia	15-49	1996	25.0[c]	14.4	1992	15.2	8.9	2.4	1.4
Zimbabwe	15-49	1994	48.1	42.2	1984	38.4	26.6	1.0	1.6
Middle Africa									
Cameroon	15-49	1991	16.1	4.3	1978	2.4	0.6	1.0	0.3
Northern Africa									
Algeria	15-49[d]	1995	52.4[c,e]	49.4[e]	1986	35.5	31.3	1.9	2.0
Egypt	15-49	1995	46.9[c]	45.5	1984	29.7	28.7	1.6	1.5
Morocco	15-49	1995	50.3	42.4	1983/84	25.5	21.1	2.2	1.9
Sudan (North)	15-49	1992/93	8.3[c]	6.9	1978/79	4.6	3.7	0.3	0.2
Tunisia	15-49	1994	60.0[f]	51.0[f]	1983	41.1	34.2	1.8	1.6
Southern Africa									
Botswana	15-49	1988	33.0	31.7	1984	27.8	18.6	1.2	3.0
Lesotho	15-49[g]	1991/92	23.2[f]	18.9[f]	1977	5.2	2.4	1.3[h]	1.2[h]
South Africa	15-49	1988	49.7	48.4	1975/76	37.0	35.0	1.0	1.1
Western Africa									
Benin	15-49	1996	16.4[f]	3.4[f]	1981/82	9.2	0.5	0.5	0.2
Côte d'Ivoire	15-49	1994	11.4	4.2	1980/81	2.9	0.5	0.6	0.3
Ghana	15-49	1993	20.3	10.1	1979/80	9.5	5.5	0.8	0.3
Mali	15-49	1995/96	6.7	4.5	1987	4.7	1.3	0.2	0.4
Mauritania	15-49	1990	3.3[c]	1.3	1981	0.8	0.3	0.3	0.1
Nigeria	15-49	1990	6.0	3.5	1981/82	4.8	0.6	0.1	0.4
Senegal	15-49	1997	12.9[f]	8.1[f]	1986	11.3	2.4	0.1	0.5
Asia									
Eastern Asia									
China	15-49	1992	83.4	83.2	1982	70.6	67.8	1.3	1.5
Hong Kong	15-49	1992	86.2	79.7	1982	72.3	63.9	1.4	1.6
Republic of Korea	15-44	1991	79.4	69.5	1979	54.5	43.1	2.0	2.2
South-central Asia									
Bangladesh	10-49	1996/97	49.2	41.5	1983	19.1	13.8	2.3	2.1
India	13-49	1992/93	40.6	36.2	1980	34.1	26.9	0.5[h]	0.7[h]
Iran, Islamic Rep. of	15-44	1992	64.6	44.6	1989	49.0	27.7	5.2[h]	5.6[h]
Nepal	15-49	1996	28.5	26.0	1986	13.9	13.9	1.4	1.2
Pakistan	15-49	1994/95	17.8	12.6	1984/85	7.6	6.4	1.0	0.6
Sri Lanka[i]	15-49	1993	66.1	43.7	1982	54.9	30.4	1.0	1.2

Major area, region and country	Age range	Most recent survey: Year	Most recent survey: Percentage using: any method	Most recent survey: Percentage using: modern method [b]	Earlier survey: Year	Earlier survey: Percentage using: any method	Earlier survey: Percentage using: modern method [b]	Annual change (percentage points): Any method	Annual change (percentage points): Modern method [b]
South-eastern Asia									
Indonesia	15-49	1994	54.7	52.1	1987	47.7	44.0	1.0	1.2
Malaysia (Peninsular)	15-49	1988	48.3	31.4	1974	32.6	23.2	1.1	0.6
Philippines	15-49	1993	40.0	24.9	1983	30.1	17.8	1.0	0.7
Singapore	15-44	1982	74.2	73.0	1973	60.1	52.8	1.6	2.3
Thailand	15-44	1993	73.9	72.2	1984	64.6	62.0	1.0	1.1
Viet Nam	15-49	1994	65.0	43.8	1988	53.2	35.3	1.9	1.4
Western Asia									
Bahrain	15-49	1995[j]	60.9[c,f]	30.4[f]	1989[j]	53.5[c]	30.3	1.1	0.0
Iraq	15-49	1989[j]	13.7[c]	10.4	1974	14.5[c]	12.9	-0.1	-0.2
Jordan[k]	15-49	1990	35.0[c]	26.9	1976	25.2	17.3	0.7	0.7
Oman	15-49	1995[j]	21.5[c,f]	18.3[f]	1988[j]	8.6	7.5	1.9	1.6
Syrian Arab Republic	15-49	1993	36.1[c,f]	28.3[f]	1978	19.8	15.0	1.1	0.9
Turkey	15-49	1993	62.6[f]	34.5[f]	1983	51.0	22.7	1.2	1.2
Yemen	15-49	1997	12.8[c,f]	9.8[f]	1991/92	7.2[c]	6.1	0.9	0.6
Latin America and the Caribbean									
Caribbean									
Antigua and Barbuda	15-44[l]	1988	52.6	51.0	1981	38.9	37.1	2.0	2.0
Barbados	15-44[l]	1988	55.0	53.2	1980/81	47.4	45.5	1.0	1.0
Dominica	15-44[l]	1987	49.8	48.2	1981	49.0	47.2	0.1	0.2
Dominican Rep.	15-49	1996	63.7	59.2	1980	42.0	35.0	1.3	1.5
Grenada	15-44[l]	1990	54.3	..	1985	31.0	27.3	4.7	..
Haiti	15-49[l]	1994/95	18.0	13.2	1983	6.9	3.9	1.0	0.8
Jamaica	15-44[l]	1993	62.0	58.3	1983	52.2	49.5	1.0	0.9
Puerto Rico	15-49[d]	1982	64.1	57.6	1968	60.0	50.8	0.3	0.5
Saint Lucia	15-44[l]	1988	47.3	46.1	1981	42.7	40.2	0.7	0.8
Saint Vincent and the Grenadines	15-44[l]	1988	58.3	54.6	1981	41.5	39.5	2.4	2.2
Trinidad and Tobago	15-49[l]	1987	52.7	44.4	1977	51.6	45.7	0.1	-0.1
Central America									
Costa Rica	15-49	1992/93	75.0	64.6	1981	65.2	55.9	0.8	0.7
El Salvador	15-44	1993	53.3	48.4	1985	48.4	45.5	0.6[h]	0.4[h]
Guatemala	15-49	1995	31.4	26.9	1983	25.0[m]	20.6	0.5	0.5
Honduras	15-44	1996	50.0	41.0	1981	27.2	24.0	1.5	1.1
Mexico	15-49	1995	66.5	57.5	1987	52.7	44.6	1.7	1.6
Nicaragua	15-49	1992	48.7	44.9	1981	27.0	22.8	1.9	1.9
Panama	15-44	1984	58.2[m]	54.2	1976	54.1	46.2	0.5	0.9
South America									
Bolivia	15-49	1994	45.3	17.7	1983	26.0	12.0	1.8	0.5
Brazil	15-49	1996	76.7	70.3	1986	65.8	56.7	1.1	1.4
Colombia	15-49	1995	72.2	59.3	1986	64.8	52.5	0.9	0.8
Ecuador	15-49	1994	56.8	45.7	1982	39.9	32.9	1.4	1.1
Paraguay	15-49	1995/96	55.8	41.4	1987	44.8	29.0	1.3	1.5
Peru	15-49	1996	64.2	41.3	1981	41.0	17.0	1.6	1.6

Major area, region and country	Age range	Most recent survey: Year	Most recent survey — Percentage using: any method	Most recent survey — Percentage using: modern method [b]	Earlier survey: Year	Earlier survey — Percentage using: any method	Earlier survey — Percentage using: modern method [b]	Annual change (percentage points): Any method	Annual change (percentage points): Modern method [b]
				B. Developed countries					
Asia									
Japan	15-49	1994	58.6	52.8[n]	1984	57.3[c]	51.0[c]	0.1	0.2
Europe									
Eastern Europe									
Hungary	18-41	1992/93	73.1[f]	59.6[f]	1977	73.1	51.8	0.0[h]	0.5[h]
Poland	< 45	1977	75.0[c]	26.0[c]	1972	60.0[c]	13.0[c]	3.0	2.6
Romania	15-44	1993	57.3[f]	14.5[f]	1978	58.0	5.0	-0.0	0.6
Northern Europe									
Denmark	15-44[o]	1988	78.0	72.0	1975	63.0[c]	60.0[c]	1.2[h]	0.9[h]
Finland	18-44[p]	1977	80.0	78.0	1971	77.0	54.0	0.6	4.0
Norway	[q]	1988/89	73.8	69.2[n]	1977	71.0	65.0	0.2[h]	0.4[h]
United Kingdom[r]	16-49	1993	82.0	82.0	1986	81.0	78.0	0.1	0.6
Southern Europe									
Spain	18-49	1985	59.4	38.0	1977P	51.0	20.0	1.1[h]	2.4[h]
Yugoslavia[s]	< 45	1976	55.0[c]	12.0[c]	1970	59.0	10.0	-0.7	0.3
Western Europe									
Belgium[t]	20-40	1991	79.4	75.2	1982	80.0	65.0	-0.1	1.2
France	20-44	1994	74.6	69.3	1978	78.7	47.6	-0.3	1.4
Netherlands	18-42	1993	78.5	75.6	1982	77.4	74.4	0.1[h]	0.2[h]
Northern America									
Canada	15-49	1995	75.2[f]	74.5[f]	1984	73.1	69.7	0.2	0.4
United States of America	15-44	1990	70.7	67.0	1982	68.0	62.4	0.3	0.6
Oceania: New Zealand	20-49	1995	74.9[f]	72.0[f]	1976	69.5	61.5	0.3[h]	0.5[h]

Sources: See list of data sources in the annex.

Two dots (..) indicate that data are not available.

[a] Except as noted separately, statistics are based on married (or in-union) women of the ages indicated.

[b] Modern or clinic and supply methods include male and female sterilization, IUD, the pill, injectables, hormonal implants, condoms and female barrier methods.

[c] Adjusted from source to exclude breastfeeding.

[d] Ever-married women.

[e] Excluding sterilization.

[f] Preliminary or provisional.

[g] For all women of ages specified.

[h] Trend may be affected by differences in the base population or geographical coverage at the two dates.

[i] Excluding areas containing roughly 15 per cent of the population.

[j] Households of nationals of the country.

[k] Excluding the West Bank.

[l] Including visiting unions.

[m] Excluding douch, abstinence and folk methods.

[n] Some women reported more than one method; figure shown assumes that modern methods were not used in combination with other modern methods.

[o] All sexually active women.

[p] Women in first marriage.

[q] Women currently married or cohabiting who were born in 1945, 1950, 1955, 1960, 1965 or 1968.

[r] Data pertaining to Great Britain.

[s] Former Socialist Federal Republic of Yugoslavia.

[t] Flemish population.

Appendix 5
Weights and Volumes of Commonly Supplied Contraceptives

The following charts show the shipping carton weight and volume of contraceptive commodities supplied by USAID and several other major international donors, along with the number of units of product included in each carton. A blank in any column means that the data item was unavailable at the time of printing. In such cases, or where commodities are procured from other sources, contact the supplier directly to obtain shipping information. *Variable* indicates that the units per carton, or dimensions and weights, vary according to the size and specifications of the order.

Note: Contraceptive information is current as of September 2000.

CONDOMS		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton
USAID Sourced domestically in the U.S. to ASTM and ISO standards and USAID specifications 52 mm lubricated Plain (no logo) Blue & Gold (for social marketing programs) Panther (for social marketing programs) Panther Gold (Bangladesh only) Raja (natural latex and red-Bangladesh only) Protector Plus (Madagascar Only) Hiwot Trust (Ethiopia Only) VIVE (G-Cap Central America, PSI, and the Democratic Republic of the Congo – production discontinued)	6,000 condoms per carton	For both sizes: 3.7 ft^3 (0.11 m^3); 46 lbs. (20.9 kg)

CONDOMS		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton
IPPF Sourced globally to recipient's choice of following specifications: Male condom ISO 4074 standard, WHO specifications Packed in boxes of 1 gross each (144 pieces), 50 gross per shipping carton.	7,200 condoms per carton	Variable, contact IPPF for specifics
USAID specifications	6,000 condoms per carton	3.7 ft^3 (0.11 m^3); 46 lbs. (20.9 kg)
Female condom	1,000 condoms per carton	11.3kg, 580x390x310mm
UNFPA Sourced globally to ISO standard, WHO specifications	7,200 condoms per carton	4.7 ft^3 (.13 m^3); 52 lbs. (23.7 kg)

ORAL CONTRACEPTIVES		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton
USAID		
Wyeth-Ayerst: Lo-Femenal, Ovrette, Lo-Gentrol (Philippines only) Duofem (for social marketing programs)	1,200 monthly cycles per carton	1.3 ft^3 (0.04 m^3); 18.25 lbs. (8.3 kg)
IPPF		
Medimpex: Rigevidon (no longer supplied as standard product)	No longer applicable	Contact IPPF for specifics
Organon: Exulton, packed in boxes of 100 monthly cycles each	1200 monthly cycles per carton	10.0kg, 420cm^3
Marvelon, packed in boxes of 100 monthly cycles each	1000 monthly cycles per carton	8.5kg, 420cm^3
Ortho/Cilag: Micronor, packed in bundles of 20 packs of 3 monthly cycles	560 monthly cycles per carton	14.4kg, 600x400x350mm
Cilest, packed in bundles of 20 packs of 3 monthly cycles	560 monthly cycles per carton	12.7kg, 600x400x350mm
Schering AG: Combination 3 (Blue Lady), Microgynon 30, Neogynon ED Fe (Blue Lady), Triquilar ED Fe (Blue Lady), Microgest (Blue Lady)	880 monthly cycles per carton	20.6kg, 0.1056m^3
Microlut 35	720 monthly cycles per carton	18.6kg, 0.1056m^3
Wyeth Pharma GmbH: Nordette 28 (Blue Lady)	600 monthly cycles per carton	4.8kg, 420x 240x250mm
Ovral 28 (Blue Lady)	600 monthly cycles per carton	4.8kg, 400x 240x250mm
Microval 35	600 monthly cycles per carton	4.8kg, 420x 240x280mm
Nordette 21 (Blue Lady)	600 monthly cycles per carton	3.9kg, 420x 240x260mm
Nordiol 28 (Blue Lady)	600 monthly cycles per carton	4.8kg, 420x 240x270mm
Trinordiol 28 (Blue Lady)	400 monthly cycles per carton	3.8kg, 350x 245x330mm
Wyeth-Ayerst: Lo-Femenal (Blue Lady), Ovrette	1,200 monthly cycles per carton	8.0kg, 17.5x15.5x8”

ORAL CONTRACEPTIVES		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton
UNFPA		
Gedeon Richter:		
Ovidon	46 inner boxes per carton (4,600 cycles per carton)	3.7 ft^3 (.11m^3); 68.5 lbs. (31.1 Kg)
Rigevidon	34 inner boxes per carton (3,400 cycles per carton)	3.7 ft^3 (.11m^3); 59.1 lbs. (26.8 Kg)
Tri-Regol	34 inner boxes per carton (3,400 cycles per carton)	3.7 ft^3 (.11m^3); 44.1 lbs. (20 Kg)
Organon:		
Marvelon 28	16 inner boxes per carton (1,600 cycles per carton)	2.5 ft^3 (.07 m^3); 26.9 lbs. (12.2 kg)
Exulton 28	24 inner boxes per carton (2,400 cycles per carton)	2.5 ft^3 (.07 m^3); 33.1 lbs. (15 kg)
Jansen Cilag:		
Micronor	No updated information available	No updated information available
Schering:		
Microgynon 30 ED Fe, Neogynon 30 ED Fe, Triquilar ED Fe	880 inner boxes per carton (2,640 cycles per carton)	3.7 ft^3 (.11 m^3); 45.6 lbs. (20.6 kg)
Microlut 35	720 inner boxes per carton (2,160 cycles per carton)	3.7 ft^3 (.11 m^3); 41.1 lbs. (18.6 kg)
Wyeth-Ayerst, Canada:		
Lo-Femenal 28, Lo-Gentrol 28, Duofem 28	12 inner boxes per carton (1,200 cycles per carton)	1.2 ft^3 (.036 m^3); 17.7 lbs. (8 kg)
Wyeth-Pharma, Germany:		
Ovral 28	200 inner boxes per carton (600 cycles per carton)	0.8 ft^3 (.024 m^3); 10.6 lbs. (4.8 kg)
Nordette 28	200 inner boxes per carton (600 cycles per carton)	0.8 ft^3 (.025 m^3); 10.6 lbs. (4.8 kg)
Nordette 21	200 inner boxes per carton (600 cycles per carton)	0.9 ft^3 (.026 m^3); 8.6 lbs. (3.9 kg)
Trinordial 28	200 inner boxes per carton (400 cycles per carton)	1.1 ft^3 (.03 m^3); 8.4 lbs. (3.8 kg)
Microval 35	200 inner boxes per carton (600 cycles per carton)	1.1 ft^3 (.03 m^3); 10.6 lbs. (4.8 kg)

IUDs		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton
USAID FEI Products Inc.: Copper T 380A	200 IUDs per carton	1.5 ft^3 (0.04 .m^3); 16.6 lbs. (7.5 kg)
IPPF Manufacturer varies: Copper T 380A (currently Pregna International 9/00)	500 pieces per carton (10 boxes of 50)	7.47kg, 435x305x415mm
Copper T 200B (not currently supplied)	Variable, contact IPPF for specifics	Variable, contact IPPF for specifics
Organon: Multiload Cu 250 (Standard size) Multiload Cu 250 (Short size) Multiload Cu 375 (Standard size) Multiload Cu 375 (Short size)	500 pieces per carton (for all models)	6.1kg, 710x310x330mm (all models)
UNFPA Organon: Multiload Cu375 Multiload Cu250	50 inner boxes of 10 units per carton (500 units per carton)	2.5 ft^3 (.07 m^3); 13.5 lbs. (6.1 kg)
Ortho Canada: CopperT 380A CopperT 200	No updated information available	No updated information available

INJECTABLES		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton
USAID		
Upjohn: Depo-Provera® (DMPA) 150 mg; Single dose	400 vials per carton	1.2 ft^3 (0.04 m^3); 14.5 lbs. (6.6 kg)
IPPF		
Organon: Megestron (MPA)	1,400 units per carton (14 inner boxes of 100)	13.0kg, 0.04 m^3
Schering: Noristerat (NET-EN), boxes of 100 ampoules	3,600 ampoules per carton	15.4kg, 0.0528m^3
Upjohn: Depo-Provera® (DMPA); 150 mg; Single dose	1,000 units per carton (10 inner boxes of 100)	7.1kg, 190x460x180mm
Depo Estradiol, 5mg/ml single dose	100 units per carton	3.18kg, 0.012m^3
UNFPA		
Organon: Megestron (MPA)	14 inner boxes per carton (1,400 units per carton)	0.7 ft^3 (.02 m^3); 23.6 lbs. (10.7 kg)
Schering: Noristerat (NET-EN)	36 inner boxes per carton (3,600 amp. per carton)	1.8 ft^3 (.05 m^3); 33.9 lbs. (15.4 kg)
Upjohn: Depo-Provera® (DMPA)	40 inner boxes per carton (4,000 units per carton)	4.9 ft^3 (0.14 m^3); 19.4 lbs. (8.8 kg)

IMPLANTS		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton
USAID Leiras Pharmaceuticals: Norplant® Levonorgestrel Implants	Accept and ship orders in multiples of 50 Norplant® sets	Shipping carton dimensions and weight vary according to size of each order. Inner carton of 50 sets: 0.8 ft^3 (0.023m^3) 2.1 lbs. (0.95kg)
IPPF Leiras Pharmaceuticals: Norplant® Levonorgestrel Implants	2 options: a) 2,000 sets (200 x 10 sets) b) 1,000 sets (100 x 10 sets)	a) 15kg, 600x 400x480mm b) 8kg, 350x 390x470mm
UNFPA Leiras Pharmaceuticals: Norplant® Levonorgestrel Implants	1. Carton of: a) 10 inner boxes (100 sets), b) 100 inner boxes (1,000 sets), c) 5 cartons each with 200 inner boxes. Total: 1,000 boxes of 10,000 sets	a) .5 ft^3 (.013 m^3); 3.3 lbs. (1.5 kg) b) 2.1 ft^3 (.06 m^3); 18.8 lbs. (8.5 kg) c) 19.6 ft^3 (.58 m^3); 171 lbs. (77.5kg)

SPERMICIDAL/VAGINAL BARRIER METHODS		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton
USAID VAGINAL FOAMING TABLETS Ortho: Conceptrol Flower (for social marketing programs)	4,800 tablets per carton	2.4 ft^3 (0.07m^3); 21.4 lbs. (9.7kgs)
IPPF VAGINAL FOAMING TABLETS Eisai: Neo Sampoon Innotech: Pharmatex FOAM Ortho-McNeil (USA): Delfen Foam DIAPHRAGMS Ortho USA JELLIES Claypark: Koromex II; Applicator Ortho-McNeil : Ortho-Gynol II;	Variable, contact IPPF for specifics	Variable, contact IPPF for specifics
UNFPA VAGINAL FOAMING TABLETS Eisai: Neo Sampoon	8 inner boxes of 400 tablets per carton (3,200 tablets per carton) (20 tubes of 20)	0.6 ft^3 (.017 m^3); 12.8 lbs. (5.8 kg)
SPERMICIDES Innotech International: Pharmatex	300 inner boxes of 12 tablets per carton (3,600 tablets per carton)	0.5 ft^3 (.02 m^3); 14.1 lbs. (6.4 Kg)
FOAM Ortho UK/USA: Delfen Foam	No updated information available	No updated information available
DIAPHRAGMS Ortho UK/USA	No updated information available	No updated information available
JELLIES Ortho UK/USA: Ortho-Gynol II	No updated information available	No updated information available
Quality Health Products: Koromex	No updated information available	No updated information available

Appendix 6
An Example Forecast Using All Data Sources

The following example provides sample forecasts made using all of the forecasting methodologies presented in this handbook. The data are for the mythical country of Anyland, a small country with a relatively well-established family planning program. For the sake of simplicity, this example includes only the forecast for one oral contraceptive, Lo-Femenal. The first year for which a forecast is required is calendar year 2000, and it is assumed (again for simplicity) that the forecast was prepared in January 2000, after all historical data for 1999 were received. The forecast extends through calendar year 2002.

6.1. Distribution System Description

The logistics unit of the government of Anyland's family planning department is based in the capital city, where the central warehouse is located. The country is divided administratively into three regions. There is a regional warehouse for each region staffed by a regional logistics coordinator responsible for maintaining logistics records. There are a total of 100 service delivery points (SDPs) in the three regions of Anyland.

There are considerable data with which to prepare forecasts of contraceptive needs. A Demographic and Health Survey (DHS) was completed recently for Anyland. The Ministry of Health (MOH) of Anyland also has logistics records and service statistics that are transmitted from the SDPs to the regional logistics coordinator, who aggregates the data for transmission to the central level. However, the MOH is concerned about the completeness and accuracy of some of the data. The MOH has also expressed concern about whether the capacity of its contraceptive distribution system is sufficient to meet the program's needs.

Although the government has extensive data with which to prepare a forecast, staff are unsure which data source will provide the most reliable data for forecasting, or whether a combination of sources should be used.

The following sections present the relevant data for use in forecast preparation, along with an explanation of data problems and adjustments that were required, forecasts prepared using each data source, the recommended "final" forecast, and the rationale for its selection. The techniques used for adjusting the data are those described in chapter 3 of this handbook; forecasts for each method were prepared using the methodologies described in chapters 2, 4, 5, 6, and 7. Considerations applied in validating and reconciling the forecasts are described in chapter 10. The methodology for preparing the requirements estimate is described in chapter 11.

6.2. Logistics Data-Based Forecast

As described in chapter 4, the basic steps in preparing a logistics data-based forecast are evaluating, correcting, and adjusting the logistics data, and preparing and adjusting the consumption projection.

6.2.1. Adjustments to Historical Logistics Data

Table 43 displays both reported and adjusted logistics data for Lo-Femenal for Anyland Region 1. The two apparent issues with the reported figures, and the adjustments made, were as follows—

- Both 1998 and 1999 reporting included only 92 percent of the SDPs. Under the assumption that these 92 percent were representative of the entire country, the adjusted quantities dispensed were obtained by dividing the reported quantities dispensed by 0.92, using the formula shown in chapter 3.
- Reported quantities dispensed in quarter 2 of both years were significantly lower than the figures for the other three quarters. This discrepancy could be due to any number of reasons, including stockouts and reporting errors. However, the pattern shown in the data and the order of magnitude of the difference in quarter 2 were the same in both years, which suggests a recurrent seasonality pattern in Lo-Femenal use. Program managers therefore concluded that quarter 2 service activity is in fact lower than in other quarters of each year. Accordingly, no additional adjustments were made to quarter 2 data.

Table 43. Summary Logistics Data for Region 1: Lo-Femenal

1998

Percentage Reporting for Year: 92%	Quantities Dispensed (reported)	Adjustments	Quantities Dispensed (adjusted)
Quarter 1	18,400	Divide by .92 to estimate quantity if 100% reporting	20,000
Quarter 2	11,960	(same)	13,000
Quarter 3	16,560	(same)	18,000
Quarter 4	19,320	(same)	21,000
Total	**66,240**		**72,000**

1999

Percentage Reporting for Year: 92%	Quantities Dispensed (reported)	Adjustments	Quantities Dispensed (adjusted)
Quarter 1	19,320	Divide by .92 to estimate quantity if 100% reporting	21,000
Quarter 2	12,880	(same)	14,000
Quarter 3	16,560	(same)	18,000
Quarter 4	20,240	(same)	22,000
Total	**69,000**		**75,000**

Table 44 displays both reported and adjusted logistics data for Region 2. Issues and adjustments were as follows—

- The 1998 reported quantities dispensed included 92 percent of the SDPs, and 1999 quantities dispensed included only 75 percent. These figures were adjusted by dividing reported quantities dispensed by 0.92 and 0.75, respectively, using the formula shown in chapter 3.
- In addition, quarter 4 data for 1999 were missing completely. Usage in Region 2 fluctuates fairly significantly in the quarters for which data were available, but shows no consistent pattern of increasing or decreasing trend or any clear indication of seasonality. Quarter 4 data for 1999 were therefore estimated using a simple average of data from the first three quarters. In accordance with the formulas in chapter 3, the adjustment for incomplete reporting was made first, and the average of the *adjusted* figures for the first three quarters was used to calculate the adjusted estimate for quarter 4.

Table 44. Summary Logistics Data for Region 2: Lo-Femenal

1998

Percentage Reporting for Year: 92%	Quantities Dispensed (reported)	Adjustments	Quantities Dispensed (adjusted)
Quarter 1	184,000	Divide by .92	200,000
Quarter 2	161,000	(same)	175,000
Quarter 3	202,400	(same)	220,000
Quarter 4	202,400	(same)	220,000
Total	**749,800**		**815,000**

1999

Percentage Reporting for Q1–Q3: 75%	Quantities Dispensed (reported)	Adjustments	Quantities Dispensed (adjusted)
Quarter 1	160,000	Divide by .75	213,333
Quarter 2	140,000	(same)	186,667
Quarter 3	170,000	(same)	226,667
Quarter 4	Missing data; calculated value: 156,667	Average of first 3 quarters (adjusted data)	Missing data; calculated value: 208,889
Total	**626,667**		**835,556**

Table 45 displays both reported and adjusted data for Region 3. In this case also, there were two significant issues—

- ❒ As in regions 1 and 2, reporting was incomplete. The 1998 reported figures were divided by 0.90, and 1999 reported figures were divided by 0.92, to correct for under-reporting, using the formula shown in chapter 3.
- ❒ Reported quantities dispensed for quarter 3 of 1998 were very low. This case differs from the data for Region 1 in that a similar pattern is *not* seen in the 1999 data; accordingly it would be inappropriate to assume that seasonality accounts for the lower value in quarter 3. A more likely explanation is a stockout or a serious reporting error in this time period. Therefore, the data should be adjusted. Since the 1999 data show no clear increasing or decreasing trend in quantities dispensed, a simple average of the other three quarters was used as the adjusted value for quarter 3 of 1998.

The estimate of quantities dispensed for the entire country was calculated as the sum of the adjusted values for all three regions. These figures, taken from table 43, table 44, and table 45, are shown in table 46.

Table 45. Summary Logistics Data for Region 3: Lo-Femenal

1998

Percentage Reporting for Year: 90%	Quantities Dispensed (reported)	Adjustments	Quantities Dispensed (adjusted)
Quarter 1	90,000	Divide by .90	100,000
Quarter 2	81,000	(same)	90,000
Quarter 3	18,000 (equivalent to no data)	Average of Q1, Q2, and Q4	Calculated value: 96,667
Quarter 4	90,000	(same as Q1)	100,000
Total	**279,000 + ???**		**386,667**

1999

Percentage Reporting for Year: 92%	Quantities Dispensed (reported)	Adjustments	Quantities Dispensed (adjusted)
Quarter 1	110,400	Divide by .92	120,000
Quarter 2	156,400	(same)	170,000
Quarter 3	128,800	(same)	140,000
Quarter 4	110,400	(same)	120,000
Total	**506,000**		**550,000**

6.2.2. Logistics Data Projection

The next step was to graph the adjusted data. At this point, a decision had to be made regarding which of the techniques described in chapter 2 to use in making the projection. In this case, the data showed a clear increase in quantities dispensed over time, so the simple averages technique was inappropriate. Because there was significant variation from quarter to quarter, use of the linear trend method would also be dangerous, since it depends solely on the first and last data points for extrapolation. It would have been easy to draw a "by eye" line through these data points, but the procedure of semi-averages gives a reproducible and more defensible result.

For these reasons, the procedure of semi-averages was used to make the projection.

Table 46. Summary Logistics Data for Anyland: Lo-Femenal

1998

Quantities of Lo-Femenal Dispensed in 1998				
	Region 1	**Region 2**	**Region 3**	**Total**
Quarter 1	20,000	200,000	100,000	320,000
Quarter 2	13,000	175,000	90,000	278,000
Quarter 3	18,000	220,000	96,667	334,667
Quarter 4	21,000	220,000	100,000	341,000
Total	**72,000**	**815,000**	**386,667**	**1,273,667**

1999

Quantities of Lo-Femenal Dispensed 1999				
	Region 1	**Region 2**	**Region 3**	**Total**
Quarter 1	21,000	213,333	120,000	354,333
Quarter 2	14,000	186,667	170,000	370,667
Quarter 3	18,000	226,667	140,000	384,667
Quarter 4	22,000	208,889	120,000	350,889
Total	**75,000**	**835,556**	**550,000**	**1,460,556**

The semi-average data points were obtained as follows: There were eight quarters of data available, so the two needed data points could be calculated by averaging the first four quarters (1998) and separately averaging the second four (1999). That is—

$$\begin{array}{c}\text{Estimated use}\\ \text{in first half}\\ \text{of series}\end{array} = \frac{\begin{array}{c}\text{Total quantity consumed}\\ \text{in quarters } 1-4 \text{ of } 1998\end{array}}{4}$$

$$= \frac{(320{,}000 + 278{,}000 + 334{,}667 + 341{,}000)}{4}$$

$$= \frac{1{,}273{,}667}{4} = 318{,}417$$

Similarly—

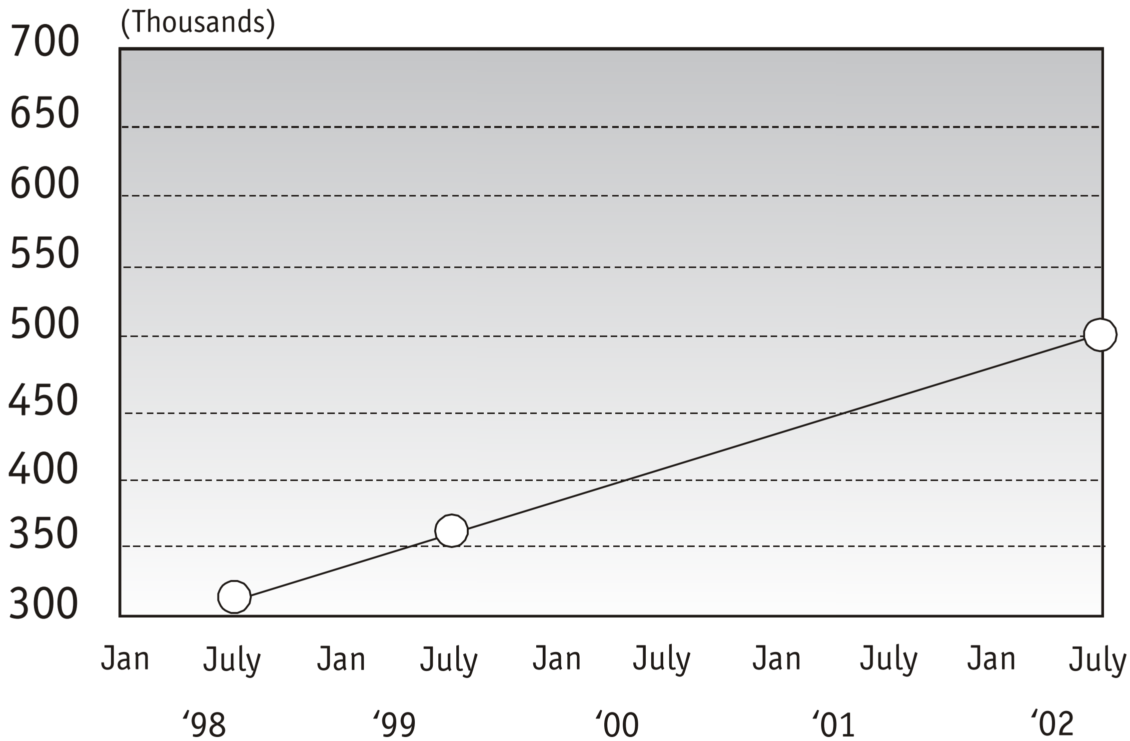
$$\begin{matrix}\text{Estimated use}\\ \text{in second half}\\ \text{of series}\end{matrix} = \frac{\begin{matrix}\text{Total quantity consumed}\\ \text{in quarters 1 – 4 of 1999}\end{matrix}}{4}$$

$$= \frac{(354{,}333 + 370{,}667 + 384{,}667 + 350{,}889)}{4}$$

$$= \frac{1{,}460{,}556}{4} = 365{,}139$$

These two points were plotted in figure 8, and a straight line through them forms the initial logistics data-based projection.

Figure 8. Logistics Data-Based Projection for Anyland



In the absence of any known plans for major changes in Anyland's service delivery program, no adjustments to the forecast were made, corresponding to the assumption that the pattern represented by the historical data is representative of the likely future trend.

6.3. Service Statistics Data-Based Forecast

As described in chapter 5, the basic steps in preparing a service statistics data-based forecast are evaluating, correcting, and adjusting the service data, and preparing and adjusting the consumption projection.

6.3.1. Adjustments to Historical Service Statistics Data

Anyland's management information system reports new visits and revisits separately. table 47 displays both reported and adjusted service statistics data for Region 1. The apparent issues with the reported figures and the adjustments made were as follows—

Table 47. Summary Service Data for Region 1: Lo-Femenal

1998

Percentage Reporting for Year: 74%	New Visits			Revisits		
	Reported	Adjustments	Adjusted	Reported	Adjustments	Adjusted
Quarter 1	2,415	Divide by .74	3,264	7,680	Divide by .74	10,378
Quarter 2	807	(same)	1,091	2,299	(same)	3,107
Quarter 3	1,982	(same)	2,678	6,004	(same)	8,114
Quarter 4	2,643	(same)	3,572	8,177	(same)	11,050
Total	**7,847**		**10,605**	**24,160**		**32,649**

1999

Percentage Reporting for Year: 86%	New Visits			Revisits		
	Reported	Adjustments	Adjusted	Reported	Adjustments	Adjusted
Quarter 1	2,360	Divide by .86	2,744	7,350	Divide by .86	8,547
Quarter 2	Missing data; calculated value: 796	See text	926	Missing data; calculated value: 2,260	See text	2,628
Quarter 3	1,827	(same)	2,124	5,805	(same)	6,750
Quarter 4	2,744	(same)	3,191	8,378	(same)	9,742
Total	**7,727**		**8,985**	**23,793**		**27,667**

- ❒ As with the logistics data, there was underreporting in both years—74 percent in 1998 and 86 percent in 1999. Under the assumption that the reporting facilities were representative of the entire country, adjusted figures for new visits and revisits were obtained by dividing the reported figures for each year by 0.74 and 0.86, respectively, using the formulas shown in chapter 3.

- In 1999, quarter 2 data were missing. It was *not* appropriate to estimate the missing time period with the simple average formula used for the Region 2 logistics example, because both new visits and revisits in 1998 for quarter 2 were much lower than the other three quarters. Thus a simple average would be unlikely to provide a good estimate for the missing data. In this case a more complex adjustment was required, as discussed below.

First, it was necessary to decide whether the pattern represented by the data for 1998 was an accurate reflection of program performance, or whether, in fact, there was a stockout or some other additional problem with the reported figures. Because the logistics data for Region 1, which were more complete, showed a seasonal decrease in the second quarter for both years, it seemed reasonable to assume that the 1998 service data for quarter 2 were representative, and that the quarter 2 decreases represented a recurrent seasonal trend. It was possible, therefore, to estimate the missing period for 1999 based on the pattern shown by the data in 1998, as discussed in chapter 3. For each type of visit—

$$\begin{array}{c}\text{Proportion of visits}\\ \text{represented by}\\ \text{a single period}\end{array} = \frac{\text{Visits in single period}}{\text{Total visits}}$$

For new visits, for example—

$$\begin{array}{c}\text{Proportion of visits}\\ \text{represented by}\\ \text{1998 quarter 2}\end{array} = \frac{1{,}091}{10{,}605} = 0.103$$

(Remember to use the *adjusted* 1998 figures in this calculation.) If the proportion of new visits represented by quarter 2 was 0.103, then the proportion of new visits represented by the other three quarters must be 0.897, because the sum of the proportions must equal 1.0. According to the procedure described in chapter 3, estimated total new visits for 1999 were then calculated by dividing the quantity reported by this latter proportion—

$$\begin{array}{c}\text{Estimated}\\ \text{total new visits}\\ \text{for 1999}\end{array} = \frac{\text{New visits for quarter 1, 3, 4}}{0.897}$$

$$= \frac{2{,}360 + 1{,}827 + 2{,}744}{0.897}$$

$$= 7{,}727$$

Estimated new visits for the missing quarter were calculated by multiplying this estimated total by the proportion that quarter 2 represents—

$$\begin{array}{c}\text{Estimated}\\ \text{new visits}\\ \text{for 1999 quarter 2}\end{array} = 7{,}727 \times 0.103 = 796$$

Finally, this figure was adjusted for under-reporting in the same fashion as the other quarters—

$$\begin{array}{c}\text{Adjusted}\\ \text{new visits}\\ \text{for 1999 quarter 2}\end{array} = \frac{796}{0.86} = 926$$

This same procedure was used to estimate adjusted revisits for quarter 2 of 1999.

Table 48 displays the service statistics data for Region 2. Here again, several adjustments were required—

- In 1998, reporting was 98 percent complete. Given the likely level of error in the other assumptions made, this under-reporting was considered negligible. Accordingly, no adjustment was made.
- In 1999, reporting was only 50 percent complete; however, program managers estimated that the sites that did report accounted for some 75 percent of the program's activity. Thus the data were adjusted by dividing by 0.75, rather than 0.50.
- Finally, quarter 4 data were missing in 1999. As with the logistics data for Region 2 (and for the same reasons), the average of the first three quarters was used to estimate the missing period.

Table 49 displays the service statistics data for Region 3. The only adjustments required were for underreporting. These were made by dividing by the proportion reporting, as in the previous cases.

Table 48. Summary Service Data for Region 2: Lo-Femenal

1998

Percentage Reporting for Year: 98%	New Visits			Revisits		
	Reported	**Adjustments**	**Adjusted**	**Reported**	**Adjustments**	**Adjusted**
Quarter 1	17,750	None	17,750	65,750	None	65,750
Quarter 2	15,500	(same)	15,500	58,500	(same)	58,500
Quarter 3	18,250	(same)	18,250	74,500	(same)	74,500
Quarter 4	21,000	(same)	21,000	77,750	(same)	77,750
Total	**72,500**		**72,500**	**276,500**		**276,500**

1999

Percentage Reporting for Year: 50% (=75% of use)	New Visits			Revisits		
	Reported	**Adjustments**	**Adjusted**	**Reported**	**Adjustments**	**Adjusted**
Quarter 1	13,200	Divide by .75	17,600	49,500	Divide by .75	66,000
Quarter 2	12,150	(same)	16,200	44,750	(same)	59,667
Quarter 3	14,500	(same)	19,333	53,500	(same)	71,333
Quarter 4	Missing data; calculated value: 13,283	Average of first three quarters (adjusted data)	17,711	Missing data; calculated value: 49,250	Average of first three quarters (adjusted data)	65,667
Total	**53,133**		**70,844**	**197,000**		**262,667**

6.3.2. Conversion of New and Revisit Data to Consumption Estimates

This completed the adjustments needed to the basic service statistics data. With adjusted figures for all three regions in hand, the next step was to convert the estimates of new visits and revisits to estimates of quantities of Lo-Femenal consumed, using the program's prescribing protocol. In the Anyland program, one cycle of oral contraceptives is given at the first visit, and the client is asked to return at the end of one month for a follow-up check. If there are no problems, she is then given three cycles of pills at each revisit.

Given this protocol, national-level consumption estimates were prepared by summing new visits for all regions and multiplying by one cycle to give estimated quantities dispensed for new visits; summing revisits for all regions and multiplying by three cycles to give estimated quantities dispensed for revisits; and then totaling the estimated quantities dispensed figures for each quarter. Table 50 displays the results of these calculations.

Table 49. Summary Service Data for Region 3: Lo-Femenal

1998

Percentage Reporting for Year: 55%	New Visits			Revisits		
	Reported	**Adjustments**	**Adjusted**	**Reported**	**Adjustments**	**Adjusted**
Quarter 1	5,297	Divide by .55 to estimate 100% reporting	9,631	21,789	Divide by .55 to estimate 100% reporting	39,616
Quarter 2	4,827	(same)	8,776	20,887	(same)	37,976
Quarter 3	3,949	(same)	7,180	16,790	(same)	30,527
Quarter 4	3,553	(same)	6,460	25,912	(same)	47,113
Total	**17,626**		**32,047**	**85,378**		**155,232**

1999

Percentage Reporting for Year: 60%	New Visits			Revisits		
	Reported	**Adjustments**	**Adjusted**	**Reported**	**Adjustments**	**Adjusted**
Quarter 1	5,243	Divide by .60 to estimate 100% reporting	8,738	24,108	Divide by .60 to estimate 100% reporting	40,180
Quarter 2	6,358	(same)	10,597	30,456	(same)	50,760
Quarter 3	6,634	(same)	11,057	27,949	(same)	46,582
Quarter 4	6,620	(same)	11,033	26,247	(same)	43,745
Total	**24,855**		**41,425**	**108,760**		**181,267**

Table 50. Conversion of Service Data Totals into Consumption Estimates: Lo-Femenal

1998

	New Visits			Revisits			Estimated Total Quantity Dispensed
	Total Adjusted New Visits	X	Estimated Quantity Dispensed	Total Adjusted Revisits	X	Estimated Quantity Dispensed	
Quarter 1	30,645	1	30,645	115,744	3	347,232	377,877
Quarter 2	25,367	1	25,367	99,583	3	298,749	324,116
Quarter 3	28,108	1	28,108	113,141	3	339,423	367,531
Quarter 4	31,032	1	31,032	135,913	3	407,739	438,771
Total	**115,152**		**115,152**	**464,381**		**1,393,143**	**1,508,295**

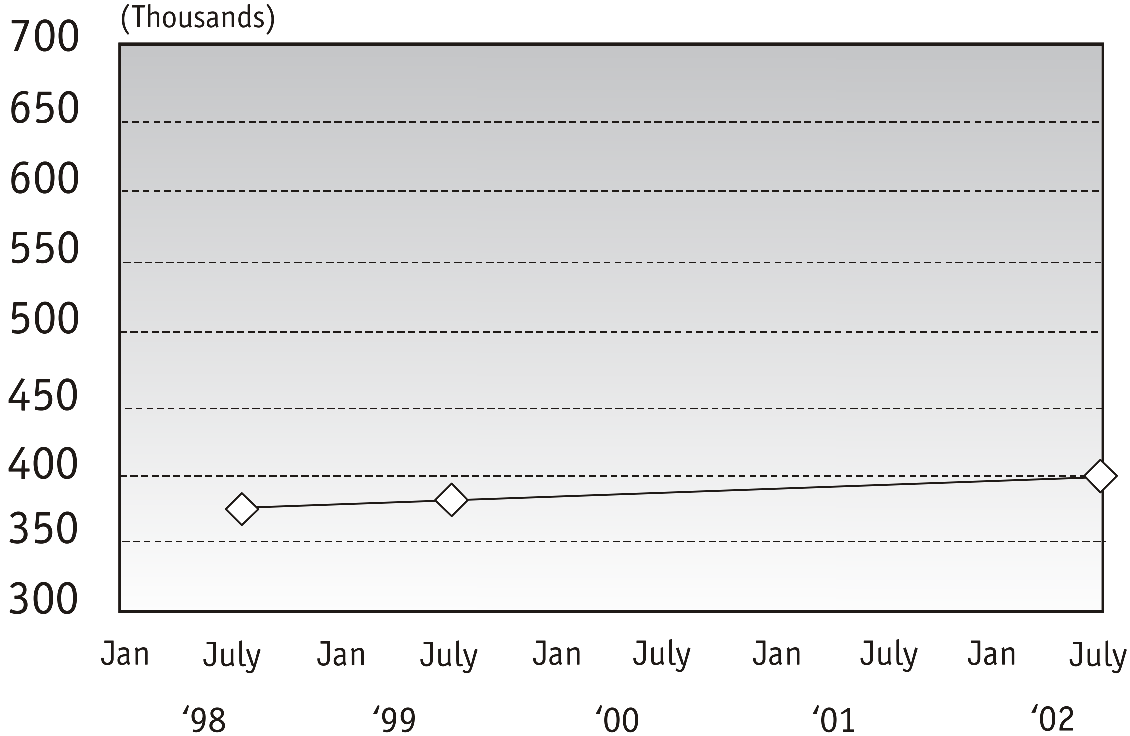
1999

	New Visits			Revisits			Estimated Total Quantity Dispensed
	Total Adjusted New Visits	X	Estimated Quantity Dispensed	Total Adjusted Revisits	X	Estimated Quantity Dispensed	
Quarter 1	29,082	1	29,082	114,727	3	344,181	373,263
Quarter 2	27,723	1	27,723	113,055	3	339,165	366,888
Quarter 3	32,514	1	32,514	124,665	3	373,995	406,509
Quarter 4	31,935	1	31,935	119,154	3	357,462	389,397
Total	**121,254**		**121,254**	**471,601**		**1,414,803**	**1,536,057**

6.3.3. Service Statistics Data Projection

The final step was to graph the data and make the projection. In this case, the procedure of semi-averages was chosen, for the same reasons it was used for making the logistics data projection. As in that case, the two data points were the average of the four quarters' consumption in 1998 and the average in 1999, with a straight line through these points forming the initial service statistics data-based projection. The results are displayed in figure 9. There are no known plans for major changes in Anyland's service delivery program, so no adjustments to this initial forecast were made, again corresponding to the assumption that the pattern represented by the historical data is representative of the likely future trend.

Figure 9. Service Statistics Data-Based Projections for Anyland



6.4. Population Data-Based Forecast

As described in chapter 6, steps in preparation of the population data-based forecast included gathering and adjusting demographic and family planning data for the base year of the forecast, estimating changes in variables over the forecast period, and preparing consumption estimates.

6.4.1. Demographic Data for the Beginning, Intermediate, and Final Forecast Years

Anyland is fortunate to have recent demographic data available, in the form of a 1999 DHS. Like many other countries, estimates of Anyland's demographic and family planning future are included in the U.S. Census Bureau International Data Base, the Population Reference Bureau's (PRB) *World Population Data Sheet*, and in the UN's *Levels and Trends of Contraceptive Use*. Because the major data sources are current as of 1999, this year was considered to be the base year for the forecast, even though 2000 was the first year for which a forecast was required. Baseline demographic data for the 1999 base year are included in table 51.

Table 51. Population Data for Anyland for 1999 Base Year Forecast

Data Item	Source	Value
Beginning (Base) Year: 1999 Ending Year: 2002		
Women of reproductive age (WRA)	U.S. Census Bureau International Data Base (1996)	4,940,447
Annual rate of population increase	PRB *World Population Data Sheet* (1999)	3%
WRA in union	DHS (1999)	100%
Contraceptive Prevalence Rate (CPR)—all methods	DHS (1999)	16%
Annual CPR increase (in percentage points)	UN *Levels and Trends of Contraceptive Use* (1998)	1.0
Method mix: Condoms Orals Other	DHS (1999)	 9.0% 45.4% 45.6%
Brand mix (orals): Lo-Femenal Other	Anyland LMIS (1999)	 50% 50%
Source mix (all methods): Public Sector Other	DHS (1999)	 65% 35%
Couple-years of protection (CYP) conversion factors: Condoms Orals	USAID defaults	 120 15

Adjustments for the base year demographic figures and projections for the final forecast year and the intermediate years were prepared as follows.

First, it was necessary to compute women of reproductive age (WRA) for the 1999 base year. For purposes of this illustration, it is assumed that the forecasters did *not* have access to the most recent U.S. Census Bureau International Data Base or UN *World Population Prospects* WRA estimates. As stated in chapter 6, it is much better to consult one of these sources if possible. Here, the forecaster used the 1996 U.S. Census Bureau WRA estimate for the base year and was required to estimate WRA for all subsequent years using the annual rate of population increase (3 percent) from the PRB *World Population Data Sheet*. As shown in chapter 6, the formula is—

$$\begin{array}{c}\text{Estimated}\\ \text{WRA for}\\ \text{year } n+1\end{array} = \begin{array}{c}\text{Estimated}\\ \text{WRA for}\\ \text{year } n\end{array} + \left(\begin{array}{c}\text{Estimated}\\ \text{WRA for}\\ \text{year } n\end{array} \times \begin{array}{c}\text{Annual rate}\\ \text{of population}\\ \text{increase}\end{array}\right)$$

So, for 1997, the calculation was—

$$\begin{array}{c}\text{Estimated}\\ \text{WRA for}\\ \text{1997}\end{array} = 4{,}940{,}447 + \left(4{,}940{,}447 \times 0.03\right)$$

$$= 4{,}940{,}447 + 148{,}214 = 5{,}088{,}661$$

This calculation was repeated for each subsequent year, yielding a WRA estimate of 5,398,561 for the 1999 base year, and a figure of 5,899,153 for the 2002 final forecast year. The base year, intermediate years, and final year figures for WRA, along with the rest of the calculations for the population data-based forecast, are shown in table 52.

Table 52. Population Data-Based Projection for Anyland MOH (1999–2002)

Data Item	1999	2000	2001	2002
Women of reproductive age (WRA)	5,398,561	5,560,518	5,727,333	5,899,153
WRA in union (see chapter 6)	100%	100%	100%	100%
Contraceptive prevalence rate (CPR)	16.00	17.00	18.00	19.00
Method mix				
Condoms	9.0%	9.0%	9.0%	9.0%
Orals	45.4%	45.4%	45.4%	45.4%
Other	45.6%	45.6%	45.6%	45.6%
Brand mix (orals)				
Lo-Femenal	50%	50%	50%	50%
Other	50%	50%	50%	50%
Source mix				
Public sector	65%	65%	65%	65%
Other	35%	35%	35%	35%
CYP conversion factors				
Condoms	120	120	120	120
Orals	15	15	15	15
Quantity required				
Lo-Femenal	1,911,738	2,092,159	2,281,684	2,480,697

The forecaster next considered WRA in union, but decided that the DHS figures for Anyland did not adequately reflect the population who are sexually active. Accordingly, as explained in chapter 6, 100 percent was used for WRA in union, and the contraceptive prevalence rate for all women, estimated at 16 percent by the DHS in 1999, was used for the base year contraceptive prevalence rate (CPR). This strategy was used for all subsequent forecast years as well.

The annual CPR increase was estimated at 1.0 percentage points per year by the UN *Levels and Trends of Contraceptive Use*. This rate is reasonable and not excessive when compared to performance of other nations' family planning programs, so the forecaster chose this rate of increase for the projection, giving an estimated CPR of 17 percent for 2000, 18 percent for 2001, and 19 percent for 2002.

According to the DHS, the method mix percentage for orals in 1999 was 45.4 percent of women using any method of contraception (calculated using the formula in chapter 6 from the DHS-reported figure for the percentage based on *all* women). Because the timeframe for this projection was relatively short, and because the Anyland MOH program managers had expressed no specific plans to attempt to influence the method mix, these figures were held constant for the entire projection. For the same reasons, the brand mix and source mix were held constant. These assumptions are probably reasonable for the case described here; for a longer-term projection for Anyland or for a projection in a more volatile service program, variations in these data items should be taken into account.

Finally, in the absence of local data, the USAID default couple-years of protection factors were used for the commodity calculation.

6.4.2. Calculation of Consumption Projections

With the figures of table 52 in hand, the calculation for the projection was straightforward. As shown in chapter 6, the formula is—

$$\begin{array}{c}\text{Estimated}\\ \text{consumption}\\ \text{of a brand}\\ \text{of a method}\\ \text{in year } n\end{array} = \begin{array}{c}\text{Estimated}\\ \text{WRA for}\\ \text{year } n\end{array} \times \begin{array}{c}\text{CPR for}\\ \text{Year } n\end{array} \times \begin{array}{c}\text{Method mix}\\ \text{for this method}\\ \text{for year } n\end{array} \times \begin{array}{c}\text{Brand mix}\\ \text{for this brand}\\ \text{for year } n\end{array} \times \begin{array}{c}\text{Source mix}\\ \text{for this method}\\ \text{for year } n\end{array}$$

$$\times \begin{array}{c}\text{CYP}\\ \text{conversion}\\ \text{factor}\end{array}$$

So, for the 1999 base year, the quantity of Lo-Femenal that should have been required was—

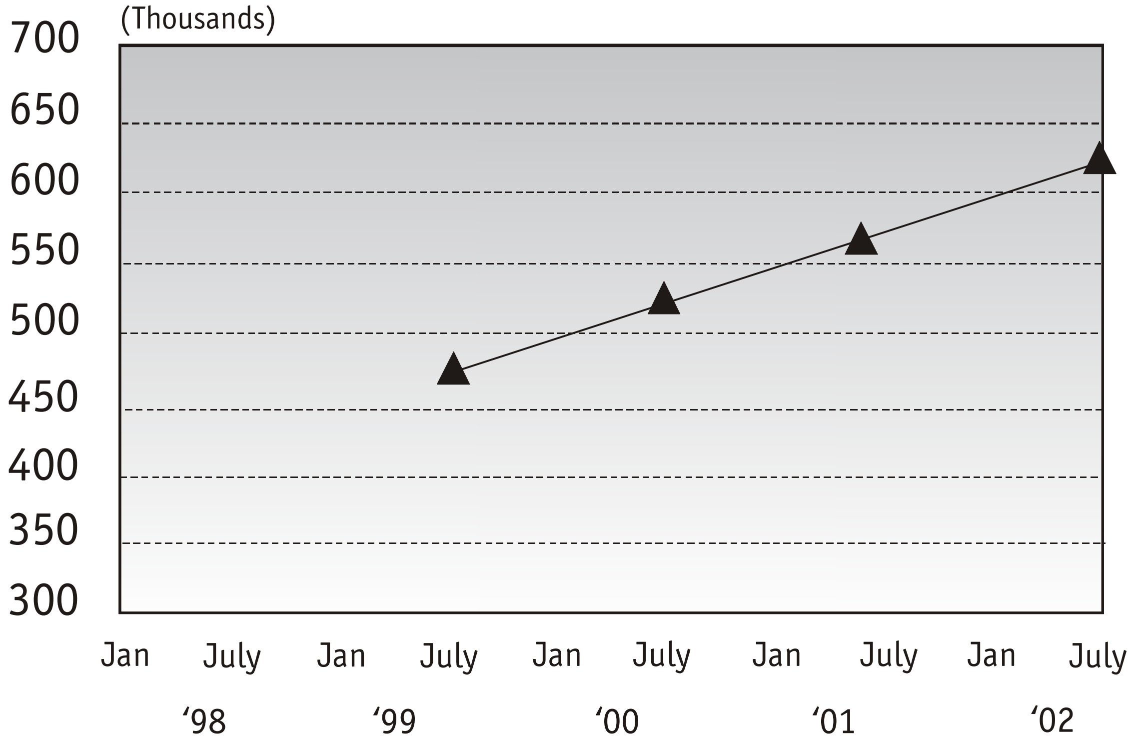
$$\begin{array}{c}\text{Estimated}\\ \text{consumption}\\ \text{of Lo-Femenal}\\ \text{in 1999}\end{array} = 5{,}398{,}561 \times 0.16 \times 0.454 \times 0.5 \times 0.65$$

$$\times\ 15$$

$$= 1{,}911{,}738$$

The consumption estimates for the intermediate and final forecast years were made in the same fashion, with the results shown in table 52. As with the other projection methods, a graphical presentation of the projection is most instructive. The population data-based projection is shown in figure 10. Annual consumption estimates presented at the bottom of table 52 were divided by 4 to produce quarterly averages which were plotted at the mid-point of each year to give a graph comparable to the preceding two projections.

Figure 10. Population Data-Based Projection for Anyland



Because this projection is based on population data rather than program data, there was no need to modify the projection further based on program plans. Differing program plans would be reflected in different assumptions for method mix, brand mix, or source mix, rather than by an after-the-fact adjustment to the projection such as the logistics data-based and service data-based projections might require.

6.5. Distribution System Capacity-Based Forecast, Part 1

It was now necessary to decide whether and how to undertake a distribution system capacity-based forecast. As mentioned in the introduction to this example, MOH staff are worried about the capability of the distribution system to meet increasing demand. However, there are no plans or resources available at present for restructuring or expanding the distribution system. Program managers are willing to make procedural changes and feel that they have limited ability to adjust the capacity of warehouses or transportation links if absolutely necessary during the relatively short time period covered by this forecast.

In these circumstances, the existing distribution system capacity must be considered as an upper limit to expansion of services. Accordingly, it is more appropriate to use a distribution system capacity-based forecast to confirm the feasibility of meeting the demand projected by the other methods.

Thus, the forecaster decided to reconcile the forecasts made using logistics, service statistics, and population data as the next step, and then to check whether the resulting projection of commodity distribution could be accommodated by the current logistics system.

6.6. Forecast Validation and Reconciliation

As described in chapter 10, validation includes review of the strengths and weaknesses of each data source and forecast. Reconciliation is the process of evaluating all available options and settling on the final forecast.

6.6.1. Forecast Validation

The strengths and weaknesses of each of the three projections are summarized in table 53, table 54, and table 55. A comparison of these tables reveals the following key points—

- The logistics data for both 1998 and 1999 were more complete than the service statistics data for either year. Though it was possible in both cases to adjust the data to estimate 100 percent reporting, the forecast error introduced by the adjustments is likely to be greater in the case of the service statistics data-based projection.
- More complicated adjustments for missing data were required in the case of the service statistics projection.
- It is not known whether dispensed-to-client data include losses or only commodities actually dispensed to clients. Similarly, it is not known whether service providers actually understand the definitions of new visits and revisits, or whether they regularly follow the prescribing protocol for any method.
- Sources of demographic data, with the exception of the U.S. Census Bureau International Data Base, were current. Estimates of WRA for the base and forecast years had to be calculated. Otherwise, there were no known problems with the survey data.
- Local information for setting CYP factors was not available; therefore, U.S. Agency for International Development (USAID) worldwide estimates were used.

Table 53. Evaluating Anyland's Logistics Data-Based Forecast

Question	Assessment
1. Were dispensed-to-client data used to make the forecast? If not, what level issues data were used?	Dispensed-to-client data were used.
2. What percentage of reports from SDPs or warehouses were missing over the period covered by historical data? What adjustments were made for incomplete reporting?	Percent reporting varied between 90% and 92%, except in 1999 in Region 2, where 75% of sites reported. Data were adjusted to estimate 100% reporting.
3. How many time periods of data were used for the projection? What percentage of reporting periods were missing from the period covered by historical data? What adjustments were made for missing time periods?	Eight quarters of data were used. Data were missing for quarter 4 of 1999 in Region 2, and for quarter 3 of 1998 in Region 3. Adjustments were made to estimate 100% reporting.
4. Were losses reported separately from consumption or issues data? If not, what adjustments were made to account for system losses?	Logistics reporting is based on "quantities dispensed," which implies that the figures are for commodities actually given to clients. It is impossible to know for sure from the available information whether losses are reported separately.
5. Were there stockouts during the time period covered by the data? If so, what adjustments were made to estimate true demand?	It is likely that there was a stockout in Region 3 during quarter 3 of 1998. It is less likely but possible that there were stockouts in Region 1 in quarter 2 of 1998 and quarter 2 of 1999. Adjustments were made in Region 3 data to estimate 100% reporting; Region 1 variations were assumed to be due to seasonality.
6. Were there special circumstances affecting past demand that no longer affect the program? If so, what adjustments were made to consumption estimates?	There were no known special circumstances.
7. What was the basis for projection of future consumption? What adjustments, if any, were made to the extrapolation of historical data?	The projection was an extrapolation from the historical data, made using the procedure of semi-averages. No adjustments were made to this extrapolation.

Table 54. Evaluating Anyland's Service Statistics Data-Based Forecast

Question	Assessment
1. Were visit data (either in total or broken down by visit or client type) used to make the forecast? If not, what service statistics were used? Are service data definitions written down? Do service delivery staff understand them?	Visit data, broken down by new visits and revisits, were used. Clarity of understanding on the part of service delivery staff is not known.
2. Are prescribing protocols documented and understood by service delivery staff? What evidence is there that such protocols are routinely followed?	There is a definite prescribing protocol, but it is not known whether the protocol is always followed.
3. What percentage of reports from SDPs were missing over the period covered by historical data? What adjustments were made for incomplete reporting?	The percentage reporting varied from 50% to 98%, with most periods in the 55%–75% range. Data were adjusted to estimate 100% reporting.
4. How many time periods of data were used for the projection? What percentage of reporting periods were missing from the period covered by historical data? What adjustments were made for missing time periods?	Eight quarters of data were used for the forecast. Data were missing in quarter 2 of 1999 for Region 1 and in quarter 4 of 1999 for Region 2. Adjustments were made to compensate for these missing data.
5. Were there special circumstances affecting past service levels that no longer affect the program? If so, what adjustments were made to service activity estimates?	There were no known special circumstances.
6. What was the basis for projection of future service levels? What adjustments, if any, were made to the extrapolation of historical data?	The projection was an extrapolation from the historical data, made using the procedure of semi-averages. No adjustments were made to this extrapolation.

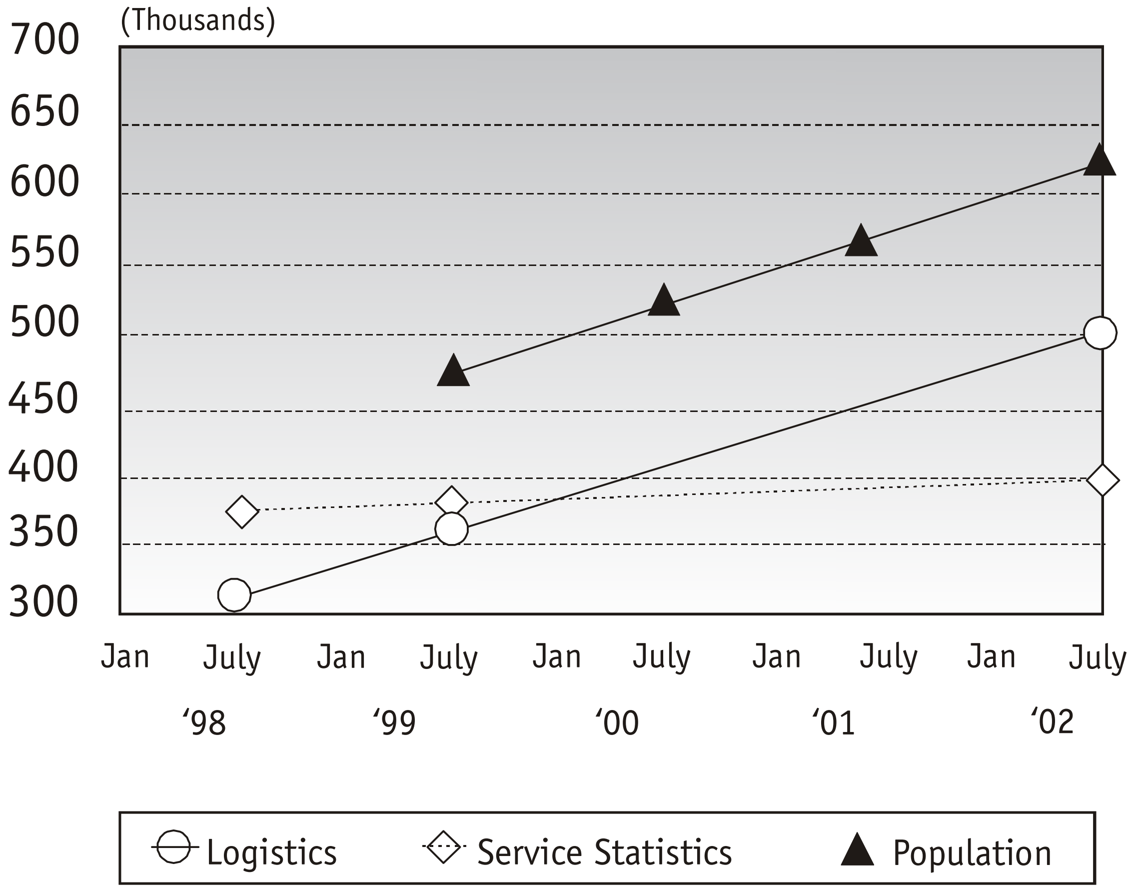
Table 55. Evaluating Anyland's Population Data-Based Forecast

Question	Assessment
1. What source(s) were used for total population, WRA, percent in union/sexually active, total fertility rate (if used in the projection), CPR, method mix, brand mix, source mix? Are there known problems with or biases in these surveys?	Sources were U.S. Census Bureau International Data Base (1996), PRB World Population Data Sheet (1999), DHS (1999), UN *Levels and Trends of Contraceptive Use* (1998), and the Anyland logistics management information system (LMIS). It was felt that the DHS women in union figures significantly underestimate the sexually active population; otherwise there are no known problems with the surveys.
2. How old were these demographic data? If adjustments were made to older data to obtain base-year estimates for the forecasts, what methodologies were used?	All data were from 1999 except for the WRA figure (1996) and the estimate of annual CPR increase (1998). Base and forecast year estimates of WRA were prepared by updating the 1996 WRA figure using an annual rate of population increase of 3.0%, obtained from the PRB World Population Data Sheet (1999).
3. What was the basis for the estimate of source mix?	DHS (1999).
4. What CYP/SYP factors were used to calculate commodity requirements?	USAID worldwide default factors.
5. If brand-specific projections were made, what was the basis for disaggregating method-specific data into individual brands?	Anyland LMIS reports were used to estimate the brand mix for orals.
6. How were population data changes over the forecast period estimated?	WRA estimates were calculated assuming a 3.0% annual rate of population increase as discussed above. CPR was estimated using the UN *Levels and Trends of Contraceptive Use* figure of 1.0 percentage points increase per year. Other variables were held constant for the time period of the projection.

These points suggest that the logistics data in this case provide the strongest projection, because the service data were less complete, and because both the service data-based forecast and the population data-based forecast required additional assumptions that the logistics data-based forecast does not.

Before making any judgment, however, the forecaster graphed all of the projections, as suggested in chapter 10. The graph is shown in figure 11.

Figure 11. Comparison of Three Alternative Projections for Anyland



Examination of the graph revealed the following additional key points—

- Though the projections are not identical, the trend in consumption shown by the population data-based forecast parallels the estimates made from logistics data.

This fact strengthened the forecaster's confidence in both of these projections.

- The service statistics projection did not show the same trend as the other two projections.

This observation reduced the forecaster's confidence in the service statistics data-based projection further. At this point, the forecaster and program managers decided to drop the service statistics projection.

6.6.2. Forecast Reconciliation

The remaining options were to select one of the remaining forecasts or take a weighted or unweighted average of the two. It is possible that the logistics data-based forecast underestimates actual consumption—for example, due to unidentified reporting errors or omissions. It is also possible that the population data-based forecast produces an overestimate—for example, due to respondent error in identifying the source of contraceptive supply or to an overly generous CYP factor (the USAID default factor includes two extra cycles per woman per year to account for client wastage). If errors in both projections were suspected, then it would be reasonable to take an average.

Because the trend lines for the two forecasts are more or less parallel, it seemed reasonable to assume that the discrepancy was caused by an error in one of the multipliers used in the population data-based projection. Such a mathematical error would produce parallel lines, but with one higher than the other. Because the logistics data-based projection required none of the types of assumptions that the population data-based projection requires, and since the logistics data set had already been judged to be the least problematic of the data sources, managers and the forecaster decided to simply use the logistics data-based forecast as the final projection.

The way in which this projection is used depends on the purpose of the forecast. In this case, a nationwide annual forecast for a three-year period was being prepared, so the forecaster only needed an annual total consumption projection for each year. The graph is a projection of quarterly consumption, so the desired total was obtained by reading the estimate from the midpoint of each year and multiplying by 4. For maximum accuracy in this reading, the vertical scale should be as large as possible (i.e., the graph should be as tall as can conveniently be drawn). The estimates the forecaster read from figure 8 are shown in table 56. The graph actually used was much taller than the example displayed here, allowing the forecaster to make a much more accurate reading than figure 8 allows.

Table 56. Final Consumption Forecast for Anyland

Year	Quarterly Estimate	Annual Estimate
1998	318,417	1,273,667
1999	365,139	1,460,556
2000	411,500	1,646,000
2001	458,500	1,834,000
2002	503,000	2,012,000

If the forecast is to be used for other purposes (for example, for quarterly scheduling of shipments), then it might be necessary to take into account the growth in estimated consumption during the year, rather than using a single quarterly average.

6.7. Distribution System Capacity-Based Forecast, Part 2

With this tentative “final” forecast in hand, the forecaster was able to determine whether the MOH’s distribution system has sufficient capacity to move and store the commodities required. Fortunately, Anyland has paid careful attention to inventory control and store-keeping procedures, and program managers are confident that the max-min inventory control system they designed is operational. Most of the storage facilities and all of the Ministry’s vehicles have been provided by a single donor, so there is reasonable consistency in capacity from place to place. The basic system structure is described in table 57.

Table 57. Anyland MOH In-Country Distribution System Structure

System Component	Central Level	Regional Level	Service Level
Number of facilities	1 central medical store	1 regional store per region	100 SDPs Region 1: 30 Region 2: 30 Region 3: 40
Storage capacity	30 ft x 40 ft 15 ft ceiling (building)	10 ft x 10 ft 10 ft ceiling (room)	30 in x 12 in x 36 in high (cabinet)
Max stock policy (Months of supply)	9	6	2
Min stock policy (Months of supply)	6	3	1
Transport capacity	5 ton truck 657 ft^3 bed	1 pickup truck per region 48 ft^3 bed	None
Delivery schedule to lower-level facilities	Quarterly	Monthly	NA

In Anyland's distribution system, it is the responsibility of each higher-level facility to transport commodities to the all lower-level facilities it serves. As table 57 shows, the delivery schedule is quarterly from the center to the three regional stores and monthly from the regions to the SDPs. At each resupply visit, the lower-level facility is stocked up to its maximum stock level, which is computed as the max stock policy (in terms of months of supply) times the average monthly consumption of the commodity.

Note that several simplifying assumptions were made in this example in the interest of clarity and brevity. First, it was assumed that storage capacity is the same at each facility of each type; all SDPs, for example, are assumed to have a single storage cabinet of the same size. Second, it was assumed that the quantity dispensed to clients is the same at every SDP. These assumptions allowed a single calculation to be used in the example for each type of facility. In real life, of course, these assumptions are likely to be false. In such cases, the forecaster must either make a separate calculation for each facility and transportation link or determine an average for each level of the system and note exceptions to the average.

In addition, the example assesses only the system's capacity to store and distribute Lo-Femenal. In a real-life situation, space requirements would be calculated for all commodities and compared to the available capacity.

The final projection for Lo-Femenal prepared above shows an increasing trend in consumption, so the forecaster chose first to calculate storage requirements for 2002, the final forecast year, because if capacity is sufficient for those quantities, the system will be able to accommodate quantities needed in the interim years.

6.7.1. Storage Capacity at the SDP Level

The average quantity to be dispensed to clients in each quarter of 2002 was read from the graph of figure 8, by tracing up to the projection line from the midpoint of 2002 on the horizontal axis, and then over to the vertical axis, giving an estimate of 503,000 cycles per quarter or 2,012,000 cycles for the entire year. Since the maximum stock policy is stated in months of supply, the annual figure was converted to a monthly figure simply by dividing by 12—

$$\begin{array}{c}\text{Average quantity}\\ \text{dispensed to clients}\\ \text{per month}\end{array} = \frac{\text{Total annual quantity}}{12}$$

$$= \frac{2{,}012{,}000 \text{ cycles}}{12} = 167{,}667 \text{ cycles}$$

Under the assumption that all SDPs distribute the same quantity, the average quantity to be dispensed to clients per month at each SDP was calculated simply as—

$$\begin{array}{c}\text{Average quantity}\\ \text{dispensed to clients}\\ \text{per month}\\ \text{at an SDP}\end{array} = \frac{\begin{array}{c}\text{Average quantity dispensed}\\ \text{to clients per month}\end{array}}{\text{Number of SDPs}} = \frac{167{,}667 \text{ cycles}}{100}$$

$$= 1{,}677 \text{ cycles}$$

According to the formula in chapter 7, the most Lo-Femenal that must be stored at each SDP is—

$$\begin{array}{c}\text{Maximum quantity}\\ \text{to store}\\ \text{(in units)}\end{array} = \begin{array}{c}\text{Maximum}\\ \text{stock level}\\ \text{(in months)}\end{array} \times \begin{array}{c}\text{Average quantity}\\ \text{dispensed to clients}\\ \text{per month}\end{array}$$

$$= 2 \times 1{,}677 \text{ cycles} = 3{,}354 \text{ cycles}$$

Appendix 5 lists weights and volumes for commonly supplied contraceptives. The volume comparison can be made in cubic feet or cubic meters, as long as a consistent measure is used for all calculations. Presuming the Lo-Femenal was obtained from USAID, a carton contains 1,200 cycles and occupies 1.33 ft^3. With these data, the required storage space at each SDP was calculated as—

$$\text{Cubic feet of storage space} = \left(\frac{\text{Maximum quantity to store}}{\text{Quantity per carton}}\right) \times \text{Cubic feet per carton}$$

$$= \left(\frac{3{,}354 \text{ cycles}}{1{,}200 \text{ cycles per carton}}\right) \times 1.33 \text{ ft}^3 = 3.7 \text{ ft}^3$$

Finally, this volume was compared to the available storage space. Converting the cabinet dimensions shown in table 57 from inches to feet gave—

$$\text{Cubic feet of storage space available} = \text{length} \times \text{width} \times \text{height}$$

$$= 2.5 \text{ ft} \times 1 \text{ ft} \times 3 \text{ ft} = 7.5 \text{ ft}^3$$

Based on this calculation, storage space for Lo-Femenal at the SDP level is sufficient at least through 2002. In a real-life situation, where multiple products are stored at the SDP, space probably would be insufficient, since more than half the cabinet would be occupied by Lo-Femenal. The other brand of orals alone, which according to the population data-based projection constitutes 50 percent of the brand mix, would fill the cabinet.

It is not necessarily true, of course, that all commodities have to be kept in the cabinet. Bulk storage (of condoms, for example) might be separate, with the limited cabinet space reserved for small and valuable commodities. Space requirements for bulk storage in a separate area can be made using the procedures shown below.

6.7.2. Storage Capacity at the Regional Level

Maximum stock policies at *all* levels in a properly functioning max-min system are based on the quantity dispensed to clients at the service level. At the regional level, then, store-keepers should expect to issue on average the same amount as all their SDPs dispense during the time period—

$$\text{Average quantity to issue per month} = \text{Average quantity dispensed to clients per month at an SDP} \times \text{Number of SDPs served}$$

So, for Regions 1 and 2, each of which serve 30 SDPs—

$$\begin{array}{c}\text{Average quantity}\\ \text{to issue}\\ \text{per month}\end{array} = 1{,}677 \times 30 = 50{,}310 \text{ cycles}$$

For Region 3, which serves 40 SDPs—

$$\begin{array}{c}\text{Average quantity}\\ \text{to issue}\\ \text{per month}\end{array} = 1{,}677 \times 40 = 67{,}080 \text{ cycles}$$

As with the SDPs, the maximum quantity to store is this quantity times the maximum stock policy. In Regions 1 and 2, this calculation was—

$$\begin{array}{c}\text{Maximum quantity}\\ \text{to store}\\ \text{(in units)}\end{array} = 6 \text{ months} \times 50{,}310 \text{ cycles per month} = 301{,}860 \text{ cycles}$$

and in Region 3—

$$\begin{array}{c}\text{Maximum quantity}\\ \text{to store}\\ \text{(in units)}\end{array} = 6 \text{ months} \times 67{,}080 \text{ cycles per month} = 402{,}480 \text{ cycles}$$

The volume of storage space required was calculated in exactly the same way as the SDPs. For Regions 1 and 2—

$$\begin{array}{c}\text{Cubic feet}\\ \text{of storage space}\end{array} = \left(\frac{301{,}860 \text{ cycles}}{1{,}200 \text{ cycles per carton}}\right) \times 1.33 \text{ ft}^3 = 334.6 \text{ ft}^3$$

For Region 3, the calculation was—

$$\begin{array}{c}\text{Cubic feet}\\ \text{of storage space}\end{array} = \left(\frac{402{,}480 \text{ cycles}}{1{,}200 \text{ cycles per carton}}\right) \times 1.33 \text{ ft}^3 = 446 \text{ ft}^3$$

As discussed in chapter 7, the maximum height of commodities stacked in bulk storage should be 2.5 meters or 8 feet, to ensure the personal safety of warehouse workers and to prevent cartons on the bottom from being crushed. Chapter 7 also suggests that an amount of handling space equal to the amount of space actually occupied by the commodities should be reserved for aisles and handling. Using the formulas shown there, the required floor space was calculated for each region. In Regions 1 and 2, the calculation was—

$$\text{Square feet of storage space} = \frac{\text{Cubic feet of storage space}}{8 \text{ ft}}$$

$$= \frac{334.6}{8} = 41.8 \text{ ft}^2$$

In Region 3, the calculation was—

$$\text{Square feet of storage space} = \frac{446}{8} = 55.75 \text{ ft}^2$$

These figures were then doubled to allow for handling. For Regions 1 and 2, then, the final total was—

$$\text{Square feet of storage and handling space} = \text{Square feet of storage space} \times 2$$

$$= 41.8 \times 2 = 83.6 \text{ ft}^2$$

For Region 3—

$$\text{Square feet of storage and handling space} = 55.75 \times 2 = 111.5 \text{ ft}^2$$

The storage space available at the regional level is 100 ft^2, because the room is 10 ft by 10 ft. Thus Regions 1 and 2 have sufficient space for Lo-Femenal storage in 2002, but Region 3 will not.

At this point, the forecaster had several options. The first was to perform these same calculations for Region 3 for the 2001 projection, and then, if necessary, for the 2000 projection, to determine exactly when the available storage capacity will be exceeded. The second was to discuss the assumptions used in the calculations with storekeepers in Region 3 and identify alternatives for obtaining the required capacity. In this case, the shortage was very slight. Storekeepers felt that using a factor of 2 in calculating handling space was generous, particularly since no mechanical handling equipment (e.g., a forklift) is used in the store. Accordingly, it was decided to assume for the present that Region 3's store is adequate, but to initiate discussions with senior managers aimed at expanding the available space in all regions over the medium term.

6.7.3. Transport Capacity at the Regional Level

In the first step in calculating the required storage capacity at the regional level, the average quantity to issue per month was calculated to be 50,310 cycles for Regions 1 and 2 and 67,080 cycles for Region 3. This is the average quantity that must be transported on a monthly basis from each regional store to its SDP. The volume occupied by these commodities can be calculated in the same fashion as above. In Regions 1 and 2, the result was—

$$\text{Cubic feet of storage space} = \left(\frac{50{,}310 \text{ cycles}}{1{,}200 \text{ cycles per carton}}\right) \times 1.33 \text{ ft}^3 = 55.8 \text{ ft}^3$$

In Region 3, the result was—

$$\text{Cubic feet of storage space} = \left(\frac{67{,}080 \text{ cycles}}{1{,}200 \text{ cycles per carton}}\right) \times 1.33 \text{ ft}^3 = 74.3 \text{ ft}^3$$

As shown in table 57, the regional warehouse pickup trucks have 48 ft^3 of storage space; thus none of the regions can deliver to all SDPs in a single trip. Two trips are required in each region.

Discussions with program managers indicated that multiple trips are normal anyway, both for geographic reasons and because drivers have other responsibilities that necessitate returning to the regional headquarters. Therefore, transport capacity at the regional level was not considered to be a constraint.

Again, note that if other commodities were considered, the capacity would likely be insufficient. Addition of an equal quantity of the other orals alone, which the demographic projection suggests is needed, would require four trips per month in Region 3 just to deliver the orals. Note also that this calculation is based on *average* issue quantities, which is appropriate for an established program. If a new SDP is opened, its first delivery must be based on the max stock policy—in this case two months of supply—rather than on the average distribution.

6.7.4. Storage Capacity at the Central Level

Storage capacity requirements at the central level were calculated in exactly the same fashion as regional storage requirements. Again, the calculation must be based on the quantities dispensed to clients at the service level, so the central medical store must plan on the basis of all 100 SDPs—

$$\text{Average quantity to issue per month} = 1{,}677 \times 100 = 167{,}700 \text{ cycles}$$

The max stock policy at the central level is nine months of supply, so—

$$\text{Maximum quantity to store (in units)} = 9 \text{ months} \times 167{,}700 = 1{,}509{,}300 \text{ cycles}$$

The volume that must be stored was—

$$\text{Cubic feet of storage space} = \left(\frac{1{,}509{,}300}{1{,}200 \text{ cycles per carton}} \right) \times 1.33 \text{ ft}^3 = 1{,}672.8 \text{ ft}^3$$

The floor space that would actually be occupied by the commodities was—

$$\text{Square feet of storage space} = \frac{1{,}672.8}{8 \text{ ft}} = 209.1 \text{ ft}^2$$

The total space required for both storage and handling was—

$$\text{Square feet of storage and handling space} = 209.1 \times 2 = 418.2 \text{ ft}^2$$

Since the storeroom measures 30 ft by 40 ft, the storage and handling space available at the central level is 1,200 ft^2. Thus, storage space at the central medical store is not a constraint.

6.7.5. Transport Capacity at the Central Level

This calculation was performed in the same fashion as the regional level calculation shown above—

$$\text{Cubic feet of storage space} = \left(\frac{167{,}700 \text{ cycles}}{1{,}200 \text{ cycles per carton}} \right) \times 1.33 \text{ ft}^3 = 185.9 \text{ ft}^3$$

Note that this represents the quantity that must be transported each month to cover commodity needs for all three regions. But Anyland MOH's policy specifies quarterly delivery from the central medical store to the regions. If the delivery schedule cannot be staggered, so that all three stores must be resupplied in a single month, then the quantity that must be transported is—

$$\text{Cubic feet of storage space} = 185.9 \text{ ft}^3 \text{ per month} \times 3 \text{ months} = 557.7 \text{ ft}^3$$

As shown in table 57, the capacity of the central medical store's truck is 657 ft^3. Thus, transport capacity at the regional level is not a constraint, even if all three regional stores are resupplied in a single trip.

Note again that this calculation is based on the *average* issue quantities, which is appropriate for an established program. If a new SDP is opened, its first delivery must be computed based on the max stock policy—in this case two months of supply—rather than the average distribution.

6.7.6. Distribution System Capacity Forecast Validation

The distribution system capacity-based forecast was evaluated for validity in the same fashion as the other forecasts; table 58 answers the questions that were discussed in chapter 10.

Table 58. Evaluating Anyland's Distribution System Capacity-Based Forecast

Question	Assessment
1. Does the program have a properly designed and functioning max-min inventory control system at every program level and facility?	Yes. Program managers feel that the max-min system is functioning well.
2. What simplifying assumptions were made about stock-level policies in preparing the projection?	None. Max and min policies differ by system level, but not from facility to facility. Actual values for the max stock policy at each level were used in the calculations.
3. What simplifying assumptions were made about storage capacity?	Storage capacity was assumed to be the same for every facility of each type.
4. What simplifying assumptions were made about transportation capacity?	None. Transport capability at the regional level is the same at all three stores. Actual vehicle capacity was used at each level in the calculations.
5. What simplifying assumptions were made about quantities dispensed to clients at the service level of the distribution system?	Quantities to be transported were based on the average quantity dispensed to clients for resupply, calculated on the presumption that all SDPs dispense the same quantities monthly.

Table 58 suggests that the forecaster's confidence in the distribution system capacity estimates should be moderately high. The only significant simplifications were the assumptions that all SDPs have the same storage capacity and that they all dispense the same quantities. These assumptions reduced the accuracy of the calculation at the SDP level; however, there are almost unquestionably alternatives for bulk storage outside the cabinet provided, so more active SDPs are unlikely to be constrained severely by storage space. Of more concern is the assumption that the quantities they dispense are the same. This is clearly untrue, based on examination of logistics data for Regions 1 and 2, which have the same number of SDPs but vastly different distribution figures. This suggests that some SDPs are significantly larger than the average, and that the transport capacity calculation at the regional level in Regions 2 and 3 may be in error. The forecaster should consider refining this analysis by making individual adjustments for large facilities in the more active regions, or by using a different assumption in each region for average quantity dispensed to clients.

In summary, the analysis so far showed that the current distribution system is adequate for distribution of the quantities of Lo-Femenal projected through 2002. However, at that time the system will be operating at capacity in several ways—

1. Storage space at the regional store in Region 3 will be completely occupied by Lo-Femenal. The other two regional stores will be nearly full.

2. Multiple trips for deliveries to SDPs will be required each month in all three regions.

3. The central medical store truck will be more than 80 percent filled by the quarterly requirement of Lo-Femenal for the three regional stores. If volumes exceed expectations, multiple trips will be required each quarter, or a larger truck will be needed.

Program managers should begin addressing these upcoming problems now, since acquiring additional vehicles and facilities is likely to be a long and difficult process in a public program. If it is expensive or impossible to obtain more space, changes in the max and min stock policies can be considered, or the frequency of deliveries can be increased to reduce the required maximum inventories.

6.8. Requirements Estimate

As described in chapter 11, the forecaster needs data on stock on hand, shipments received/on order, and adjustments, in addition to the consumption estimates discussed above to prepare the requirements estimate.

6.8.1. Stock on Hand Estimates

Table 59 displays the stock on hand data that were available for 1998 and 1999 from Anyland's LMIS, along with the adjustments the forecaster had to make to the reported figures. Since these data came from the same source as the consumption figures discussed above, they suffer the same shortcomings. Adjustments made were as follows—

- ❒ Reporting was incomplete in all cases. Using the same procedure discussed above, the forecaster adjusted the data by dividing the reported figure by the percentage of SDPs reporting to obtain adjusted figures, with the exception of the 1999 data for Region 2.

- ❒ CY1999 fourth quarter LMIS data for Region 2 were missing, so no year-end stock balance figures were available for the SDPs in that region. This case required a more complex adjustment, as described below.

Table 59. SDP Stock Data for Anyland: Lo-Femenal

1998

Region (% reporting)	End of Year Stock (reported)	Adjustments	End of Year Stock (adjusted)
Region 1 (92%)	6,796	Divide by .92 to estimate quantity if 100% reporting	7,387
Region 2 (92%)	76,930	(same)	83,620
Region 3 (90%)	35,705	Divide by .9	39,672
Total	**119,431**		**130,679**

1999

Region (% reporting)	End of Year Stock (reported)	Adjustments	End of Year Stock (adjusted)
Region 1 (92%)	7,079	Divide by .92 to estimate quantity if 100% reporting	7,695
Region 2 (75%)	Missing Data for quarter 4	See text	54,765
Region 3 (92%)	51,915	Divide by .92	56,429
Total	**???**		**118,889**

As mentioned above, MOH program staff feel that their max-min inventory control system is functioning well; accordingly, it is reasonable to assume that Region 2's SDPs are maintaining stock balances that fluctuate between max and min. The forecaster therefore assumed that each SDP in Region 2 had stock on hand at the end of 1999 equal to the average of max and min. According to table 57, the max stock policy is two months of supply at the SDP level, and the min stock policy is one month. On average, then, each SDP should have had 1.5 months of supply on hand.

Using the same logic applied in making the distribution system capacity-based forecast for 2002, the average quantity dispensed to clients per month at an SDP in 1999 was calculated by using the consumption estimate for the whole nation as a base—

$$\text{Average quantity dispensed to clients per month} = \frac{\text{Total annual quantity}}{12}$$

$$= \frac{1{,}460{,}556 \text{ cycles}}{12} = 121{,}713 \text{ cycles}$$

And—

$$\text{Average quantity dispensed to clients per month at an SDP} = \frac{\text{Average quantity dispensed to clients per month}}{\text{Number of SDPs}} = \frac{121{,}713 \text{ cycles}}{100}$$

$$= 1{,}217 \text{ cycles}$$

Therefore, 30 SDPs with an average of 1.5 months of supply on hand were expected to have—

$$\text{Estimated stock on hand at Region 2 SDPs} = 30 \times 1.5 \times 1{,}217 = 54{,}765 \text{ cycles}$$

This is the figure that the forecaster used to estimate stock on hand data for Region 2 in 1999.

As an alternative, the calculation could have been based on LMIS distribution figures for Region 2 rather than on nationwide figures. Because Region 2 is clearly more active than other regions, this strategy would have resulted in a much higher estimate of stock on hand, since the average quantity dispensed to clients per month is higher in Region 2 than in the nation as a whole. Estimating a higher existing balance would reduce the estimate of additional quantities that might be needed, thus increasing the risk of stockouts if the SDPs in fact have less inventory on hand. Accordingly the more conservative strategy shown here was chosen.

Central and regional stock on hand data, which are provided directly by the four warehouses, were available for both years and considered accurate. These data, along with the nationwide totals—including the SDP estimates of table 59—are shown in table 60.

Table 60. Central, Regional, and SDP Stock Data for Anyland: Lo-Femenal

Facility	1998 End of Year Stock	1999 End of Year Stock
Central medical store	651,100	746,600 **
Region 1 warehouse	20,600	21,450
Region 2 warehouse	233,250	239,100
Region 3 warehouse	110,600	157,400
SDP total	130,679	118,889
Grand total	**1,146,229**	**1,283,439**

** 12,000 cycles expiring April 2000

These data provided the basis for both beginning of year stock and end of year stock in the requirements estimate shown below. Because the requirements estimate was prepared in January 2000 on a calendar year basis, no adjustment of the stock on hand figures to estimate balances at the beginning of the forecast period was required.

6.8.2. Current and Future Losses

As stated in table 60, 12,000 cycles of Lo-Femenal are expected to expire in April 2000, and the forecaster discovered that these are stored at the central medical store. Although nearby service facilities could dispense a portion of these supplies quickly, program policy prohibits dispensing products that have less than a three-month shelf life remaining, since clients may store products for some time before using them. Accordingly, these commodities have to be destroyed.

No data were available for losses for previous years, because Anyland's LMIS was modified to track losses only recently. In a properly operating max-min inventory control system that keeps sufficient stock to ensure there are *never* any stockouts, there is always some level of loss due to expiry. Accordingly, the forecaster assumed that losses of 10,000 cycles per year—about the 2000 level—will be experienced in future years as well.

6.8.3. Shipments Received and On Order

Data on shipments already received or already scheduled were available from central medical store records for 1998, 1999, and 2000. These are shown in table 61.

Table 61. Lo-Femenal Shipments Received or Scheduled

Year	Quantity Received at CMS	Quantity Scheduled for Shipment
1998	1,000,000	N/A
1999	1,597,800	N/A
2000	186,000	376,800

6.8.4. Other Adjustments to Inventory

The Anyland MOH does not routinely share products with other programs; therefore no other adjustments to inventory were anticipated.

6.8.5. Desired Inventory Levels

As described in chapter 11, the desired stock at end of period in a normally functioning max-min system is the average of the max stock policy and the min stock policy for the whole distribution system. Using the policies specified in table 57, the forecaster calculated the desired end of year stock as—

$$\text{Desired end of year stock} = \frac{9 + 6 + 2 + 6 + 3 + 1}{2} = 13.5 \text{ months}$$

This was rounded up to 14 months of supply.

6.8.6. Requirements Estimate

Table 62 shows the requirements estimate prepared on the basis of these assumptions. This multi-year requirements table embodies the basic requirements estimation calculation in chapter 11 directly into the table format.

Notes on the table are as follows—

- **Beginning of year stock** figures for 1999 and 2000 were taken from table 60. For these years, the beginning of year stock in each case must be equal to the end of year stock from the previous year. The 1998 beginning of year stock was not given in the data, but was calculated by reversing the mathematical steps shown in the table—end of year stock minus contraceptives received or scheduled, plus estimated consumption, equals the beginning of year stock. This calculated figure should be checked against historical data if possible.
- **Sales or distribution** figures were taken from the final forecast of table 56 for each year. *Loss or disposal* figures were estimated as described above.
- **Received** and **scheduled** shipments were taken from table 61.
- **End of year stock** figures were calculated by the formula embodied in the table—beginning of year stock, minus estimated consumption, plus additional contracep-

tives scheduled or received, equals the end of year stock. For the historical years 1998 and 1999, this figure must equal the actual balances shown in table 60. For the forecast years, this balance can be augmented by procuring additional quantities, as the rest of the table shows.

- ❒ **Desired end of year stock** is the quantity that the program wishes to have on hand at the beginning of the following year to meet that year's needs, plus any amounts expected to be lost or otherwise removed from the distribution system. This calculation is illustrated below.

Table 62. 2000 Contraceptive Procurement Table

Country: Anyland			Prepared by: Richard C. Owens, Jr.		
Program: MOH/Dept. of Family Planning			Prepared on: January 28, 2000		
Contraceptive: Lo-Femenal					
All Numbers in 1,000s					
	1998	1999	2000	2001	2002
1. Beginning of year stock	1,419.9	1,146.2	1,283.4	2,149.7	2,357.3
MINUS					
2. Estimated consumption					
a. Sales or distribution	1,273.7	1,460.6	1,646.0	1,834.0	2,012.0
b. Loss or disposal	0	0	12	10	10
c. Transfer or adjustment	0	0	0	0	0
PLUS					
3. Additional contraceptives received or scheduled					
a. Received	1,000.0	1,597.8	186.0		
b. Scheduled			376.8		
EQUALS					
4. End of year stock	1,146.2	1,283.4	188.2	305.7	
MINUS					
5. Desired end of year stock: *14* months			2,149.7	2,357.3	
EQUALS					
6. Net supply situation					
a. Surplus **OR**					
b. Quantity needed			1,961.5	2,051.6	

As discussed above, the program wishes to maintain an average of 14 months of supply as its desired end of year stock. For 2000, this quantity was calculated based on expected consumption in 2001 (in thousands) as—

$$\begin{array}{c}\text{Desired}\\ \text{end of year stock}\\ \text{for 2000}\end{array} = \left(\frac{\text{Sales/distribution for 2001}}{12}\right) \times \begin{array}{c}\text{Desired}\\ \text{months of supply}\end{array}$$

$$= \left(\frac{1{,}834}{12}\right) \times 14 = 2{,}139.7$$

The annual loss estimate of 10,000 cycles was added to this figure, for a grand total of 2,149,700 cycles. The same calculation was used for the 2001 desired end of year stock.

Finally, the calculated end of year stock and the desired end of year stock were compared. If the desired end of year stock is larger, as is the case here in 2000 and 2001, additional product in the amount of the difference is needed to bring balances up to the desired levels.

Here, 1,961,500 additional cycles are needed in 2000, and the forecaster has assumed that this product will actually be procured or obtained from donors in 2000. Accordingly, the beginning of year stock for 2001 was set to the desired end of year stock level from 2000, and the same calculation was repeated for 2001 to give a requirement of 2,051,600 cycles for 2001 procurement. If program managers feel that it will not be possible to obtain the entire quantity needed in either year, then the beginning of year stock in the following year should be reduced accordingly.

It is notable in this example that the desired balances in the forecast years are substantially larger than the balances in the historical years, and that the difference is much greater than could be accounted for by program growth alone. The implication of this finding is that the system has *not*, in fact, been operating at the average of the max and min levels specified in table 57, but rather at lower inventory levels. Since the data do not show frequent stockouts, and program managers have not stated that stockouts are a problem, it may be desirable to review the max and min stock policies to decide whether they can be reduced, thus shortening the in-country pipeline and reducing the chance of product expiry.

This completed the forecast and requirements estimate for Anyland. Once program managers agree on the calculations and assumptions described here, the forecaster should assist in preparation of desired shipping schedules for the product to be procured. As described in chapter 7 and 11, the resupply interval must be less than or equal to the difference between the max stock policy and the min stock policy if the central medical store is to maintain balances between max and min. According to table 57, Anyland's deliveries should be scheduled at least quarterly.

For more information, please visit deliver.jsi.com.

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