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SAMPLE VITAL REGISTRATION EXPERIMENT

Presented by

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I. INTRODUCTION

Need for Improved Vital Registration

Vital registration in almost all countries serves two objectives. The first is legal identification and the second is for statistics. The sample vital registration experiment which is discussed here is concerned with the latter objective.

Vital statistics are useful as base data for prediction and planning a variety of social and economic programs. Many countries have not developed sufficiently their vital registration systems to a point where the resultant statistics are reliable enough for planning purposes. This results in a waste of scarce public funds and delays the implementation of adequate facilities which need data for their planning. At the same time, international programs of considerable social and economic significance are handicapped and often based on casual observation and guesses.

The sample vital registration experiment was designed to test the feasibility and practicality of improving vital registration practices and obtaining data quickly and cheaply in a less-developed area. It was an attempt to apply sampling for this purpose. It was considered that without special statistical techniques such as this, reliable estimates on vital statistics would not be available for many years in the future. The design was implemented keeping in mind that special statistical techniques must be invented, devised and employed in many areas of the world if reliable estimates are to be produced.

Vital Registration in Latin America

For the most part, Latin countries use a vital registration system generally known as the "Registro Civil". Some combine the civil register with church registers and births and death certificates. The system administration varies from country to country. Some have centralized systems in which considerable control is exercised, others have highly decentralized systems with little or no control. In Peru, for example, no centralized national registration office exists; the Ministry of Justice establishes the legal structure; the Ministry of Police and Government indirectly appoints registration personnel and the Ministries of Public Health and Finance tabulate the statistics.

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/All Latin

All Latin American Countries report statistics on live births and deaths in one form or other. Fetal deaths and marriage statistics are compiled by many but divorce statistics are not so widely available. Reportin in many countries are on listings even though the United Nation's recommendations call for individual reports on certificates. A number of countries have adopted standardized birth and death certificates which are used for statistical but not legal purposes.1/

Vital Registration Problems

In Latin America, as well as many other countries in the world, certain problems and difficulties impede proper vital registration practices and bias vital statistics. Among those most important are the following:

1. Registration omission, as evidenced by vital rates which are not internally or externally consistent, is great in some areas.

2. Legal procedures governing registration are antiquated and cause operation inefficiency.

3. Standardized definitions are often not conformed to.

4. Reporting procedures are often cumbersome and reports are not properly pre-edited.

5. Many countries do not exercise sufficient administrative control over the functioning of their vital registration systems.

6. The populance are not well acquainted with their rights and obligations in respect to civil registration and many registration officials are not aware of the statistical value of an adequate civil registration system.

Since most countries are becoming more aware of the vital necessity of adequate vital statistics estimates, over a period of time many of these conditions will be corrected. However, the time factor is important and it is expedient to employ a system which can be implemented quickly within the present legal and administrative framework leaving the necessary long-term improvements to developed as they may.

One method that has been proposed for improving vital registration is the "registration area" method which has been used in the United States. Registration units which are considered adecuate by certain previously selected criteria are included in a registration area. As other units improve by means of directed assistance, they are added to the registration

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1/ "Vital Statistics in Latin America: Collection Program in Terms of United Nations Recommendations", Nora P. Powell, (Reference document for III Inter-American Statistical Conference Quitandinha, Petropolis, Brazil) June 1955.

/area until

area until ultimately all registering units are included. The major difficulty with this method is that the units which comprise the registration areas are not necessarily representative of the whole country and vital statistics estimates cannot be considered representative of the universe. This objection is not inherent in the "sample registration" method employed in the experiment described in this paper.

Advantages of Sampling

Sampling in vital registration and statistics has been recommended by various international statistical agencies including the III Inter-American Statistical Conference (Brasil, 1955), First Inter-American Seminar on Civil Registration (Chile, 1954) and the United National Statistical Office.

The most important advantages in the application of sampling to registration improvement can be summarized as follows. Sampling can contribute greatly towards operational cost reduction. The method, if properly designed, can produce statistical estimates quickly. Greater overall efficiency and quality may be achieved because detailed concentration on a relatively few representative units can be made. At the same time, greater control can be exercised over the system because few units are involved.

The statistical processing operation will be less costly and made more rapidly because a lesser number of units will need tabulating. More tabulations may be made with the same facilities since such time consuming activities as coding and punching will be greatly reduced. 2/

II. AN EXPERIMENT IN SAMPLING FOR VITAL REGISTRATION

General Procedures and Objectives

The vital registration system in Peru is composed of over 1,500 registration districts (Oficinas de Registro Civil) in which all vital events are recorded in large books. Each political district has or should have, by law, a registration office. In addition, in some populous places distant from the capital of the district where the registration office is located, municipal agents have been appointed and entrusted with the work of vital registration. This practice exists even though there is some question about the strict legality of their function as a registrar of vital events.

The administrative functioning of the whole registration system depends in part on several governmental agencies. There does not exist a central administrative office which controls and coordinates the entire

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2/ "The Use of Sampling for Vital Registration and Statistics", Philip M. Hauser, (paper prepared for the International Conference of National Committees on Vital and Health Statistics, London) 1953.

functioning operation. The lack of centralized administrative control is a major weakness of the system and contributes to inefficient operation both from the legal point of view as well as a source of vital statistics.

Peruvian law does not provide for compulsory registration. However, all cemeteries are controlled in such a way that a permit from a registration office is necessary before legal burial may be performed. An unknown number of deaths, especially among infants, are buried each year in clandestine cemeteries and of course, these are not included in the official vital statistics. The law in Peru makes no provision for recording fetal deaths. Since little supervision exists over registration practices, fetal deaths are often recorded oficially as either a birth or a death or both, thus contributing to an erroneous over-registration.

Tabulated vital statistics on a national scale use the vital registration offices as their principal source. This is accomplished by means of various types of report forms to two principal statistical agencies, the Biostatistics Program in the Inter-american Cooperative Health Service (SCISP) and the National Statistical Office (DNE) in the Ministry of Finance. For the Biostatistics Program, the report forms consist of standardized birth, death and fetal death certificates which conform to international standards with adaptations for national needs. These forms are used in cooperation with the registration offices, the 50-odd field health units operated by the Ministry of Public Health, the physicians and mid-wives. Unfortunately, their use has been confined to urban and semi-urban areas where physicians and mid-wives practice, since each death and fetal death certificate must be signed by a physician and each birth certificate by either a mid-wife or physician. About 35 per cent of all known births and deaths are recorded on certificates and vital statistics tabulations produced by the Biostatistics Program are based on these data.3/ The entire population of Lima and Callao, which has a combined population of 1,500,000, uses the certificates exclusively for all births and deaths.

The report form which is sent to the Peruvian National Statistics Office from all registration districts consists of a vital event form on which all births and deaths are listed and classified by specified characteristics. This form is used for all registration districts except Lima-Callao and a limited number of other urban districts where reporting on certificates is complete. Some, but not enough, coordination exists between these two data processing agencies. One area in which coordination is not yet complete is in the duplication of statistical reports received on certificates and schedule listings.

3/ See "La Demografía de las Principales Ciudades Peruanas", (The Demography of the Principal Peruvian Cities) Inter-american Cooperative Health Service, Ministry of Public Health, Lima, Peru, 1956, 1957, 1958, 1959.

/Certain serious

Certain serious defects in the registration system have been evident for a number of years. These defects effect considerably the reliability of the tabulated and published statistics. Already mentioned is the lack of centralized supervision over the whole system by a national civil registration office and the improper recording of fetal deaths as births and deaths. Other defects include, lack of compulsory registration causing in some small districts up to 70 per cent omission, transcription errors, poor reporting on cause of death by physicians, the comparatively short length of time (8 days) allowed for registering births especially in backward areas, lack of knowledge about legal requirements of registration both on the part of the public and the registrars of smaller vital registration offices, the lack of funds and necessary equipment for registrars, the lack of a strict legal provision for appointing municipal agents encharged with registration in populous places which are distant from the principle vital registration office.

In order to try to correct some of these deficiencies without a major overhaul of existing national legal procedures, an experimental sample vital registration plan was designed and implemented within the present legal framework. Since there were serious financial limitations, the plan was minimumally designed and limited to a specific area in Peru. The design consisted of the improvement of vital registration utilizing a representative sample of districts, instructing each sample district office on correct registration methods, surveying present registration conditions and facilities and using the statistics thus collected from these registration districts to make estimates for the universe of districts in the chosen area.

As in most economically under-developed areas in the world, Peru does not yet have adequate vital statistics on a national basis. However, the tendency towards closer interaction among all nations and peoples dictates that it is not possible to wait for many more decades to pass before reliable vital demographic data are available. It is necessary to design measurement techniques which are especially adaptable to lesser developed areas in many statistical fields and especially in vital statistics. This design must include economical methods to fit very limited economic resources. The designs must not be complicated, must be efficient and easy to administer. The collection of vital statistics using a representative sample of registration districts is an example of this type of design.

The vital registration sample experiment was administratively located within and coordinated with the National Biostatistics Program in the Peruvian Interamerican Cooperative Health Service. This had the advantage of the utilization of existing administrative and physical facilities. The Program Director also directed the experiment and employed a supervisor and two field workers to implement the design. Administrative costs were kept to a minimum in this manner and the only extra costs for the implementation of the experiment were for salaries of four persons and travel for two field workers.

/The experiment

The experiment area consisted of a large geographical area in Southern Peru extending from the Pacific to the border of Bolivia and which includes seven Departments, 40 provinces and 372 vital registration offices, i.e., one for each district. The total population was estimated as 2,437,000 in 1959. The whole area is predominently rural, vastly economically under-developed and for the most part composed of a culturally indigenous population. With the exception of small parts of three Departments which border the Pacific Ocean, the experimental area is located in an extremely mountainous, high plain region. One of the Departments on the extreme north-eastern side is principally jungle and sparsely populated. Communication and transportation is poor. Some districts are almost completely isolated from the main Peruvian flow of commerce.

In short, the region in which the experiment was performed is backward, indigenous, comparatively highly populated in certain areas such as Puno, Arequipa and Cuzco and covers a tremendous geographical area. It is an area of considerable economic and social potential influence and its principal resources is its people. These inhabitants are estimated to have a high crude birth and death rate. A possible exception is that the death rate is slightly lower in the urban population which includes a small fraction of the total. Infant mortality also is comparatively high even in most of the urban areas. Other reliable demographic data for the region are not available and must be made from crude estimates. A notable exception are data from some urban areas from which the figures are comparatively reliable.

The specific objectives of the registration experiment were as follows:

1. Select a representative sample of all registration districts and attempt to improve vital registration practices within the sample.

2. Reduce the number of vital event omissions and improve the reliability of the reporting procedures.

3. Collect and tabulate vital statistics from a sample of districts and use these as a basis for estimating the universe.

4. Improve registration practices and hence the reliability of vital statistics by visits to each sample unit and instruct each registrar how to improve registration.

5. Introduce and encourage the use of birth and death certificates in areas not using them and where at least one physician or midwife is working.

6. Collect data about the actual and present functioning of the vital registration system in a determined area using a representative sample to generalize about the universe.

/Use of

Use of Registration Supervisors

Funds permitted the employment of two vital registration field supervisors in order to implement the objectives of the experiment. They were selected for their capacity to travel, speak one or more native languages and for their general knowledge of the area. Both were educated Peruvians and lived in the areas to which they were assigned.

The field supervisors were given a month's intensive training on what their duties and responsibilities were to be. They were instructed in vital registration law and general practices for statistical purposes. The study of reference materials on vital registration practices was required. Visits to local vital registration offices were made in order to acquaint them with the duties that they would be expected to carry out.

Their principle duty was to visit each sample registration unit and by the use of certain techniques and methods, attempt to improve registration practices. These techniques included coordination with public health, school and ecclesiastical authorities in order to reduce the number of omissions, instruction in correct registration methods both from the statistical as well as the legal viewpoint, distribution of propaganda on the value of civil registration, implementation and correct use of standardized birth and death certificates, where feasible, and the appointment of municipal agents for registration purposes in populous areas distant from the central registration office.

Supervisor control from the central office was accomplished by means of special reports. The itinerary and division of areas were designed previously and was strictly adhered to with the exception of some changes due to inclement weather or impassable roads. A further supervisor control was the requirement that a registration survey form be filled out for each sample district office visited.

General Sample Design and Selection

The principle objectives from the standpoint of sample design for sampling vital registration districts were determined early in the formulation of the experiment. They were (1) to increase the quality of the registration, (2) to estimate the number of vital events in the universe and (3) to make actual tabulations of detailed items.

Any plan for vital registration improvement and statistics based on a sample must fulfil certain pre-requisites and take into account certain conditions. For example, the sampling units must be complete primary registration areas or combinations.4/ The sample must be representative

4/ It is important to understand that the individual vital event is not the basic sample unit here but rather the registration office from where the vital events come.

of the universe in respect to certain selected criteria. Within stratifications, (if strata are used), the sample chosen must be representative of that stratification in order to make reliable estimates of fractions of the universe. The actual design and selection must be according to probability theory and its restrictions so that the part is representative of the whole, sampling error can be measured and, if plausible, costs may be taken into account (optimum allocation). Strong consideration must be given to maximum efficiency, i.e., minimum sampling error, in terms of stratification if data are available. A gain in sampling efficiency can be achieved by the groupings of homogeneous units together according to pre-determined criteria and sampling each according to the requirements of optimum allocation and probabilities proportionate to their size. Registration units which are desired to include because of administrative reasons can always be included by putting them into a separate strata. The sample must be so designed that statistical test of success or failure can be applied after the experiment was in process for a given period of time.

A district vital registration office was chosen as the primary sampling unit. As previously stated the universe consisted of 372 units located in seven geographically large areas (Departments) in Southern Peru. This area was selected for the experiment because funds were available as part of a large scale socio-economic survey being performed there. The immediate problem was to select a representative sample of vital registration units from this area.

Some previous information was available for the sample design. For example, the number of reported births and deaths from each reporting universe unit was available. From this information it was possible also to assess indirectly the approximate quality of each registration unit in terms of estimated omission. The location of each registration unit was also known. If needed, crude estimated population sizes could be computed using vital statistics and corrections as a basis.

In most sample surveys a combination of sample methods is used and no one "pure" design is usually employed. The design for this experiment was no exception. A stratified design was chosen in order to reduce sampling error, i.e., variance and increase homogenity of strata groupings. A modification was introduced in that all registration units located in capitals of provinces were treated as a stratum and sampled 100 per cent.

The criteria finally selected for stratification were (1) capitals of Departments which were used as a criteria for a separate strata, (2) area, classified roughly by general geographical regions, (3) quality which in part was measured by putting all registration units which are capitals of Departments into a separate strata, and another index, the ratio between the number of births and deaths, i.e., $\frac{x_i}{y_i}$ where x_i = the total number of births per year in i unit and y_i = the number of deaths in i unit. The final criteria (4) was an index of size of each unit in terms of number of vital events.

/Stratification by

Stratification by geographical regions was considered important because it was concluded that the quality of registration practices varied considerably among the three geographic regions selected, i.e., coast with highest quality, sierra and jungle with the lowest. The level of literacy and general cultural attainment of the population, the availability of equipment and the type of registration employees affect adequate administration of registration and this varies generally by geographic regions in Peru. Finally, stratification by regions permits making final estimates by regions, if desired, and permits a proportionate representation from the complete geographical area of the universe.

Quality of registration using an indirect indice was also considered an important criteria because it was desired to increase the probability that all levels of registration practices be selected in proportion to their incidence in the population. The definition of quality was the ratio between births and deaths using 3.5 births to 1 death as a "normal ratio" in a district where registration was complete. This ratio may have a limitation in some areas or countries where there is an under-registration of both births and deaths. However, it was not considered a limiting factor for this experiment because it was suspected that generally the under-registration of deaths is and was not great in most Peruvian areas. In any case, a higher or lower ration than 3.5 to 1 would indicate that under-registration exists and classification made accordingly. An exception would be isolated districts in which unusual demographic changes were taking place. Quality is also stratified in the size criteria because there is generally a direct correlation between size of district and quality with the larger units having better administration of civil registration.

The capitals of Departments were put into a separate strata because quality was highest, they were homogeneous urban areas with a higher cultural level, more facilities were usually available and the variance expressed by various indices is great between the capitals and other districts.

In some countries stratification by size would prove to be a most simple operation. However, in Peru, accurate census statistics on population size of isolated indigenous districts (registration units) were not available. It was deemed necessary to stratify by some index of size because it was desired to sample in proportion to district size. This was necessary to reduce sampling error and for making future vital statistics estimates.

Finally accepted as an indirect index of population size for each unit was a figure which represented the corrected number of births. This technique had the advantage that it produced an average or a smoothing of the errors caused by omission of the reported number of births or deaths. The technique uses both births and deaths at the same time which is an improvement over the use of only birth or deaths. In some cases the corrected number of births were less than those reported. However, this is not a calculation or definition error, but rather signifies a very probable omission in death registration. On the contrary, a larger corrected number of births than reported means an omission in births. Both extremes signify poor quality

in civil registration and in this sense can be used for quality stratification. Calculation for corrected births for each i district were made according to:

$$B_{c_i} = \frac{Bi \pm RDi}{2} \quad \text{where, } R = 3.5$$

When the corrected number of births were less than the reported births, the reported births were used in the stratification for size.

Two groups were used for size stratification by computing the mean of corrected births for all units (B_{c_i}) its γ N_{c_i} and including in the first strata all districts having values less than $x \pm \gamma$, and in the second all districts with values $\bar{X} + \gamma$ and over.

A continuance of the same procedure may be used for quality stratification. Quality of registration was measured in terms of the relative magnitude or differences ($R_i - R$) between a calculated ratio (R) of the sum of total of births and deaths reported, i.e.,

$$R = \frac{\sum_{i=1}^{N} Bi}{\sum_{i=1}^{N} Di}$$

and, a ratio of births and deaths for each district, i.e..... $R_i = \frac{B_i}{D_i}$

The differences were classified into two strata, one which included all values of $R \pm$, and the other all remaining values. This was feasible because the extremes at either end of the distribution of R_i showed poor quality, i.e., either a great omission of births, or values less than R; or an omission of deaths, i.e., values greater than R.

Ten stata were finally selected and consisted of combinations of districts classified by coast, sierra, jungle, large or small, poor or good quality.

Estimating Procedures

A principal objective of the experiment was to design a sample in such a manner that adequate estimates of the universe could be made. Several methods are available. One is by means of direct inflation in accordance with the reciprocal of the sampling ratio. Another would consist of calculating the amount of omission before and after the experiment, then applying this omission to each strata and summing of all strata. In countries where previous data are available, ratio estimation, difference estimates or linear regression methods may be employed. The specific method used should be tailored to the specific conditions found.

Vital Registration Practices in Sample Area

The experiment had as another major objective the acquisition of information about the general status and quality of vital registration practices in Southern Peru. This information was obtained by the field registration supervisors on a survey schedule and tabulated.

The tabulations indicated that registration unit budgets were so small in most localities that qualified personnel and necessary equipment were impossible to obtain. The registration function is generally a part-time, honorary, political position for the registrar in which few facilities and small remuneration are provided. Records were defined as organized in but 60 per cent of the units. Although the law provides for legal inspection, facilities are available for this service in only a few of the larger registration units. This condition produces a virtual abandonment of effective supervision. The reliability of the vital statistics are affected by a general lack of knowledge as to correct registration practices and their application on the part of the registrar.

Registration convenience to the general public affect greatly the extent of omission. In this respect, comparatively few districts employed municipal agents for vital registration in populous areas which are distant from the central district registration office. Generally, it was estimated that more omission existed in births than deaths. The estimated omission pattern is presented in the following table:

ESTIMATED OMISSION OF BIRTHS AND DEATHS IN SAMPLE AREA

Per cent omission	Number of districts	
	Births	Deaths
No omission	10	47
1 - 19	7	6
20 - 39	20	21
40 - 59	16	17
60 - 79	37	1
80 - 99	3	1
100	0	0
Overestimated	4	3
Unknown	13	5
TOTAL	110	110

The foregoing conditions, problems and difficulties were found in the sample survey and it is assumed that the universe has similar attributes. Also similar conditions are probably common in other comparable regions of Peru and even other countries in Latin America and vary only in degree and according to local conditions.

/III. CONCLUSION

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Limitations and Problems in the Execution of the Experiment

Except for the population included in the sample, sample registration improvement does not improve legal benefits for the population universe. However, a continual change in the sample selection every two or three years would eventually include all units in the universe thus actually improving legal benefits over a period of time.

Some sample units selected were impossible to be visited by field workers because of complete lack of transportation. The number of these units made up 5 per cent of the total. The experimental project was designed to be a continuing project so that control and follow-up could be maintained over a period of at least three to five years. However, continuation funds were not available after one year. During this year, the first phase of the work was completed, i.e., field personnel were trained and each sample unit was visited and registration improvement begun. This unavailability of continuation funds had a serious limiting effect in that follow-up could not be performed, adequate universe estimates could not be made, general strict supervision over sample registration units could not be continued and a general adequate evaluation as to success or failure was difficult. Three factors contributed to the failure to secure continuing funds. One was due to resistence and timidity in less developed areas to change or modification of established methods. The second had to do with the complex functioning of vital registration and the lack of a centralized agency which could continue the project. The third was due to a lack of understanding and interest of this type of project.

A definite limiting factor was the general backwardness and primitiveness of the sample area in which mail, communication, transportation and language difficulties all contributed to the problems of developing the project.

Some generalized conclusions and recommendations emerged which may be useful for future guidance in countries interested in implementing the improvement of vital registration on a sample basis. Most important is that any design to be implemented must take into account the requirements, needs and conditions inherent in a given country. The formulation of the general improvement design including sampling should be performed by a highly trained technician. In countries where no central registration agency exists, the coordination and cooperation of all agencies performing some functional control is very important to the success of the project. Adequate training of field personnel and their subsequent control in the field cannot be over emphasized, because their effectiveness is one of the most important aspects of the design. The design should provide for pilot experimental work before embarking on large-scale national registration improvement. Evaluation procedures, complete with objectives and evaluation criteria must be included in the basic design.

/SUMMARY

SUMMARY

The uses and advantages of sampling for securing adequate vital registration and statistics has been recognized by various international statistical agencies. In accordance with the recommendations made, a sample vital registration experiment was undertaken in 1958 in Peru. The experiment was designed to test the feasibility of improving vital registration using a representative sample, and estimating vital statistics for a universe from the sample. It also had as a major purpose the gathering of information on the actual state of vital registration in a rather indigenous area of a lesser developed country.

Since much of the world's population lives in less-developed areas and statistical knowledge emanating from vital registration installations are usually lacking or unreliable, it was desired to demonstrate how sampling could be used to improve registration and obtain statistics quickly and economically. Most lesser developed nations must employ special statistical techniques such as this used in the experiment if they are to have reliable estimates of demographic data. This is because they lack technical personnel, funds and equipment to administer more complicated statistical designs. In some cases, the situation reduces itself to the fact that new techni ues such as sampling must be used if any reliable statistics are to be available.

The general procedures, administration and objectives of the experiment are pointed out. Specifically, the objectives were to select a sample in an area which included almost 2,500,000 inhabitants, improve registration procedures by means of special visits by registration supervisors, teach registrars correct legal and statistical procedures, gather data concerning actual registration practices and problems, use the sample statistics as the most reliable estimate of the universe.

A 25 per cent sample of registration units was selected from a universe of 372 units. The design consisted of a modified stratified sample in which four criteria for stratification were chosen. One stratum consisted of all registration units which are capitals of provinces and where registration was considered reliable. Other criteria consisted of location, quality as measured by registration omission estimates, and size in terms of the number of vital events registered. This technique greatly reduced sampling error, i. e., the variance, and increased the reliability of the sample as a device for representing the universe.

The survey of registration practices indicated a great many problems pertaining to the administration of vital registration which tend to greatly reduce their effectiveness as sources for vital statistics. These include considerable omission in the registration of vital events, almost complete lack of official supervision and control, inadequate and under-paid personnel, lack of equipment and transportation and many other problems.

/The experiment

The experiment had various limitations of which the most important was the unavailability of continuing funds for more than one year. Because this approach for securing adequate statistics is new and different and because this sort of activity is not sensational, considerable difficulty was encountered in arousing interest. The experiment pointed out certain procedural techniques, problems and difficulties which should be of value to other countries who are contemplating the implementation of vital registration improvement and statistics on a sample basis.