Tools: Impact and Outcomes

Measuring child mortality to assess impact of the Integrated Community Case Management (ICCM) of Childhood illnesses programs

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Demonstrating the mortality impact of the ICCM program requires, first and foremost, accurate direct measurement of child mortality. This can only be achieved if an appropriate approach for mortality data collection and analysis is used. Household surveys with full birth (or pregnancy) history from women aged 15-49 years are one such approach with comparative advantages over other existing approaches. In this note, we summarize advantages of adopting a full birth history approach for ICCM program evaluation. We also briefly discuss steps for data collection and strategies for obtaining and safeguarding good data quality.

The main purpose of this note is to provide an indicative guidance to those planning mortality impact evaluation of large scale ICCM program and to donors. It is not a comprehensive and detailed description of all steps to take for implementation a mortality impact study. Those planning such study should consult more detailed manuals available on the subject.

Data sources for child mortality

In general, three main data sources are available for mortality measurement. First, the ideal data source is ***vital registration*** with complete accounts of births and deaths over time. In settings where registration of births and deaths is exhaustive and complete, data collected includes number of births, with dates of births, and number of deaths by age and date of death, over time. Therefore, if the system is complete and provides timely data, it will represent the ideal source of data for child mortality measurement. However such system is not yet functioning in most low- and middle-income countries at a level that can be used to produce reliable mortality estimates for program evaluation.

In absence of complete and exhaustive vital registration, the next best source relies on ***demographic surveillance***. This consists of frequent and regular (short intervals) censuses of all households to collect information on births and deaths that occurred within the interval since the last visit, including date of birth, date of death and age at death. This approach is used in typical demographic surveillance systems (DSS) to collect demographic data (Indepth Network).[1] Because it requires intensive and frequent visits to all households, with sophisticated quality control, this approach can only be implemented in small geographic areas and therefore is not flexible enough for use for program evaluation in areas where it has not yet been set up and fully functioning with complete and high quality data. Finally, ***household surveys*** represent the most flexible approach to collect mortality data. While several strategies can be implemented in these surveys to collect these data (for example, asking questions on births and deaths

within the past twelve months), the most satisfactory strategy to date, in producing accurate levels and trends in mortality, has been the implementation of a full birth or full pregnancy history from women of reproductive age.[2] Surveys with full birth history are flexible in that they can be appropriate designed for one-time data collection and for a specific purpose. However, to be successful the approach must include rigorous training and close field supervision of data collectors and careful data editing, necessary steps required to guarantee good data quality. Because the survey is typically implemented in settings where women school education is low, fertility relatively high and women experience reproduction throughout their full reproductive age, collection of accurate information on date of birth and age is particularly challenging. Strict procedures must be put in place and enforce to ensure good data quality. Missteps in these procedures can render the data unusable due to quality deficiencies.[3] Due to these requirements, the full birth history approach can be relatively expensive to implement.

Surveys with full birth histories

Full birth history interviews consist of asking women of reproductive age (15-49 years old) during a survey to provide full account of all their live births including the date of birth, survival status, age if currently alive, and age at death if died, starting from the first child (forward method) or the last (Backward method). In general, to help women refresh their memory and be ready for the full birth history, questions on total children ever born and children who have died are asked first. These questions, referred to as summary birth history questions, also provide basis for double-checking the accuracy of the full birth history. They are also generally subdivided by the sex of the child and whether he/she lives with the respondent or elsewhere. However, summary birth history questions alone do not provide sufficient information for an evaluation. An alternative approach to the full birth history approach is the full pregnancy history which focuses on all pregnancies women have ever experienced in the lives. It typically asks each woman in a survey to provide full account of all pregnancies she ever had, the outcome of each pregnancy, and in cases of live births, the survival status of each birth, including date of birth and age at death (in cases where the child died). In cases where a pregnancy did not result in a live birth, information is also collected on pregnancy gestation. The full pregnancy history, therefore, requires much greater attention than a full birth history in order to guarantee accuracy and data quality.

The full birth history approach has been implemented for decades in standardized international survey programs such as the Demographic and Health Surveys (DHS, www.measuredhs.org) and Multiple Indicator Cluster Surveys (MICS, www.childinfo.org), and implementation techniques have improved overtime.[4,5]

Full birth history surveys present several comparative advantages over other data sources, especially when it comes to the evaluation of the mortality impact of large scale programs such as ICCM.

(a) Full birth history data allow estimation of levels and trends in childhood mortality. All types childhood mortality (neonatal, post-neonatal, child and under-five) rate can be computed for a defined periods prior to the survey. DHS programs typically compute childhood mortality rates over periods of five year before the survey, however if sample size allows, rates can be computed for smaller periods. In

addition, several periods before the survey can be defined allowing an assessment of mortality trends. In general mortality rates are computed going as far as back up to 15-20 years before the survey.

(b) Full birth history data allow analysis of age patterns of deaths and mortality disparities across selected socio-economic and demographic characteristics of interests. In addition, advanced regression analysis can be conducted, adjusting for confounding factors to assess program impact.

(c) Because the data allows trends analysis, mortality rates can be computed for defined baseline and endline periods from a single survey dataset to assess changes in mortality between baseline and endline periods or changes associated with the implementation of the ICCM program if the evaluation is designed to make such inference.

(d) Using a single survey conducted at the end of the program to measure mortality on both baseline and endline periods has also an added advantage of potentially increasing the efficiency of the mortality analysis by eliminating differential measurements or increased variance due to multiple surveys.

(e) Because only a single survey is conducted at endline to measure mortality at baseline and endline periods, pre-assessment of whether mortality data collection is warranted given progress observed in the strength of the ICCM implementation, the utilization of the program, coverage level achieved and contextual factors can be implemented. In addition, funds can be put toward carrying out a good and well powered endline survey when conditions indicate possible impact of the ICCM.

(f) Finally, using full birth history approach for mortality measurement in ICCM impact evaluation will allow comparison of resulting mortality rates with rates from national surveys such as DHS and MICS or other subnational survey that used similar approach. Such comparison allows an external data quality assessment of the mortality data used for the evaluation.

Data quality issues in FBH

Similar to any household survey, surveys with full birth history are subject to measurement errors as well as sampling errors. However, due to the specific nature of the information collected during full birth history interview, data are particularly vulnerable to some key errors that must be kept in mind while designing such surveys.

(a) *Completeness of information*: Data completeness can be affected in three main ways: Missing of eligible respondents, event omission, and missing response to specific questions such as questions related to dates and ages.

   i. When substantial number of eligible women or category of women are missed during the survey, it can bias the mortality estimates if women missed have somewhat differentially higher or lower child mortality than those surveyed. Unfortunately, there is no way to ascertain this once the survey is complete. It is therefore critical that during fieldwork all steps are put in place to interview all eligible women. For example, data collection during market days, funeral days or some campaign days can miss several women of reproductive age. Proper call-backs are therefore needed to capture all these women. Full birth history for mortality measurement is subject to an inherent completeness error due to the fact that only surviving women are interviewed during the survey and therefore child deaths from mothers who also died are not picked up. Since the risk of death of a child is increased by the death of the mother, mortality rate estimated from full birth history can be biased downward and estimated trends can also be distorted. However given

low level of adult mortality, the level of underestimation can be negligible, except in settings seriously affected by HIV. Studies have proposed correction to mortality level and trends in settings with generalized HIV prevalence (Walker et al, 2012?).[6]

ii. Full birth history data are particularly vulnerable to event omission. This occurs when respondents omit to report some births and deaths during the interview, either voluntarily or because of recall issues. In general, deaths, especially early deaths, are more likely to go unreported than births, thus leading to serious under-estimation of mortality rates. A well conducted full pregnancy history may reduce the risk of omission of early death. It is also believed that the degree of omission in full birth history surveys increases for periods that are further back from the date of the survey.

iii. Substantial missing of responses for key questions such as date of birth and age at death will affect estimated mortality rates. Date of birth allows the assignment of birth to specific period of interest and age at death is necessary to identify the type of mortality group to place the death. Imputation procedures are often used to deal with missing information but they are not satisfactory when the proportion missing is substantial and cases with missing information are substantially different from other cases. For example, information on date of birth (month and year of birth) is likely to be missing for children who died than for those surviving. The resulting consequence is the underestimation of the mortality rates.

(b) *Accuracy of information*: date of birth and age at death information collected can be inaccurate due to recall errors from the respondents or interviewer errors. Errors in reporting date of birth and age can result in substantial under or over-estimation of mortality rates.[7] Commonly well documented reporting errors include age misreporting resulting in heaping at age with preferred digits, age displacement resulting in pushing out eligible women from eligibility age range, date of birth misreporting resulting in transference of births from one period to another. During household member listing to identify eligible women, it has been noted that interviewers may push out girls aged 15-19 to the lower age range 10-14 or women aged 45-49 to the upper age range 50-54 to avoid additional interviews. For surveys that include additional modules (e.g. health modules in DHS survey) for specific target group of children such as children born in the past five years, it has also been noted that interviewers transfer births from the age group interest to earlier age groups in order to reduce the workload. For the specific cases of children born in the past five years that are targeted for the health modules in DHS programs, births are typically transferred from the five years prior to the survey to the earlier, a phenomenon termed “birth transference”. These transfers can seriously affect estimated mortality rates especially when it occurs between baselines and endline periods defined for the program evaluation.

(c) Sampling errors: sampling errors consist of errors introduced by randomly selecting a particular sample. This is inherent to every survey and can only be reduced by increasing the size of the sample. For evaluation of the ICCM, it is essential that sample size be carefully computed to obtain precise mortality estimates. This requires that sample size considerations must be taken into account in the design of the evaluation to ensure that the sample is powered appropriately to detect the desired or

hypothesized changes in mortality. Unfortunately, a key challenge is that needed sample sizes can be very large, especially in low mortality settings and when the measurement period is short.

The full birth history Questionnaire

It is essential that when planning to conduct a household survey with full birth history, standard questions used by prior national surveys and well accepted at global level be used to not only ensure comparability of results but also to be able to use lessons learned from prior surveys. In the context of the evaluation of the ICCM program, we recommend adopting the birth history modules implemented by the DHS program because these modules and interview approach have been tested and improved for the past three decades. Table 1 and 2 below show modules of summary and full birth history respectively, excerpted from the DHS core questionnaires.[8] An increasing number of survey designs use Computer Assisted Personal Interviews (CAPI) for data collection. Data are collected directly on Personal Digital Assistants (PDAs), tablets, or laptops. The CAPI approach presents several advantages including automated checks and quality control during interviews and the ability to explore and correct the datasets in real time while the survey teams are still in the field. Nevertheless, this does not remove the necessary need for intensive training, close field supervision and data editing. Whether one choses a paper-based questionnaire or a CAPI questionnaire, the questions must strictly follow the same wording and structure and stringent quality assurance implemented. In settings where the questionnaires are translated into local language, translated questionnaires must be well pilot-tested to ensure accuracy in the translation and the understanding of the questions by respondents.

Table 1: Model summary birth history module

SECTION 2. REPRODUCTION

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
201	Now I would like to ask about all the births you have had during your life. Have you ever given birth?	YES . . . . . 1 NO 2	→ 206
202	Do you have any sons or daughters to whom you have given birth who are now living with you?	YES . . . . . 1 NO 2	→ 204
203	How many sons live with you? And how many daughters live with you? IF NONE, RECORD '00'.	SONS AT HOME . . . . . [ ][ ] DAUGHTERS AT HOME . . . . . [ ][ ]	
204	Do you have any sons or daughters to whom you have given birth who are alive but do not live with you?	YES . . . . . 1 NO 2	→ 206
205	How many sons are alive but do not live with you? And how many daughters are alive but do not live with you? IF NONE, RECORD '00'.	SONS ELSEWHERE . . . . . [ ][ ] DAUGHTERS ELSEWHERE [ ][ ]	
206	Have you ever given birth to a boy or girl who was born alive but later died? IF NO, PROBE: Any baby who cried or showed signs of life but did not survive?	YES . . . . . 1 NO 2	→ 208
207	How many boys have died? And how many girls have died? IF NONE, RECORD '00'.	BOYS DEAD . . . . . [ ][ ] GIRLS DEAD . . . . . [ ][ ]	
208	SUM ANSWERS TO 203, 205, AND 207, AND ENTER TOTAL. IF NONE, RECORD '00'.	TOTAL BIRTHS . . . . . [ ][ ]	
209	CHECK 208: Just to make sure that I have this right: you have had in TOTAL _____ births during your life. Is that correct? YES ↓ NO → PROBE AND CORRECT 201-208 AS NECESSARY.		
210	CHECK 208: ONE OR MORE BIRTHS ↓ NO BIRTHS →		→ 226

Source: ICF International. 2011.
http://www.measuredhs.com/publications/publication-DHSQ6-DHS-Questionnaires-and-Manuals.cfm

Table 2: Model summary birth history module

211 Now I would like to record the names of all your births, whether still alive or not, starting with the first one you had.
RECORD NAMES OF ALL THE BIRTHS IN 212. RECORD TWINS AND TRIPLETS ON SEPARATE ROWS.
(IF THERE ARE MORE THAN 12 BIRTHS, USE AN ADDITIONAL QUESTIONNAIRE, STARTING WITH THE SECOND ROW).

212 What name was given to your (first/next) baby? RECORD NAME. BIRTH HISTORY NUMBER	213 Is (NAME) a boy or a girl?	214 Were any of these births twins?	215 In what month and year was (NAME) born? PROBE: When is his/her birthday?	216 Is (NAME) still alive?	217 IF ALIVE: How old was (NAME) at his/her last birthday? RECORD AGE IN COM-PLETED YEARS.	218 IF ALIVE: Is (NAME) living with you?	219 IF ALIVE: RECORD HOUSE-HOLD LINE NUMBER OF CHILD (RECORD '00' IF CHILD NOT LISTED IN HOUSE-HOLD).	220 IF DEAD: How old was (NAME) when he/she died? IF '1 YR', PROBE: How many months old was (NAME)? RECORD DAYS IF LESS THAN 1 MONTH; MONTHS IF LESS THAN TWO YEARS; OR YEARS.	221 Were there any other live births between (NAME OF PREVIOUS BIRTH) and (NAME), including any children who died after birth?
01	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 → 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (NEXT BIRTH)	DAYS . . . 1 MONTHS 2 YEARS . . 3	
02	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 → 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH
03	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 → 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH
04	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 → 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH
05	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 → 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH
06	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 → 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH
07	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 → 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH

Source: ICF International. 2011.
http://www.measuredhs.com/publications/publication-DHSQ6-DHS-Questionnaires-and-Manuals.cfm

Selection of fieldworkers, training and deployment

The number of fieldworkers and survey teams required to complete the survey depends on the context, the overall length of the questionnaires, the expected duration and the size of the survey. However, these numbers must be limited to the maximum number than can be controlled and supervised without jeopardizing the quality of the survey. In every case, careful assessment must be conducted during pretest of survey instruments to determine the duration of an interview in order to estimate the total number of questionnaires that an interviewer can reasonably complete in one day, without rush or exhaustion. The duration of the summary and full birth history modules will depend on the education level of the respondent, and her number of children ever born. It can range from ten minutes to over thirty minutes. A survey team can typically be composed of 3-4 interviewers, a supervisor, an editor and a driver.

The duration of training will depends on the various modules in the questionnaires and should be determined to ensure that fieldworkers learn thoroughly the questions, the fieldwork and quality assurance procedures and field-practice the questionnaires sufficiently to independently administer them with minimum supervision. Several days should be allocated to the training on the summary and full birth history modules during which in-depth practice of interviewing techniques including probing for date of birth and age at death determination are mastered. In several settings a companion calendar of significant events in the country history is used to increase recall of dates and age. In addition, a card can also be provided to fieldwork to aid in age determination based of date of birth or vice versa.

Typically surveys that include CAPI will have a longer training duration given the time it will take for the fieldworkers to master the computer applications, the CAPI questionnaires and the field data transfer procedures.

Sampling size

Sample size calculation for ICCM mortality impact evaluation must take into account the hypothesized effect of the program over the implementation period. Estimated sample size would therefore be powered to detect this effect as statistically significant based on the adopted design. Unfortunately, the sample size will typically be large given that mortality is generally a rare event. It will be even larger the shorter the measurement period and the smaller the expected mortality change. As an an example, table 3 shows estimate of sample size of households needed to detect specific

Table 3: Estimate of sample size needed to detect a significant change between baseline and endline in intervention arm

Percent change to detect as significant between baseline and endline	Estimated sample size of households (Three-year period)
10	39,129
15	17,109
20	9,466
25	5,954
30	4,063

Sample size based on following assumptions: Baseline U5MR = 100 per 1000; Average household size = 5; Crude birth rate =36 per 1000; Design effect = 1.5; power = 80%
Sample size based on three-year mortality rate

changes between baseline and endline as statistically significant. As can be seen the sample size increases rapidly with smaller changes. Sample size computation will depends also on the type of impact analysis being planned. It must also be kept in mind that assumption large changes in mortality may also be unrealistic and unachievable. Determination of the expected change in child mortality based on baseline health coverage level and expected coverage targets can be conducted using a tool like the Lives Saved Tool (LiST).

Summary

Household surveys with full birth history present comparative advantages over existing data sources for mortality measurement to demonstrate the impact of the ICCM program. However the quality of the data collected is largely dependent on the quality of training and supervision of fieldworkers and the adherence to the standard tools and procedures for data collection as implemented through international standard survey programs such as DHS and MICS. Partners planning to conduct mortality impact assessment must strictly adhere to such procedures to ensure high data quality and comparability of the resultant child mortality rates with similar other surveys conducted in other settings or with national surveys.

References

1 For more information on demographic surveillance systems, consult In-depth Network website at http://www.indepth-network.org/

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