Causal analysis and the SQUEAC toolbox  
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Background

In this article we report our experiences using the SQUEAC toolbox to undertake a causal analysis of severe wasting (SAM) in a rural area of Eastern Sudan. The work reported here took place during a trainers-of-trainers course in SQUEAC and SLEAC coverage assessment methods. The course was organised by UNICEF and held in the city of Kassala in Eastern Sudan in September 2011. Course participants were drawn from UNOs, NGOs, and state and federal ministries of health. None of the course participants had prior experience with SQUEAC, SLEAC, or CSAS coverage assessment method.

A semi-quantitative model of causal analysis model was proposed and tested. The elements of this model are outlined in Figure 1. It is important to note that many of the activities required to undertake the causal analysis are existing SQUEAC activities or extensions to existing SQUEAC activities.

The approach used SQUEAC tools to identify risk factors and risk markers for subsequent investigation by case-control study. A case-series was compiled using data from in-depth interviews with carers of thirty-three current and recovering SAM cases attending CMAM sites or in their own homes (i.e. for current SAM cases found during SQUEAC small-area surveys). This data was supplemented by routine monitoring data, data extracted from beneficiary record cards, and data collected from clinic staff, community health workers, community-based volunteers, community leaders, traditional health practitioners, and traditional birth attendants using a variety of methods. Data were validated using triangulation by source and method and sampling to redundancy.

The collected data were used to generate hypotheses relating to SAM causality to be tested using a case-control study that was nested inside the SQUEAC likelihood survey. A matched case-control design was proposed and tested as this requires a smaller sample size than an unmatched design for the same statistical power. Matching was done on location and age. Cases were children aged between six and fifty-nine months with a mid-upper-arm-circumference (MUAC) below 115 mm and / or bilateral pitting oedema. Controls were near neighbours of cases and of similar age (i.e. within ± three months) with a mid-upper-arm-circumference greater than or equal to 115 mm without bilateral pitting oedema. Data were collected on 35 sets of matched cases \( n = 35 \) and controls \( n = 78 \).

Collection of causal data using the SQUEAC toolbox

Trainees had no difficulty collecting case-histories from the carers of SAM cases in the program and from carers of non-covered SAM cases found in the community during SQUEAC small-area surveys and in treating the collected data as an epidemiological case-series. Trainees also had no difficulty collecting causal information from a variety of informants (e.g. medical assistants, CBV, TBAs, THPs, village leaders, &c.) using informal group discussions, in-depth interviews, and semi-structured interviews. They also had no difficulty in collating and analysing the collected data using concept-maps and mind-maps (see Figure 2). Trainees had little difficulty expressing findings as testable hypotheses. These are all core SQUEAC activities. Trainees selected potential risk factors and risk markers for further investigation with minimal intervention from the trainer.
Translation of findings to data collection instruments

Some trainees had difficulty in designing instruments (i.e. question sets) to test stated hypotheses. The problem appeared to be in formulating unambiguous questions and in breaking down complex questions into small sets of simple linked questions. Future development work should explore whether role-playing might help with this activity. Trainees found little problem identifying, adapting, and using predefined question sets (e.g. for a household dietary diversity score and for IYCF practices) when these were available. Future development work should focus on building a library of pre-tested and ready-to-use questionnaire components likely to be of use. Trainees had little difficulty field-testing their data collection instruments and adaptations were made and tested in the field and again at the survey office.

Case-finding and questionnaire management

Trainees quickly developed the skills required for active and adaptive case-finding (this was expected from previous SQUEAC trainings). Identification of matched controls was performed well under minimal supervision. The management of questionnaires for a matched case-control study was also performed well under minimal supervision.

Applying the case-control questionnaire to cases, identifying appropriately matched controls for each case, applying the case-control questionnaire to controls, and the management of study paperwork added a considerable data-collection overhead above that already required by the SQUEAC likelihood survey. It is estimated that surveyor workload for the likelihood survey may increase by 50% or more.

Data-entry and data-checking

Great difficulty was experienced and much time wasted working with EpiInfo for Windows. This software proved both difficult to use and unreliable. Data were lost on two occasions. Switching to EpiData proved necessary. This software proved much easier to learn and use. Future development work should use a simple and reliable data-entry system such as EpiData. This software can be run from a USB flash drive and does not require software to be installed.

Data-Analysis

No attempts were made to teach the details of the techniques required for data-management and data-analysis. This component was not tested because the computers available were configured so as to prevent the installation of software (the intention had been to test this activity using a free student version of major commercial statistics package). Data were analysed using the MSDOS version of EpiInfo (v6.04d) and the cLogistic add-in software. This command-line driven software may not be suitable for use by workers used to using more graphical software. The process of data analysis (i.e. conditional logistic regression with backwards elimination of non-significant variables) was demonstrated to a local supervisor with some experience with the analysis of cross-sectional survey data (e.g. SMART, IYCF, MICS). He managed to replicate the demonstrated analysis using EpiInfo and cLogistic. He later demonstrated the analysis to the trainee group and independently reproduced the analysis using STATA. The results of the analysis (from cLogistic) are shown in Figure 3.

Further work is required to identify useful software and to develop a practical manual including worked examples. The manual could be a self-paced programmed learning course. This would allow both self-teaching and classroom-based teaching. The manual should cover data-entry and checking, data-management, data-analysis, and reporting.
Summary

The data collected in this exercise were sufficient to identify risk factors and risk markers (i.e. diarrhoea, fever, early introduction of fluids other than breastmilk – a marker for poor IYCF practices) that were significantly associated with SAM. This suggests that it is possible to use the SQUEAC toolbox to collect causal data using the level of staff selected for training as SQUEAC supervisors and trainers. Data analysis may, however, require staff with a stronger background in data-analysis.

Consideration should be given as to whether a case-series or set of case-reports collected from carers of cases in a CMAM program and non-covered cases found in the community during SQUEAC small-area surveys could provide a useful causal analysis. Collected data could be organised and presented using a mind-map (as in Figure 2). This would be a simpler and cheaper than a case-control study and would probably be more robust than currently utilised methods which tend to use a single round of focus groups (typically excluding carers of SAM cases) and a “problem-tree” analysis.

The work reported here supports the further development and testing of the proposed model for a causal analysis add-in to SQUEAC. This article is intended to inform the emergency and development nutrition community of our experiences with this model so as to allow us to judge the level of interest in further development of the method.
Figure 1: The proposed model of causal analysis

Case-histories, in-depth interviews, and group discussion with carers of SAM cases

Semi-structured interviews with MoH, clinic Staff, and CHWs

Group discussions with CHWs, CBVs, and community leaders

In-depth interviews with THPs / TBAs

Semi-quantitative analysis

Data extracted from beneficiary record cards

Routine monitoring data

Time / Place / Person

Host / Agent / Environment

Folk terms

Folk Aetiologies

Local Aetiologies

Treatment seeking behaviour

CAUSAL ANALYSIS

Matched Case-control study

Report of semi-quantitative analysis

Report of quantitative analysis

Existing SQUEAC activity

Additional activity for causal analysis
Figure 2: Mind map of potential risk factors and risk markers for severe wasting created using standard SQUEAC tools
This analysis shows that diarrhoea (DIA) and fever (FEVER) are strongly and positively associated with SAM. The variable FLUID is the age (in months) at which the mother reports that fluids other than breastmilk were introduced into the child's diet. Increasing age is negatively associated with SAM (i.e. early introduction of fluids other than breastmilk increases the risk of SAM).

Analysis of other data that were collected during the case-control study revealed that c. 63% of carers whose child had a recent episode of diarrhoea had (inappropriately) restricted the intake of both fluids and solids.

This analysis suggests the following interventions:

- Promotion of ORS
- Promotion of hand-washing and other hygienic practices
- Improved provision of antimicrobials at PHC facilities
- Increasing water availability (supporting hygiene promotion)
- Promotion of appropriate IYCF practices