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An electronic register for vital registration in a rural village with no electricity in Malawi

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Setting: Chalasa village, Traditional Authority Mtema, Lilongwe District, Malawi.
Objectives: To report on the deployment of an electronic register in a rural village with no electricity. Specific objectives were to document 1) challenges in setting up the electronic village register (EVR); 2) demographics of village residents, along with births and deaths over three quarters; and 3) the costs of setting up the system.
Design: A descriptive study.
Results: The main challenges were slow adoption of the EVR by the village headman, lack of health passports for village residents, double counting of some residents and difficult connectivity. These challenges were overcome. In terms of data, of 790 village residents, 379 (48%) were male, 417 (53%) were aged <15 years and 29 (3.6%) ≥65 years. From April to December 2013, there were 18 births and 5 deaths. The cost of the EVR, including maintenance costs for 12 months, was US$6210.
Conclusion: An EVR was successfully deployed in Chalasa village, rural Malawi, and data on the resident village population, along with quarterly births and deaths, are now available. This is the first step towards a village-level civil registration system in rural Africa.

Most people in Africa and Asia are born and die without appearing in any legal record or official statistic, and the situation has generally remained unchanged for the last 50 years.[1] This is in stark contrast to what happens in industrialised nations, where the systematic recording of births and deaths, known as vital registration, is a core component of public health, helping to formulate, plan, implement and evaluate health and social policies.

In the absence of well-developed birth and mortality statistics from routine health information systems, surveys have mainly been used to capture this type of information.[2,3] In Malawi, for example, the main sources of birth and mortality data have been population censuses carried out every 10 years, demographic health surveys (DHS) every 4 years and disease-specific surveys such as the Malaria Indicator Survey.[3] Between these surveys, birth and death rates are estimated.

In 2007, the Government of Malawi, through the National Registration Bureau (NRB), introduced a national registration system that is devolved to districts using paper-based village registers to record information on the number of persons living in a village, new births and deaths. Each village has a register and the responsibility for completing and safeguarding the register lies with the village headman. Registers are a potential source for obtaining vital registration statistics. The NRB information flow architecture was designed to be in line with the district commissioner's village activities. The NRB looked at this arrangement as an opportunity for collating the information in the village register. However, an operational research study conducted in nearly 300 villages serving a population of 150 000 in Zomba District showed first that the recording of births and deaths was inaccurate, and second that the collation and analysis of data from villages up to traditional authorities and then up to the district commissioner was almost impossible due to poor infrastructure, lack of intermediary human resources and inadequate transport.[4] A potential solution to the problem of collation and analysis of village-level data was to develop and deploy an electronic register at the village level so that data could then be collected and transmitted through existing cellular phone networks or wireless communication links from village headmen, to group village headmen, to traditional authority chief, to district commissioner, and at the same time shared with health facilities.

The first challenge was to deploy and use an electronic register in a rural district of Malawi where there is no established electricity supply. The aim of this study was to report on the deployment of the electronic village register (EVR) in a rural village. Specific objectives were to document and report on 1) the challenges of setting up the EVR; 2) village demographics, along with new births and deaths, over three quarters; and 3) the costs of setting up the system.

METHODS

Study design

This was a descriptive study.

Setting

General setting

Malawi is a small country in Central Africa with an estimated population of 16.5 million and a nominal per capita gross domestic product of US$250. The country is divided into five health zones and 28 districts. The district of Lilongwe, where the capital city is located, is divided into 18 traditional authorities, with a total of 221 group village headmen and 2234 villages, each with a village headman.[5] The established system is for village headmen to report to their group village headman, who in turn reports to the Traditional Authority (TA) Chief. These chiefs report to the District Commis-

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sioner, who is the officer in charge of local government in each district.

Site setting

The study site is Chalasa village, situated within the TA Mtema. The TA Mtema has an estimated population of 65 000, with nine group village headman and 85 villages, including Chalasa village. The whole of the TA is poor and with no electrical power supply.

Village registers

Each village is under the control of a village headman; current demographic details of the resident population (name, sex, date of birth, place of birth, names of parents or guardians, place of residence, birth certificate number [if available], date of death and other details), new births and deaths are recorded in the paper-based village register. All new births and any deaths are reported to the village headman. The motivation for this is that if the baby dies and the birth has not been reported then no plot for the burial will be provided unless a fine is paid for failing to notify the birth. The same situation applies to a death: this must be reported to the village headman so that a plot for burial is provided – failure to do so results in paying a fine. Village headmen in TA Mtema have struggled to keep the paper registers in good shape. Registers have been damaged by water, and others have been eaten by termites despite being kept in plastic bags.

Deployment of the electronic village register in Chalasa village

Before designing the EVR system, a situational analysis was conducted to better understand the challenges and opportunities of such a system in the village setting. The absence of power, low literacy levels among village headmen and the lack of computer skills were identified as potential barriers to implementation. To address the absence of computer skills, a touchscreen computer was chosen over a traditional mouse and keyboard approach. This has been shown to work well in health care settings in Malawi.[6,7] To accommodate low literacy rates, the user interface was developed in the local language of Chichewa. Software was designed for the touchscreen to provide registration functions in a stepwise approach that was both easy to learn and easy to use. The absence of power was addressed using solar power. The entire system is powered by a deep-cycle battery, which is charged using a solar panel mounted on the roof of the village headman's house. The power installation allowed for the addition of lighting through a single light bulb in the village headman's home. This represented a small extra cost overall, but was perceived by the village headman as greatly valuable and an additional incentive for the installation and use of an EVR.

The software was designed and developed by a local team of software developers from the Baobab Health Trust (BHT), Lilongwe, Malawi. The touchscreen computer, thermal label printer and barcode scanner were available in the region and were purchased off the shelf. BHT is currently supporting electronic medical record systems at more than 50 health facilities in all districts in Malawi, and this experience provides the logistics for supporting EVR work.

The selection of hardware for the EVR was guided by the need for low power consumption and robust design. The touchscreen computer chosen for this application is manufactured primarily for use in retail settings and restaurants as a point-of-sale device. As the paper-based register was incomplete, it was decided that all residents in the village would have to visit the village headman and have their details entered into the EVR. Each member of the village had his/her details entered in the EVR and the person was

FIGURE 1 Village headman sitting registering a person from the village in the computer.

then issued with a nationally unique health ID number that was represented on a barcode and printed on an adhesive label, which was then stuck onto the member's health passport. The presence of a demographic record in the EVR enables search and re-issue of the adhesive label for a new health passport in case of loss or damage to the passport.

The situational analysis had shown that most village residents had a health passport, a patient-kept medical record booklet issued by the Ministry of Health.[6] This presented an opportunity to adapt the emerging tool for issuing unique patient ID numbers in the country as a platform for documenting village residents in the EVR. Harmonising the EVR with the national patient ID system had several advantages. First, many village residents already had a national patient ID number issued to them during a visit to a nearby health centre. This eliminated the step of recording the demographic details for the village headman, allowing him to simply scan the barcode on the health passport and 'import' the information directly into the EVR. Second, more than two thirds of the births in a Malawi community take place at a rural health centre.[8] By linking the EVR with the national patient ID system, births are captured automatically, and need only be certified by the village headman. This also provides both a necessary link to the National Health Management Information System and an opportunity to link health outcomes to the respective communities or villages for surveillance purposes.

Deployment of the EVR system started in March 2013. The wiring of the house and installation of the equipment took 4 days to complete, followed by a 5-day training session. Figure 1 shows the village headman sitting at the computer registering patients and Figure 2 shows the user interface and main menu page.

Study population

The study population included all persons resident in Chalasa village, Lilongwe District, registered in the EVR, and all new births and deaths that occurred at quarterly intervals from April to December 2013.

Data variables and analysis

Data variables for the study were obtained from the EVR, and included numbers of males and females resident in the village, stratified by age group, and new births and deaths that occurred

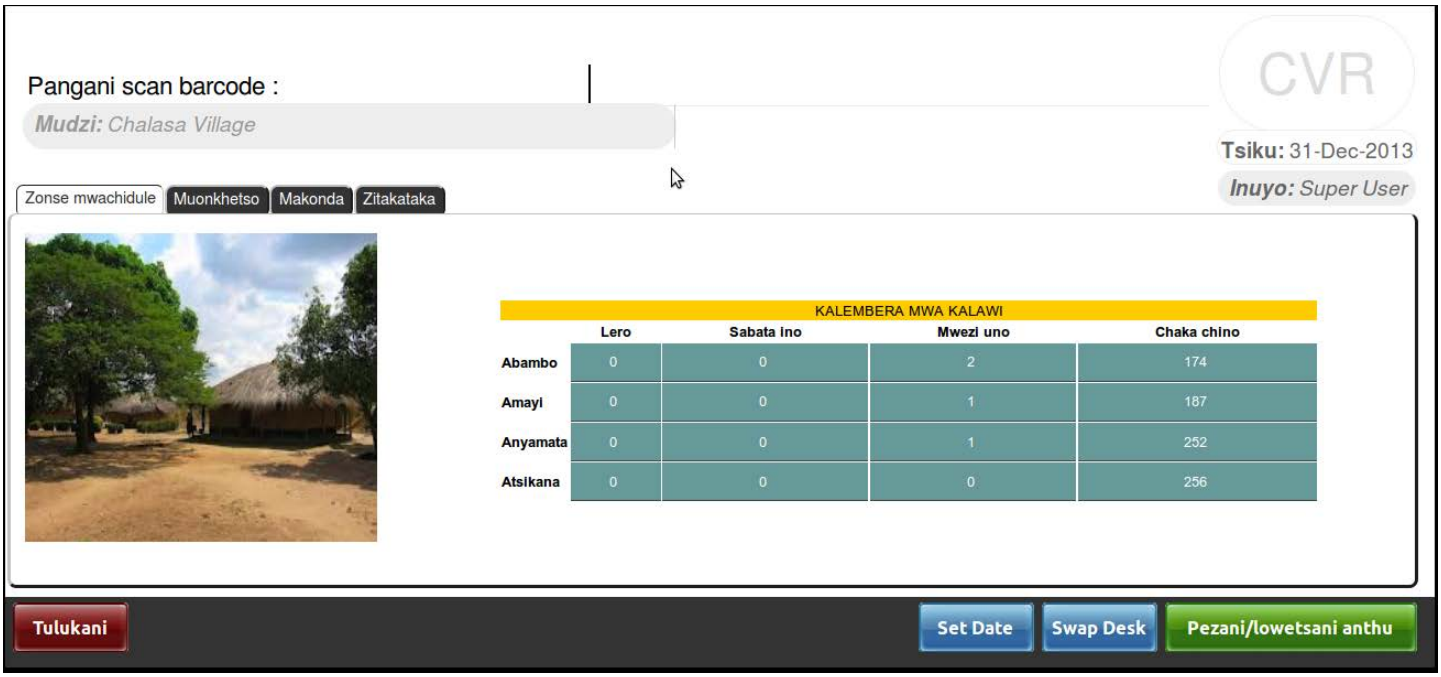

FIGURE 2 Computer user interface and main menu page.

in each quarter between April and December 2013. The costs of implementing the EVR and the estimated annual costs of maintenance were obtained from the BHT record systems. A descriptive analysis was performed.

Ethics

The deployment of the EVR was agreed upon and authorised by the Malawi NRB, and was not regarded as research. Nevertheless, permission to use, report and publish the collected data was obtained from the Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease, Paris, France, and approval to conduct a pre-technology assessment was sought from the Malawi National Commission of Science and Technology, Lilongwe, Malawi.

RESULTS

Challenges with deploying the electronic village register

Several challenges were encountered when deploying and making the EVR system operational. First, adoption of the EVR was slow at the beginning, resulting in incomplete village registrations. Furthermore, the village headman believed that the EVR was complete based on the number of village residents in the EVR roughly matching the number in his paper register. However, following a house-to-house survey conducted in October 2013, it was found that 200 village residents had not yet been recorded in the EVR, and these persons were entered in October and November 2013. Some of these village residents were not citizens of the village and were thus not recorded in the paper-based village register or in the EVR, consistent with NRB policy. However, other residents were citizens but had not had their records entered into either the electronic or the paper-based village register.

Second, many village residents in the area where the system was being piloted did not have health passports. This contrasted with the findings during the situation analysis, where the majority of village residents indicated that they had health passports. Passports were purchased and issued to village residents.

Third, the literacy level of the village headman was low. This necessitated selected literate members from the village headman's clan being trained in the use of the touchscreen computer. This impacted the speed of registering residents of the village, as the clerk who was responsible for the task was also assigned other duties by the chief.

Fourth, some residents were registered twice in the system in an attempt to correct data entry mistakes, mostly around spellings of names. Duplications were identified and corrected.

Fifth, the system required that the EVR be connected to a central level in order for data to be aggregated and passed to the group village headman, then to the traditional authority and then to the District Commissioner. Establishing a line of site connection between Chalasa village and the TA proved challenging.

Village population, births and deaths

By the fourth quarter of 2013, the number of residents in the village, stratified by age and by sex, had been entered into the EVR (Table 1). There were 790 residents, of whom 379 (48%) were male. Almost 53% of the village population was aged <15 years, and fewer than 4% were aged ⩾65 years. The numbers of new births and deaths in each quarter from April to December 2013, which had been recorded in the EVR, are shown in Table 2.

Costs of installing the electronic village register

The costs of setting up the EVR, stratified by equipment costs, installation costs and the estimated annual cost of maintenance, are shown in Table 3. The total cost, including a 12-month cost for maintenance, was US$6210.

DISCUSSION

This is the first report from Africa of an EVR being set up in a rural village with no electricity with the prime purpose of collecting demographic information about the resident village population

TABLE 1 Persons resident and alive in Chalasa village, Malawi, and registered in the electronic register by the fourth quarter of 2013 by age group

Age group, years	Male *n*	Female *n*	Total *n* (%)
<1	10	16	26 (3.3)
1–4	71	58	129 (16.3)
5–14	126	136	262 (33.2)
15–24	50	73	123 (15.6)
25–34	46	53	99 (12.5)
35–44	29	27	56 (7.1)
45–54	21	15	36 (4.6)
55–64	9	21	30 (3.8)
65–74	6	8	24 (3.0)
⩾75	1	4	5 (0.6)
Total	379	411	790

TABLE 2 New births and deaths in Chalasa village, Malawi, in quarters 2–4, 2013

	Male	Female	Total
Quarter 2: April–June 2013			
New births	1	1	2
Deaths	2	0	2
Quarter 3: July–September 2013			
New births	3	7	10
Deaths	3	0	3
Quarter 4: October–December 2013			
New births	3	3	6
Deaths	0	0	0

TABLE 3 Costs of setting up the village electronic register, Chalasa village, Malawi

Costs of installing the village electronic register	Costs $US
Equipment: subtotal	2760
Touchscreen computer (J2-225, J2 Retails Systems)	720
Thermal label printer (GC420T, Zebra Technologies)	345
Barcode scanner (LS-2208, Symbol)	135
Solar panel	410
Deep-cycle battery	400
Power converter	300
Home lighting	150
Miscellaneous wiring	300
Installation costs: subtotal	2900
Transport	400
Human resources	1500
Other	1000
Maintenance on annual basis: subtotal	550
Total	6210

and new births and deaths in the village each quarter. Despite several challenges, the system was made operational over a period of 9 months, with all residents entered into the system and births and deaths recorded on a quarterly basis.

The concept and installation of the hardware and software was simple—solar power and a deep-cycle battery to provide the electricity not only for the computer but also for the electric light bulb in the village headman's house, which was perceived by the headman and the village as an added bonus; a touchscreen computer with the user interface developed in the local language to overcome the lack of computer skills; and the identification of a young person in the village headman's clan to act as the village headman's clerk, with sufficient education to be able to accomplish the task of entering demographic, birth and death data and generating electronic quarterly reports.

The costs of setting up the EVR amounted to just over US$6000, with an estimated US$550 for annual maintenance. While this may appear substantial, it has to be balanced against the difficulties and high costs of transportation and logistics of running a paper-based system, which has been shown not to work.[4]

This is the first step in a long journey to determine whether a civil registration system can be set up at grassroots level. Many believed that an EVR would not feasible in such a setting, but with the unfailing support of the Malawi NRB, we have shown that it can indeed work. However, there are several challenges ahead. First, we need to show that the EVR in Chalasa village is sustainable, that it will be used by the village headman and his clerk and that it can function with the level of supervisory support envisaged. Second, we are in the process of installing EVRs, with either a computer touchscreen interface or tablet interface, in eight other villages that will connect with three group village headman villages and then to the TA chief. We plan to have this operational by mid-2014, with data on resident populations, births and deaths collected, transmitted, aggregated and further transmitted up to the TA level on a quarterly basis. If this can be made to work, we will have a viable system of counting births and deaths and abolishing the current scandal of invisibility of the world's poor.[1,9] Third, once we have ensured that the counting is accurate, we will need to try and determine causes of death among adults,[2,10] pregnant women[11] and children.[12] This will require formal research around the use and accuracy of verbal autopsies conducted at the village level.

In conclusion, an EVR has been deployed in Chalasa village, Malawi, where there is no electricity. Over a period of 9 months, several challenges were overcome and we were able to electronically report on the resident population of the village, along with quarterly births and deaths. This is the first step towards a civil registration system functioning at the village level in rural Africa.

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Contexte : Village de Chalasa, autorité traditionnelle de Mtema, district de Lilongwe, Malawi.
Objectifs : Rapport sur le déploiement d'un registre électronique dans un village rural sans électricité. Les objectifs spécifiques consistaient à documenter 1) les défis de l'installation de ce registre électronique villageois (EVR), 2) la démographie des habitants du village, notamment en termes de naissances et décès pendant trois trimestres, et 3) le coût de l'installation.
Schéma : Etude descriptive.
Résultats : Les défis principaux ont été la lente adoption de l'EVR par le chef de village, l'absence de cartes de santé des habitants du village, les doubles comptages de certains habitants et les difficultés de connexion. Ces défis ont cependant été surmontés. En termes de données, sur 790 habitants dont 379 (48%) étaient des hommes, 417 (53%) avaient <15 ans et 29 (3.6%) avaient ⩾65 ans. D'avril à décembre 2013, il y a eu 18 naissances et 5 décès. Le coût de l'installation et de la maintenance du registre pendant 12 mois s'est élevé à 6210$US.
Conclusion : Un EVR a été installé avec succès dans le village de Chalasa, dans le Malawi rural et il fournit maintenant des données sur la population du village ainsi que sur les naissances et les décès survenant chaque trimestre. Ceci constitue la première étape vers un système d'enregistrement d'état-civil villageois dans l'Afrique rurale.

Marco de referencia: La aldea de Chalasa en la autoridad tradicional de Mtema, en el distrito de Lilongwe en Malawi.
Objetivo: Presentar un informe sobre el despliegue de un registro electrónico en una aldea rural que carece de fuentes de suministro eléctrico. Los objetivos específicos fueron documentar: 1) los obstáculos encontrados en la puesta en marcha del registro electrónico en la aldea (EVR); 2) las características demográficas de los residentes, además de los nacimientos y las defunciones durante tres trimestres; y 3) los costos de instalación del sistema.
Método: Fue este un estudio descriptivo.
Resultados: Los principales obstáculos en la puesta en marcha del proyecto fueron la lentitud en la adopción del EVR por parte del jefe de la aldea, la falta de pasaportes sanitarios de los residentes, la doble contabilización de algunos habitantes y el difícil establecimiento de la conectividad. Estas dificultades se superaron. Según los datos obtenidos, la aldea contaba con 790 residentes, de los cuales 379 eran de sexo masculino (48%), 417 tenían <15 años de edad (53%) y 29 tenían ⩾65 años (3,6%). Entre abril y diciembre del 2013 se presentaron 18 nacimientos y 5 defunciones. El costo del registro electrónico de la aldea, incluidos los costos de mantenimiento durante 12 meses, fue de 6210 dólares estadounidenses.
Conclusión: Se logró introducir un EVR en la aldea de Chalasa, en una zona rural de Malawi y en la actualidad se cuenta con datos sobre la población de la aldea e información trimestral sobre los nacimientos y las defunciones. Esta iniciativa constituye el primer paso hacia el establecimiento de un sistema de registro civil a escala de la aldea en las zonas rurales de África.

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