Computing Technology in Global Humanitarian Research

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Abstract -- **This paper offers a look at computing technology as it supports global research in health, education, governance and other humanitarian domains. Computing technologies include mobile and web platforms for research tools, data collection tools, data coordinating centers that bring global information together for analysis, and more. Subject areas include the study of health behaviors, establishing good practices for sub-governance, interventions for social well-being and evaluating educational levels. The paper discusses in brief the selection and usefulness of specific technologies, some of the challenges involved in research around the world, and the value of the resulting information.**

Keywords – computing technologies, humanitarian, global research, data systems

I. INTRODUCTION

Computing technology underlies much of the activity of the developed world but may be largely absent from research, business, social services, education and daily life in the underdeveloped parts of the world. Often there may be no insurmountable technical or economic barrier to use of computer hardware, software or data systems, and when given appropriate assistance, such as a joint effort for acquisition, setup, training and installation, it is possible for remote or non-technological areas to make a quick jump to advantageous use of computer technology.

Among the domains of research that depend on technological advances in developed countries, the fields of health studies, education, governance and sub-governance achieve benefits from data-based research or operations, and within these many areas of study, researchers rely on a broad range of tools. Data collection and subsequent usage may be facilitated by the use of computers and software for data management, analysis and communications. Technologies used to support such research may include ordinary mobile phones and devices, smart phones, custom software, commercial software or any combination of those. Because of the range and diversity of computing technology, it is easy to overlook its contribution to global research.

In this paper, we present some examples of projects supported by RTI International for various humanitarian research efforts. We do not attempt to offer a comprehensive survey of options or opportunities, but rather we offer a bouquet of possibilities. Each of the projects highlighted here has addressed a particular humanitarian goal through strategic evaluation and selection of hardware, software and data. We present this information as a starting point for other researchers to consider the ways in which their own interests and activities might be achieved better by the inclusion of computing technologies.

II. HEALTH

A. Global Adult Tobacco Survey

Health issues are of fundamental concern to people around the world, and many humanitarian efforts focus on health. Whether health assessment, health intervention, response to catastrophic events, drug or procedure testing, disease control or simply dispensing information, each country has needs and programs for meeting those needs. At the heart of many programs is an information system.

The Global Adult Tobacco Survey (GATS), funded by a coalition of the US Centers for Disease Control and Prevention, Johns Hopkins University's Bloomberg School of Public Health, and the World Health Organization, is an international effort to quantify and track the use of tobacco products [1] in low to middle-income countries with a high smoking rate. Conducted in countries such as India, Turkey, Mexico, Ukraine and Thailand, the survey tracks smoking and smoking-cessation efforts among adults. From 2007 to 2009, the survey was converted from a paper questionnaire to handheld electronic data collection tools, to improve data quality, consistency and ease of information capture. Data collection is continuing, with reports issued already for several countries.

The GATS questionnaire was implemented originally for use on the Hewlett Packard iPaq, through the Generalized Survey System (GSS). The GSS is an XML-based survey-presentation language [2]. For GATS, the sponsoring organizations provide each country with the standard core questionnaire in English, and a simple MS Access-based system for customization by non-programmer staff. Study sponsors within the country arrange for translation to as many native languages as needed, and they can add

country-specific questions to the questionnaire if desired. Because the questionnaire is fundamentally the same across all participating nations, the core response data can be compared through cross-sectional analysis for world-wide trends or findings.

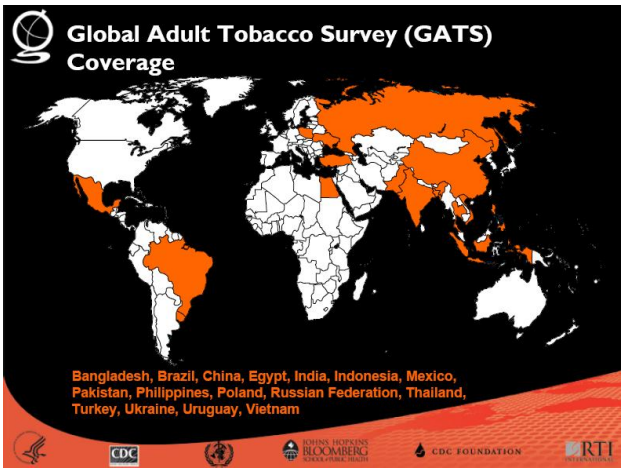

Figure 1 Countries participating in the Global Adult Tobacco Survey

Enabling countries to adopt whatever hardware is readily available, the GSS software now runs on Windows CE, Android and Windows Phone mobile platforms, with data conveyed to central locations through cellular, wireless, internet, landline telephone transmission or through transfer of physical media such as encrypted data cards. The GSS offers GPS capability, table-driven language choices, and currently supports over 30 languages and associated fonts, enabling each country to tailor the survey to its local needs and populations.

B. Cape Town Women's Health CoOp

An example of a different type of health research is found in the Cape Town Women's Health CoOp and its intervention research on HIV-risk behaviors among drug abusers. [3] In this research, a small infusion of technology was coupled with non-computerized methods to allow collection and evaluation of alternatives for reducing HIV risk. Primarily, the study examined whether a group-based intervention or an individual-oriented intervention would be more effective for changing women's HIV-risk behaviors. Secondarily, the study looked at the impact of sociocultural characteristics of the participants, to assess whether the results were generally supported or whether they varied by ethnic identification or type of drug use.

The Cape Town study blended a modest investment of computing and statistical technology with a larger amount of non-technological personal effort. Researchers selected a study sample through computerized statistical algorithms (high tech), collected data through in-person administration of paper questionnaires (low-tech), evaluated results with data analytic software (high-tech), and provided guidance to local social welfare and aid workers in operational terms (low tech). The use of paper questionnaires removed any need for computer access, specialized training or even electricity. In this way, a few computer-equipped researchers could provide the necessary expertise and technological support for a study in an underdeveloped area, which enabled the Women's Health CoOp to evaluate the efficacy of their programs via rigorous scientific methods.

As it turned out, both individual and group interventions were effective in the short term, but groups were both more cost-effective and more likely to lead to formation of long-term relationships among participants. As a side note, the study found evidence that the interaction between drug use and sexual habits underlay the spread of HIV in the region. These findings let the CoOp provide intervention programs at lower cost, with increased effectiveness and confidence that the program could help reduce the spread of HIV.

C. Recipient Epidemiology and Donor Evaluation Study

For certain research, the best approach may require a high degree of technology, providing capabilities that would be unrealistic without the use of digital storage and global communications. Data coordinating centers offer an example of this situation. Like the Cape Town study above, the Recipient Epidemiology and Donor Evaluation Study (REDS) collects data locally and analyzes it centrally. [4] Like GATS, information is being gathered from widespread locations. However, the scale of REDS is vastly greater than that of the Cape Town study, and its treatment as a unified global study differs from the country-run research of GATS.

The REDS study is a multi-site data-gathering effort. Based on local collection and central storage and analysis, REDS began in 1989 as a smaller scale study and will continue through 2018 in the current global format, looking at trends across geography, time and populations, to evaluate blood banking and transfusion practices that affect the spread of disease among blood donors and recipients. Conducted at multiple medical sites in the US, Brazil, China and South Africa, it requires a high degree of collaboration and coordination. Though data collection is just beginning on an international scale, it is believed that the resulting database will serve as the basis for numerous epidemiological, operational and health outcomes investigations.

With such a long timeframe and broad reach, REDS relies on advanced technologies of computer-assisted survey research [5]; global communications

for data transfer; high-powered databases for data storage; data management software for matching, merging and linking; large-dataset statistical analysis; and computerized graphics for reporting. These technological capabilities are combined with medical expertise, laboratory analysis, statistical expertise and other skills to produce the full research package.

III. EDUCATION AND GOVERNANCE

A. Early Grade Reading Assessments

Like health, education is a topic that garners worldwide attention. And as in health research, educational programs may target assessment, intervention, communication, support, infrastructure or other country-specific needs. Humanitarian workers who assist from within or as visitors supported by foreign aid are often faced with needs best met through computing technology.

Many areas struggle to identify children with reading problems. Early-grade reading assessments (EGRA) offer a standardized way to diagnose gaps in reading competencies. Now in use in school systems in over 50 countries and 70 languages, a smartphone-base application introduced in 2006 has helped conduct assessments in a rigorously scientific way. [6]

Figure 2 The Tangerine application

To demonstrate results for policy makers and others, projects must collect adequate data for comparative analysis. A sample of 2,300 is the average size for national baselines, according to the EGRA Tracker on www.eddataglobal.org, and allows countries to examine the impact of interventions. While the traditional forms of assessment are capable of providing good-quality baseline data, the costs are high for management of paper-based administration, including logistics, copies, supplies, and especially of subsequent data entry from the forms, prior to data analysis.

Tangerine™, a mobile software application, was designed by RTI International specifically for recording student responses during oral reading and mathematics assessments. By capturing test results on mobile devices and then synchronizing automatically over Wi-Fi or mobile phone networks to a cloud data storage location, data can be available for analysis with less manual effort, better consistency and faster availability.

The computerized system was tested in Nairobi, Kenya, in early 2012, testing reading ability in English and Swahili as well as competence in mathematics. [7]

Though Tangerine has been optimized for use on Android tablets, with the use of open source, web-browser focused approach, Tangerine works on everything from laptops to e-readers, such as the Kindle, and smartphones such as the iPhone. Technologies such as HTML5 [8] and CouchDB [9] mean that Internet access is not required, but that data can be synchronized automatically with remote cloud databases over a variety of connectivity options including WiFi and mobile phone networks.

B. Citizen Communication with Local Government

The topic of participatory governance has been the subject of extensive study and debate, as it relates to democracy, development, stability and other aspects of society. [10] Though details and opinions differ, it is generally believed that those who are allowed to participate in aspects of the governance of their regions play a more active role and feel more ownership of their society. Yet the level of participation may be limited by lack of means or opportunity to communicate. The rise in cell-phone usage, particularly in developing countries, offers a novel way to encourage participatory governance.

Figure 3 Flier distributed at the launch of the SMS communication system at Olutindo, Uganda

In many areas, residents have had difficulty bringing issues to the attention of local officials. To make it easier for those who live in the Kayunga District in Uganda, district officials devised a new way to enable citizens to notify them of concerns with public services in health, education, or public works. [11] Anyone with a complaint can use Short Messaging Service (SMS) to send a text message

describing the problem, along with their location, such as a village, clinic, or school. The "trouble ticket" is then forwarded to the appropriate district official in the department of health, education, or public works, who can in turn re-contact the sender when the ticket is closed.

For management of the tickets, each district health, education, and public works official is equipped with a small 3G tablet and a simple tracking application. The application was developed using open-source software called Coconut [12], a mobile application tool used for data entry applications. Coconut can be used on smart phones, tablets, and other computers, and can scale from a few to thousands of remote devices connecting to a single server. Recognizing that the tablets may not always be online, though equipped with wireless broadband, data are stored on the device. When a network connection is available, data are synchronized automatically with the remote database. The option for off-line use and later synchronization is particularly useful in areas with intermittent electrical outages, common in many rural areas of Africa.

Through the use of SMS, ordinary cell phones, Coconut and tablets, the project could further its goal of improving communications and promoting participatory governance for better service delivery in health, education and public works. The approach simplified and offered a better alternative for reporting problems and will continue to facilitate local participation as well as governmental response.

IV. CONCLUSION

The reach of humanitarian work is broad, because both the needs and the responses to those needs are diverse. Each humanitarian group attempts in an effective way to address the problems, overcome the challenges, and leave behind a better situation. Whether for health issues, education, governance or any other domain in which one group helps another, computing technologies may be able to help find a better, faster, more reliable or more powerful way to look at the conditions and seek a path to a solution. The examples given above are only a sampling of work that is being supported around the globe for the betterment of individuals, communities and populations.

V. REFERENCES

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