

the number of questions from 30–60 in the original index to 8–18 questions in the new index. The new index has high agreement with the original survey results ($\kappa > 0.75$). The new questions are easier to answer than the original questions, with fewer response options. Data collection has been further simplified through the creation of a phone/tablet-based survey that aggregates and analyzes results.

Outcome & Evaluation: The simplified mobile survey was piloted in India and Colombia where users report satisfaction and ease-of-use. Additional pilots will begin in December 2015.

Going Forward: Our simplified, mobile-version of the DHS wealth asset makes it possible for any social service program to determine the relative wealth of those they are serving through a short client survey, transforming the performance of programs and improving health outcomes. Moving forward we will conduct research to assess the wealth of populations receiving care in a range of facility types using the simplified index and DHS data to contextualize program results.

Funding: Work has been funded by Population Services International, under a grant from USAID, and Metrics for Management, under a grant from the Alchemy Foundation.

Abstract #: 2.034_TEC

Midterm evaluation of health-provider alert functionality in a program of automated telephone monitoring and self-care support for diabetic patients in Colombia

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Purpose: Trials suggest that mobile health (m-health) interventions can improve self-care behaviors and outcomes for patients with diabetes mellitus (DM) [1,2]. Llamada Saludable is interactive voice response (IVR) m-health program used to monitor DM patients and provide self-care education between outpatient visits. The program was implemented in Medellin, Colombia from July–September 2015 in collaboration with the Living Lab Telesalud program at the Universidad de Antioquia and a large insurer for low-income patients (SaviaSalud). In addition to evaluating effects on DM management, this trial assessed the provider alert system with real-time monitoring of patient-reported adverse health events.

Methods: 150 DM patients received weekly, automated calls for 12 weeks. At program entry, patients received education on healthy living and DM symptom management. Patients were informed they would receive a follow-up call from a health professional if their responses indicated a need for additional assistance. During IVR calls, patients answered questions using touch-tone phones, which triggered automated email alerts to clinical staff. Paramedics completed less critical follow-up calls while physicians called insulin dependent patients reporting blood sugar < 90 mg/dl or > 300 mg/dl.

Outcomes and Evaluation: Participants completed roughly 1,300 IVR assessments (72%) and clinicians received 319 email notifications regarding 129 individuals. Although clinicians were concerned about the potential for patients to exploit the alert feature to quickly access a physician, patients expressed reassurance that providers were “accompanying” in their illness. A majority of follow-up (87.5%) included self-care education, while only 6.2% resulted in advising the patient to visit their primary care physician (5.9%) or emergency services (0.3%).

Going Forward: Based on this successful pilot, the Llamada Saludable program is expanding to additional municipalities around Medellin and other chronic diseases (e.g., renal disease, COPD). The functionality of the alert aspect of the program is integral to sustainability and scaling so the system is responsive to adverse health events. Our experience indicates institutions implementing m-health programs with provider-alert feedback mechanisms should consider their role as patient education rather than solely an emergency response system.

Funding: None.

Abstract #: 2.035_TEC

References:

- [1] Piette JD, et al. *Telemedicine and e-Health* 2016.
- [2] Handley MA, et al. *Ann Fam Med* 2008.

Innovating for global health: Study of healthcare technology failure in southern Malawi

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Background: Physicians in low and middle-income countries (LMIC) face many challenges, including overwhelming patient-to-staff ratios, an unstable electric grid, and a general lack of resources. Technology in LMIC often fails, further compounding the difficulty of providing adequate healthcare. Few medical devices are manufactured locally, making equipment problematic to maintain and repair. In 2013, the World Health Organization estimated 70% of medical devices in LMIC are non-functioning, affecting the ability to provide adequate healthcare. Additionally, devices that cannot be repaired locally are placed in “medical device graveyards”, potentially causing adverse long-term health effects due to chronic exposure to electronic waste sites. Therefore, the aim of this study was to establish an understanding of challenges associated with medical device donations, repair, and maintenance in LMIC in order to improve short- and long-term health outcomes.

Methods: To understand LMIC barriers to acquiring, maintaining, and repairing medical equipment, an exploratory study was conducted at clinical settings in southern Malawi. Thirty-six clinical staff participated in surveys and focus groups to provide information on medical device challenges. The study was approved through the Virginia Tech Institutional Review Board as well as hospital administrators at collaborating institutions.

Findings: Results from the study emphasize the inadequacy of donating medical devices and the importance of community-based

participatory innovation to improve global health. Nearly all equipment available at participating hospitals required electricity to function; however, 56% of clinical staff reported experiencing power outages two or more times per week, rendering electricity-dependent technology useless. Many clinical staff expressed frustration regarding inability to prevent mortality attributed to equipment failure. Over 56% of clinical staff reported average time to repair a single piece of medical equipment as longer than six months. Reported barriers to repairing medical equipment included shortage of maintenance personnel (77.8%), lack of replacement parts (64.7%), lack of proper tools (61.1%), and lack of user's manuals for equipment (53%).

Interpretation: Health and technical education efforts should be intensively explored to increase working knowledge of medical device maintenance in LMIC. This study demonstrates that medical device donations fail to sustainably improve health outcomes, and technology innovation in global health should incorporate community expertise and local resources.

Funding: None.

Abstract #: 2.036_TEC

Improving access to safe surgical care by collaboratively developing a low-cost, ultraportable device platform: pilot trial results

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Background: We organized a tri-institutional, interdisciplinary collaboration to develop, evaluate, and deploy a new technology to help increase access to safe surgery. We reduced to practice a novel paradigm of surgical sterility in austere settings: that the space that determines patient outcomes—and thus warrants regulation—is not the operating theater, but the incision site.

Methods: We engaged in iterative and parallel prototyping with multi-stakeholder input to produce a low-cost, ultraportable, modular system. This comprises sterile, disposable clear drapes covering the incision, with arm and material ports. The drapes attach to a reusable frame with a battery-powered system supplying filtered air to control enclosure conditions. The entire system collapses to fit into small spaces such as duffels or unmanned aerial vehicles. We used an optical particle counter on a test mannequin torso to benchmark the device's ability to maintain the sterile field in a passively contaminated environment and when stressed with talcum puffs outside each wall. Particle counts were tested with active airflow and different port configurations (no port, materials port, materials and arm port) over 10 minutes at points along a simulated laparotomy incision and at the flanks.

Findings: Without airflow, the system reduced particle counts by 22.8% (20.0–25.6%) between the outside and inside five minutes after nonsterile setup. Talcum puffs increased external particle concentration by 28.3% but did not significantly change the internal particle count. Active airflow produced 0 particle count in 83.8 seconds (73.4–94.1 seconds). Low airflow was required to maintain 0 particle count.

Interpretation: Analysis of results recognizes limitations of using particle counts for dynamic approximation of microbiological burden. Successive ergonomic, optical, and mechanical testing generated an easy-to-use, ultraportable system capable of being customized via modules for different procedures. The system provides an effective passive barrier to active external contamination. In all port configurations, initially-contaminated enclosed air was fully purged of detectable particles within two minutes. Ongoing work includes reducing airflow requirement, obtaining microbiological data, reducing system cost, and assessing in vivo outcomes such as surgical site infection rates.

Funding: This project was supported by grants from the Harvard Scholars in Medicine Office (2012, 2015).

Abstract #: 2.037_TEC

From global to local: Virtual environments for global-public health education

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Project Purpose: Recent events such as the devastating earthquakes in Nepal, outbreaks of deadly infections like MERS and Ebola, and ongoing violent unrest around the world, are reminders that while even the most experienced travelers must prepare for the unexpected, the same dangers can also occur at home. Globalization has increased the overlap between global and local public health. However, it may be difficult to show learners who have never travelled internationally how similar the social, environmental, and economic determinants of health are for U.S. and international populations.

Virtual environments are online computer-generated simulations, in which users can be in different locations, but have real-time interaction in the same 3D space. These environments are accessed through a computer using a 3D viewer application. They can be used to present educational material in context and bring together learners in geographically separated locations.

The Aims of the Project Were: 1) To improve preparation for international global health (GH) electives through virtual experiences; and 2) To increase knowledge of the social determinants of health in both local and global settings in both GH and non-GH learners.

Design: Africa Traveler, with environments representing African settings, developed in 2013; and SPH Places, an urban and suburban U.S. neighborhood, developed in 2014; were piloted with health professional students and individuals without a health-care background. Using Kolb's theory of experiential learning as