Health Economics and Epidemiology Research Office
HE²RO
Wits Health Consortium
University of the Witwatersrand

HE²RO Policy Brief

Number 39 · March 2021

NOVEL ELECTRONIC TECHNOLOGY TO ASSESS OPERATIONAL EFFICIENCY OF HIV CLINICS IN JOHANNESBURG

Background

Measuring the impact of an intervention or technology on clinical tasks often involves performing a time and motion study. While some studies rely on passive observation and specific activities are timed, others ask staff to keep a log file to estimate the time spent on a specific activity (Kranzer et al, 2012), but both are subject to observer errors. HE²RO and IBM investigators worked together to develop non-invasive electronic devices or “wearable tags” to conduct a time and motion (TIM) study at healthcare facilities in Johannesburg, South Africa.

Methods

This was a feasibility study to determine if personal devices or wearable tags could be used to accurately measure the length of patient and health care provider interaction during routine clinic visits.

Figure 1 shows a schematic of the different components of the TIM study. We conducted several rounds of pilot work at two facilities in the City of Johannesburg, the Themba Lethu HIV Clinic at Helen Joseph Hospital and Crosby Clinic in Brixton, Johannesburg.

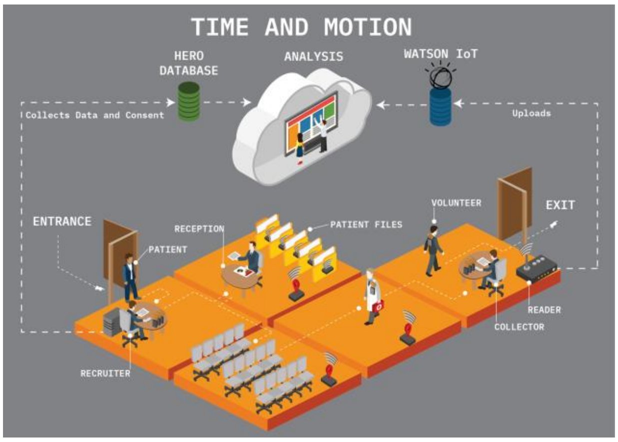

Figure 1. Electronic devices in a time and motion study.

We conducted site evaluations at the two facilities and determined the optimal location of tags, location tags, and tag readers (Figure 2).

- Wearable tags (referred to as "**tags**"; Figure 2A and 2B): Tags simply send out pings (using radio frequency between 2.4GHz and 2.5GHz) at regular intervals, and also listen for pings from other nearby tags.
- Fixed-location tags (referred to as "**location tags**"; Figure 2C): Location tags work the same way as tags, but detect tags within a wider range (e.g. about 20 meters line-of-sight, or within a room). Both tags and location tags store data internally, they are not connected to the internet.
- Tag readers (referred to as "reader"; Figure 2D): The reader has a similar range to the location tag and is able to download and reset the data from tags or location tags. This happens automatically, as soon as a tag or location tag is within the range of a reader. The data that the reader downloads are then uploaded to Watson's IoT platform for storage and analysis.

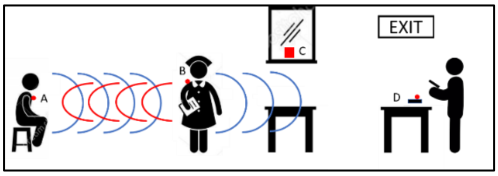

Figure 2. Electronic devices in a time and motion study.

Box 1. Summary of activities and recruitment

Facilities mapped out. The patient flow, size of rooms and type of services offered at each facility were documented.

Focus group discussions (FGDs) held. FGDs were conducted with health care workers to understand the wearability, consumer needs and feasibility of the tags (wearable devices).

Health care workers (HCW) recruited. HCWs were invited to participate and provided written informed consent to participate in the study. HCWs at the facility agreed to wear the devices each day while they performed their normal clinic duties.

Convenience sampling of patients attending the facility. Adults were recruited when they visited the facility. Research staff obtained written informed consent, recorded the visit type and basic demographic information. Participants agreed to wear the device for the duration of their visit and return it at the end. Participants received a snack pack for their participation in the study.

Locators, tags and readers deployed. Short, medium and long-range locators were placed around the facility at the start of the study. HCW and participants tags were prepared each day by the research staff. At the start of each visit, research staff used the reader to activate the tags and assign them to HCWs or participants. The tag number and target (e.g., HCW role or participant study ID) was recorded.

Manual data verification by passive observation. Research staff randomly selected some participants and passively observed their activity, and recorded the start and stop time (in minutes) for each step in the patient flow.

Data analysis. Data from the readers was uploaded to Watson's IoT platform for storage and analysis. All patient-level data w collected in REDCap, an electronic data capture tool, hosted by the University of the Witwatersrand (Harris et al, 2019). For analysis, data were imported and analysed using R software.

PEPFAR U.S. President's Emergency Plan for AIDS Relief
USAID FROM THE AMERICAN PEOPLE
HE²RO Health Economics and Epidemiology Research Office, Wits Health Consortium, University of the Witwatersrand
WITS UNIVERSITY
BOSTON UNIVERSITY

Electronic technology Passive observation Time (mins)

Figure 3. Patient flow through the clinic and HCW-patient interaction, measured by electronic technology vs. passive observation.

Results

Overall, we conducted 2 FGDs with HCWs and enrolled 66 HCWs and over 100 patients to participate in the study.

First, to determine the patient flow through the clinic, we conducted a site evaluation to document the layout of the facility, the size of the rooms and types of services offered in each, and the different cadres of patient-facing staff that offered services to TB and HIV patients. An example of this can be seen in Figure 3.

Next, we conducted FGDs with HCWs, to determine the "wearability" of the tags. Most staff understood what the devices were being used for. Some had safety concerns for pregnant women or babies, while others had concerns that the data would be used for lean management (i.e., removing redundancies).

Then, we placed locators in rooms, enrolled patients and HCWs, and assigned tags to both to measure the interaction (i.e., Figure 3 auto-green). We compared this to data obtained from passive observation (Figure 3 manual-red). Because tags are short range devices and picked up brief or fleeting interactions (e.g., nurse passing the patient in the waiting room (Figure 3 – last 3 lines) we concluded that triangulating data from tags and data) provided more accurate and reliable patient and HCW interaction estimates than the tags alone.

Lessons Learnt

- Understanding the physical layout of the clinic was key for optimal placement and in informing the design of the hardware.
- Successful implementation required buy-in from participants and HCWs.
- Providing incentives (e.g., snack pack) at the exit helped to ensure that participants returned the tags at the end of the visit.
- We opted for a tamper-proof tag that can be clipped to clothing on the right or left shoulder. The tags and locators use batteries, which can easily be changed without specialized skills.
- Assigning tag numbers, starting and ending the session, and testing the ranges of the locators could be easily performed with a tablet-based application.

Funding Statement: This study has been made possible by the generous support of the American People and the President's Emergency Plan for AIDS Relief (PEPFAR) through US Agency for International Development (USAID) under the terms of Cooperative Agreements AID-674-A-12-00029 and 72067419CA00004 to Health Economics and Epidemiology Research Office (DE, NM) and under the terms of Cooperative Agreement 674-A-00-09-00018-00 to Boston University (LL).
This study was approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (Wits HREC-Medical protocol M170874).

 Recommended citation: Evans D, Musakwa N, Kurien T, Makhanya S, Shingirirai Mapiye D, Molapo M, Magadla M, Long L. Time and motion of TB and HIV clinic services in Johannesburg, South Africa. HE²RO Policy Brief Number 39, Health Economics and Epidemiology Research Office, 2021.