HE²RO Policy Brief

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PHARMACY AUTOMATION FOR HIV TREATMENT: AN EVALUATION OF COSTS

Background

Improving the efficiency of service delivery through innovative approaches is essential to confronting HIV/AIDS in South Africa. One such innovation is an automated dispensing system (ADS), which includes a storage compartment, a mechanical arm, and an accompanying computer system that allows pharmacies to store, count, and dispense medications automatically or with less human effort than would otherwise be required.

In October 2012, an ADS for dispensing antiretroviral medications (ARVs) was installed in the pharmacy in an outpatient HIV care and treatment site located in a public hospital in Johannesburg, South Africa. This site dispenses ARVs to almost 300 patients per day. The Health Economics and Epidemiology Research Office (HE²RO) evaluated the introduction of the ADS in this facility. In this policy brief, we report the estimated cost per script dispensed under manual and automated environments in stylised scenarios.

Methods

We conducted a retrospective evaluation from August-September 2014. To understand the potential for changes in costs pre- and post-automation, we created an Excel-based costing tool which could be used to model various scenarios. Costing for calibration of the model was done from the provider's perspective using a bottom-up costing approach. Data collection, which included a time and motion assessment, took place only after the ADS had been installed. Pre-automation values were estimated from conversations with pharmacy staff and from observations in the hospital's other large, non-automated pharmacy.

Our approach assumes full productivity of staff and that staff time is perfectly divisible across tasks, and thus is likely a conservative estimate of staff costs. The costs included reflected those required for dispensing a three-month script of fixed-dose combination ARVs. Costs included were: personnel (for dispensing and stock management), consumables and equipment required for dispensing, and shared costs (rent, utilities and cleaning services). We excluded both the cost of the drugs, which were unlikely to be affected by automation, and costs incurred by patients. We assumed an average working life of the ADS equipment of 20 years and used a discount rate of 5%.

Three hypothetical pharmacy environments were created within the model:

- ***Typical*** – Assumes staffing and patient volumes based on actual levels recorded for the year preceding the evaluation,
- ***Enhanced*** – Assumes increased patient volumes,
- ***Ideal*** – Assumes increased patient volumes plus infallibility of the machinery and task shifting from pharmacists to pharmacy assistants.

Table 1 provides information on the parameters used for each environment within the model. Using study data, the model was calibrated for the typical pharmacy environment.

Table 1: Pharmacy profiles for cost model

Environment	Scripts per day	Technical reliability	Task shifting
Typical			
Manual	281	N/A	No
Auto*	281	No**	No
Enhanced			
Manual	500	N/A	No
Auto	500	No**	No
Ideal			
Manual	500	N/A	Yes****
Auto	500	Yes***	Yes****

Manual = Pre-automation, Auto = Automated pharmacy
*Actual pharmacy during evaluation.
** Assume batch loading fails once in five days (based on conversations with current pharmacy staff.
*** Assume no technical failures.
**** Assume lowest cadre of staff for each task.

Next we estimated and compared the costs of all possible combinations of pharmacy environments for an automated versus a manual dispensing system.

Uncertainty analysis was conducted to assess potential changes in several parameters (e.g. working life of the ADS, discount rate, cost inputs, etc.). Finally, we explored cost drivers and produced a breakdown of the total costs by cost category.

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Results

Table 2: Modelled cost per script, manual and automated pharmacies, with uncertainty analysis (ZAR 2014)

	Manual pharmacy			Automated pharmacy		
Pharmacy profile	Expected case	Low (% change)	High (% change)	Expected case	Low (% change)	High (% change)
Typical	17.94	12.34 (-31%)	22.47 (+25%)	17.11	11.76 (-31%)	21.95 (+28%)
Enhanced	17.24	11.93 (-31%)	21.43 (+24%)	14.79	10.45 (-29%)	18.46 (+25%)
Ideal	13.30	9.08 (-32%)	16.49 (+24%)	13.44	9.24 (-31%)	16.90 (+26%)

The average cost per script in the typical pharmacy environment with manual dispensing (R17.94) and automated dispensing (R17.11) are provided in Table 2. Uncertainty analysis yielded wide ranges around the unit cost estimates.

Table 3 lists all possible comparison scenarios. Using expected case cost estimates, the typical automated pharmacy cost 5% less per script filled than the typical manual pharmacy. The best scenario in terms of cost comparisons would require moving from the typical to the ideal pharmacy environment in parallel with automation.

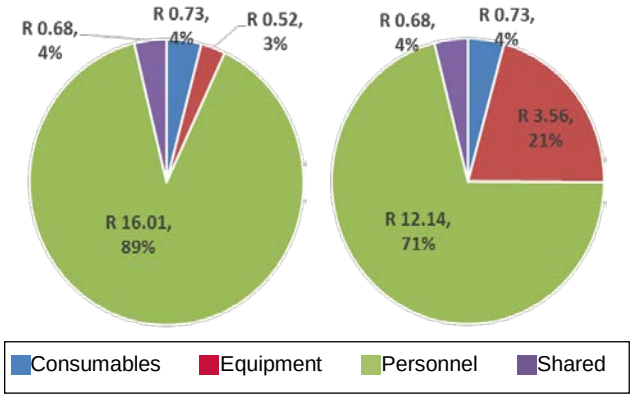
Table 3: Modelling comparison scenarios*

Scenario	Manual pharmacy	Automated pharmacy	% change in cost per script
1	Typical	Typical	-5%
2	Typical	Enhanced	-18%
3**	Typical	Ideal	-25%
4	Enhanced	Enhanced	-14%
5	Enhanced	Ideal	-22%
6***	Ideal	Ideal	1%

* Using expected case cost estimates
** Possible best case in terms of potential cost savings
*** Possible worst case in terms of potential cost savings

The cost per script in high volume facilities appears to be relatively insensitive to the cost of purchasing the automation technology when considering a long useful life for the equipment (varied from 10-25 years). Staff costs were the largest single driver of the overall cost per script both before and after automation (Figure 1).

Figure 1: Cost per script, breakdown by cost category for manual (left) and automated (right) dispensing in the typical pharmacy environment



This evaluation faced a number of challenges which limit its generalizability. Some of these limitations, such as the reliance on routinely collected data, are common to programmatic evaluations in general; others were specific limitations of this evaluation such as incomplete or missing data, the phased in approach to automation at this site, and secular changes in staffing and patient management which occurred concurrently with automation.

Policy relevance

The ADS evaluated here and the setting in which it was implemented are very specific and potentially not representative of most automation circumstances. However, this evaluation does provide guidance for addressing the costs of pharmacy automation in settings considering this technology. Staff costs are the largest single driver of the overall cost per script both before and after automation. Also, perhaps surprisingly, the cost per script in high volume facilities appears to be relatively insensitive to the cost of purchasing the automation technology when taking into account a long useful life for the equipment.

We did not find significant differences in the cost per script dispensed before and after the implementation of the ADS in the typical pharmacy profile. However, cost savings might be attained under several specific conditions:

- When automation is accompanied by an increase in patient volumes (comparison scenarios two and four (Table 3)), we see potential savings. However, uncertainty around the estimates remains large.
- The importance of increasing patient volumes fell away when technical reliability and task shifting were introduced along with automation.
- Automation accompanied by efforts to reduce staff costs presents the greatest possible savings.
- Automating an already efficient pharmacy (i.e. one with high patient volumes, technical reliability and low staff costs) does not seem to present cost saving opportunities.

Because of its limitations, the results of this evaluation should be interpreted as one data point that can contribute to an overall understanding of the potential for pharmacy automation in South Africa. The evaluation points out key issues and questions that should be examined going forward.

The full report can be found at: www.heroza.org. For detailed results, contact Naomi Lince-Deroche nlince-deroche@heroza.org.

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