Designing a Dashboard for HIV-data Reporting Performance by Facilities: Case Study of Kenya

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Abstract. Health management information systems implemented in low-and middle-income countries (LMICs) have provided availability of HIV-data. As such, dashboards have become increasingly popular as they provide a potentially powerful avenue for deriving insights at glance. This promotes use of data for decision-making by various stakeholders such as Ministries of Health as well as international donor organizations. Nonetheless, despite the use of dashboards in LMICs, their potential may go unrealized with underutilization of good design principles. In various LMICs, health facilities are required to submit HIV-indicator data on time for its use in decision-making. Hence, dashboards can be utilized in assessing facility reporting performance overtime in order to identify where interventions are needed. In this study, we applied good design principles in developing a dashboard, which presents the performance of facilities in reporting HIV-indicator data overtime (2011-2018). Timeliness and completeness in reporting were used as performance indicators and were extracted from the District Health Information Software Version 2 (DHIS2) in Kenya. Results for the system usability scale used in evaluating the dashboard was 87, which meant the dashboard usability was good.

Keywords. Visualization, dashboard, DHIS2, reporting- performance

1. Introduction

Dashboards can play a role in assessing facility reporting performance of HIV-indicator data, which is salient for Ministries of Health as well as international donors in identifying progress and formulation of interventions for improvement [1].

Dashboards contain a collection of information visualizations for selected relevant indicators, which can be utilized by management for decision-making [2]. Well-designed dashboards have the potential to reduce information overload especially with the existence of large amounts of data gathered from health management information systems (HMIS) [3]. Nonetheless, designing of dashboards in the health sector has been faced with issues such as: lack of availability of skilled human resource[1],[4]; lack of adherence to design principles [2],[4]; organizational issues[1]; training, and maintenance costs [1],[5]. Moreover, there is still underutilization of good design principles in developing interactive dashboards [1],[4].

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2. Method

2.1. Data sources and analysis

The HIV-indicator reporting data used for designing the dashboard was extracted from the District Health Information Software Version 2 (DHIS2) in Kenya as part of a larger study. The data was gathered for all health facilities providing HIV-services in all 47 counties in Kenya, for the year 2011 to 2018. Facility reporting completeness (extent to which facilities submit expected number of reports) and timeliness (extent to which facilities submit expected number of reports on time), were selected as facility reporting performance indicators, given that these are some of the salient reporting requirements mandated by the Ministry of Health. The extracted data was then cleaned using a systematic approach, resulting in a clean data set used for analysis. In this paper, we present only facilities providing HIV Testing and Counselling (HTC) services. The K-means clustering algorithm was used in identifying various performance groups within the facilities. Details of the analysis are discussed elsewhere [6].

2.2. Dashboard design process: Application of design principles

An interactive dashboard of facility reporting performance was designed using Tableau, as it offers diverse dashboard features. Designing of the performance dashboard was guided by dashboard design principles proposed by Few [2], as he offers comprehensive guidelines that are more specific to dashboards; and identifies 13 visual design problems to be avoided. Furthermore, we also utilized the World Health Organization (WHO) guidelines for graphical presentations of health information, intended to monitor areas such as HIV [7]. A task based approach similar to that used in our previous study [8], was used in selecting the tasks to be performed on the dashboard.

Three tasks were selected that aimed at assessing the performance of facilities at meeting completeness and timeliness reporting requirements, hence allowing for testing the usability of the dashboard. The visualizations for the three tasks were confined to a single screen (Figure1), which is a best practice recommendation for dashboards [2].

An informative legend was used to provide useful context as it enables comparison of performance based on reporting completeness and timeliness, which was distinguished by color. The performance measures used (reporting timeliness and completeness) were meaningful and aimed to support users in measuring HIV-data reporting performance by facilities. The performance measures were represented in average percentage and were reduced to two decimal places to avoid excessive precision, which may slow the viewer down. In addition, appropriate scales were considered in encoding the quantitative data.

A combination of map, scatter chart and line graph were selected as the appropriate display media for the identified tasks, based on WHO recommendations [7]. The map enables the user to identify at a glance by use of color on regional disparities based on performance in reporting completeness and timeliness (Figure. 1). A full range color saturation of the hue blue was used for completeness. On the other hand, a 'traffic light' approach was used in selection of colors for timeliness, using a combination of green, orange and red. A darker shade of green represents good reporting timeliness, while red represents poor performance in reporting timeliness.
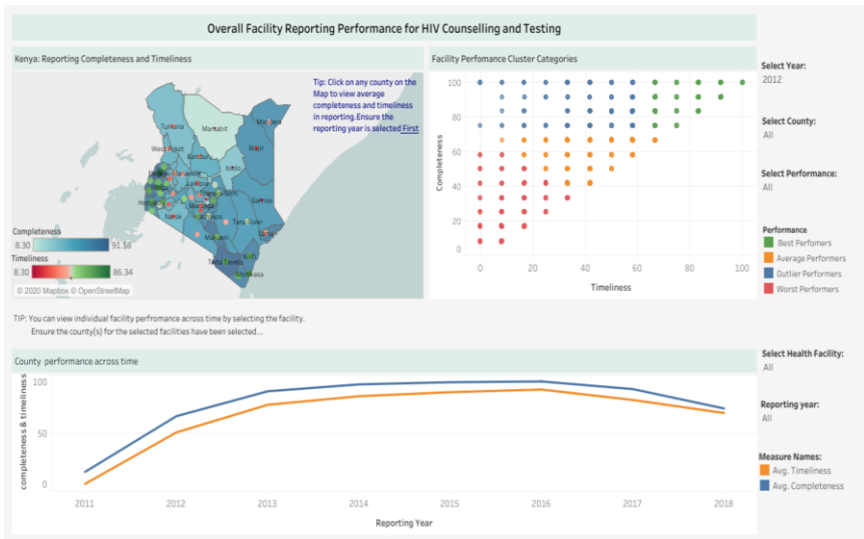
Figure 1. Performance dashboard design of the three identified tasks, after application of design principles. The dashboard contains a map, scatter chart, and line graph

A scatter chart was selected for this task to display the distribution of facility cluster group performance based on reporting completeness and timeliness. Line graphs were selected to display the performance trend over time, hence utilizing a gestalt principle of continuity [2]. Simplicity was maintained by avoiding overusing color.

2.3. Evaluation of the dashboard

Five IT experts performed the usability study to improve on the design of the performance dashboard and observe whether the selected tasks are met with ease. The assessment consisted of a think aloud session and use of the System Usability Scale (SUS)[9] to inform design improvements. A researcher and HIV monitoring and evaluation (M&E) officer were interviewed upon using the improved dashboard.

3. Results

The first task involved identifying reporting completeness and timeliness of a selected county for a given year. Users were able to quickly perform this task with no problem. The second task involved identifying the performance cluster category for a selected facility, and particular year. Users were able to perform this task quickly with no issue. Nonetheless, some of the users were confused with the logic behind the performance filter. The third task involved listing the figures for average completeness and timeliness based on years performed best and poorly, for a selected county and facility. Users were able to drill-down the data using filters and managed to perform this task well.

The system usability scale score for the designed dashboard was found to be 87 which is above average (68) [9]. In addition, responses from the interviewed domain experts (researcher and M&E officer) revealed that the designed dashboard had the potential to provide insights at facility-level, enabling facilities to view their progress.

4. Discussion

A challenge that presents itself whilst designing a dashboard is the need to squeeze a lot of information within a small amount of space, in order to provide at a glance visualizations for purposes of deriving insights [2]. Nonetheless, we were able to utilize good design principles in designing an interactive dashboard, which incorporated three visualizations that fit on a single screen. Moreover, the performance dashboard designed in this paper, aimed at promoting use of data by enabling users to explore and derive insights on facility reporting performance at a glance. The dashboard contained various aspects to it that required evaluation by experts as well as intended users. IT experts focused on usability. Hence, they successfully evaluated the performance dashboard by conducting three salient tasks. Despite lacking domain knowledge on the area, their response based on the dashboard usability was good. We also identified areas that needed improvement such as redesigning the performance filter. Hence, even though a dashboard may contain all the right information, it also must be user friendly. This provided a good baseline for design refinement and evaluation with domain experts. Two domain experts (researcher and HIV M&E officer) were interviewed although three would be preferable to identify majority of usability issues [10]. Nonetheless, due to their professional background, their responses were valuable as they affirmed the practicality of the dashboard in identifying facility reporting performance.

This study represents one of the first attempts to our knowledge, in designing a performance dashboard for assessing retrospective HIV-indicator reporting by facilities, and further evaluate its usability. This design can also be extended for performance dashboards developed within DHIS2 to further reveal data quality issues.

5. Conclusions

Future work entails different types of performance dashboards to facilitate HIV-program monitoring as well as dedicated evaluation studies with healthcare professionals.

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