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METHOD ARTICLE

Hospital quality monitoring and evaluation system using linked spreadsheets on Microsoft SharePoint [version 1; peer review: 2 approved with reservations]

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Abstract

Background

Establishment of a systematic way of measurement and utilization of indicators for improvement is one of the most challenging issues in monitoring and evaluation of indicators in healthcare settings. In realizing these fundamental challenges, we designed a monitoring and evaluation system incorporating a hospital-wide quality variance report (QVR) system using linked Microsoft Excel® spreadsheets on Microsoft SharePoint®.

Methods

Indicators were determined at the departmental/unit level in line with the institutional goals, departmental functions, quality expectations, inputs/outputs, clinical priorities, compliance to policies/procedures/protocols/guidelines/pathways as well as in response to gaps in service delivery picked during root cause analyses.

The sample design was determined in accordance with the characteristics of the population. Drawing of sample units was done using a simple random sampling technique without replacement or systematic random sampling.

The indicator's monitoring was enhanced visually by allocating colour codes based on performance across the months and quarters.

The action plan tab consisted of a platform that aids in documenting corrective actions arising from the performance reviews.

Results and discussion

The QVR reporting system ensured a standardized format of monitoring throughout the institution with a reduced turnaround time from data collection to analysis. Further, continuity of the monitoring and evaluation (M&E) system was guaranteed even if an

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individual left the institution.

The analysis of the QVR allowed hospital-wide trending on cross-cutting indicators with consequent ease of communication to multiple stakeholders.

The automation has saved time and increased accuracy which has enhanced credible engagements during quality meetings.

Conclusions

Use of this system greatly enhanced quality performance monitoring in the hospital, identification of major bottlenecks that warranted hospital-wide projects or departmental-level projects. The QVR system enhanced the efficiency and accuracy of quality monitoring from data collection through to performance reviews. The QVR structure allows for customized development of an M&E database application software.

Keywords

QVR, quality variance reports, monitoring and evaluation, hospital quality, key performance indicator, Microsoft SharePoint, Microsoft Excel

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Introduction

Monitoring and evaluation encompasses a systematic establishment of indicators, data collection and analysis as well as periodic reviews to identify suitable action plans for improved performance of ongoing processes (Fajardo Dolci, Aguirre Gas, and Robledo Galván 2011). Indicators refer to specific metrics that enable evaluation of goals' and objectives' achievements, they are specifically referred to as key performance indicators (KPIs). It is imperative that the KPIs are SMART (specific, measurable, achievable, relevant and time-bound) and linked to inputs, activities, outputs, outcomes and goals (Kusek and Rist 2004). A profound monitoring and evaluation system ought to incorporate mixed research approaches (Bamberger, Rao, and Woolcock 2010). All relevant stakeholders' involvement is necessary in determination of indicators to be tracked (Emberti Gialloreti et al. 2020, Malone et al. 2014, Diallo et al. 2003, Guijt 1999). Participatory monitoring and evaluation involves incorporation of all the stakeholders in all stages and processes of the M&E system, and the engagement helps in determination of the way forward and what modifications are needed for better M&E (Izurieta et al. 2011, Estrella et al. 2000, Guijt 1999, Estrella and Gaventa 1998).

The most challenging issue in monitoring and evaluation of indicators in healthcare is the development of a systematic way of measurement and utilization of indicators for improvement, development of such a system which incorporates variance reporting requires concerted effort and inclusion of each team member (Brown and Nemeth 1998). There are myriad challenges towards the design, development, and implementation of an effective M&E system; such as stakeholder buy-in, knowledge gap, time constraints, logical frameworks, resources available, and the validity of data, sampling techniques, and the indicator measurements (Emberti Gialloreti et al. 2020, Anderson et al. 2019, Mthethwa and Jili 2016, Cameron 1993). Emberti Gialloreti et al. (2020) concluded that multiple stakeholder involvement is necessary for a successful and timely system in collection and monitoring of health information. Participatory M&E systems promote efficiency, relevant and effective processes leading to an elaborate corrective action (Guijt, 1999). In realizing these fundamental challenges, we designed and developed a monitoring and evaluation system incorporating hospital wide key performance indicators. We named the system; quality variance report (QVR) system, and it is developed by use of linked Microsoft Excel 2010 (Microsoft Excel, RRID:SCR_016137) spreadsheets on a Microsoft SharePoint 2010 on-premises (intranet). SharePoint being a Microsoft product, it has new and exciting features in every new release, among the functions available are; web content management, social media functionality, and search features, among others (Perran et al. 2013). Utilization of SharePoint fosters centrality of online access to collaborative information (Ennis and Tims 2012). Knowledge sharing via various media is possible through SharePoint (Weldon 2012). A well constituted SharePoint implementation strategy enables an institution to enhance collaboration, communication, and storage (Diffin et al. 2010) and in addition enables flexibility of spreadsheet data linkage (Prescott et al. 2010).

This was an improvement on the previous KPI's monitoring process which entailed submission of hard copies of filled data collection tools to the monitoring and evaluation unit. This was a time-consuming process confounded with challenges, including lost forms, late submission, illegible handwriting, and transcription errors. In a study conducted by Jordans et al. (2019), illegible information was considered as incorrect which was similar to our experiences. Automation of data collection tools was one way our project intended to reduce the challenge of illegible handwriting.

The previous system was heavily dependent on individual quality focal points from the departments who maintained data on standalone computers and data were shared by use of emails. This presented another challenge during staff turnover, or cases where some data and related literature would be lost if the machines crashed or the data got accidentally deleted. There was also a lack of standardization on how the data was maintained among various quality focal points. The Microsoft SharePoint server hence came in handy, albeit its utilization bringing about need for elaborate training to ensure maximum utilization (Dahl 2010). Initially utilization of SharePoint was limited to document management, where staff working on policies updated the drafts in a dedicated folder on Microsoft SharePoint enhancing collaboration which was later extended to indicator monitoring.

This article presents a description of the system that we designed and implemented at the quality department of the Aga Khan University Hospital, Nairobi and rolled out across the entire hospital. It started as a basic standard system design which was improved with various features over time to address the emerging challenges experienced in monitoring and evaluation of quality indicators.

Methods

The QVR monitoring and evaluation (M&E) system refers to a mechanism that enables KPI's dashboards appearance and availability to be standardized and linked using spreadsheets on a Microsoft SharePoint server. The QVR adopted its name from the ability of the quality monitoring dashboards generated to show the difference between achievement and targets/benchmarks (variance). The quality indicators are gathered from the smallest unit level to the highest institutional level. The highest hierarchy of classification of the hospitals' quality leadership includes institutional leadership, divided into; clinical and non-clinical departments that are branched further into various sub-sections and units. KPIs dashboards

Figure 1. Quality Variance Reports (QVR) hierarchy.

are aligned in the same order from the smallest unit to the highest in the echelon. A Microsoft SharePoint server anchored in the institution's intranet configuration enables data capture and access through spreadsheets to be done centrally to everyone with rights of access. Rights of access are obtained from the institution's Information Communication and Technology's (ICT) administrator. The spreadsheets are linked allowing similar indicators to be grouped together at a higher level of departmental structure up to the institutional level which enhances comparisons. The linking of data from data-entry screens allows seamless real-time tracking of indicators. The spreadsheets are saved in folders which are arranged in line with departmental organograms, with sub-folders equivalent to all sub-units, the data entry sheets (templates) are placed in each of the unit folders. **Figure 1** demonstrates how QVRs are linked from a unit level to institutional level. Several units comprise a department or a section/program of which several of these form a department. X in the illustration indicates the possibility of multiple available departments/units.

Determination of indicators

The indicators are determined at the departmental/unit level in line with the institutional goals, departmental functions, quality expectations, inputs/outputs, clinical priorities, compliance to policies/procedures/protocols/guidelines/pathways as well as in response to gaps in service delivery picked during root cause analyses. The committee that prepares the quality plans and indicator measures are referred to as departmental quality improvement and patient safety (DQIPS) committees. It is usually essential to incorporate all stakeholders in the formulation of indicator measures (Diallo et al. 2003). Each department has a quality advisor attached to it, from the quality department, who acts as a required liaison between the department's needs and quality expectations. The indicators are then presented by the institutional quality improvement and patient safety (QIPS) committee to the joint staff committee (JSC) for reviews and approval. **Figure 2**

Figure 2. Data aggregation process flow.

portrays the data aggregation process flow we developed to guide the practice; the process begins with identification of what needs to be measured; a review of the literature is undertaken to find out appropriate research questions and benchmarks if available (where benchmarks are not available internal targets are set up after the pilot phase), a research design is determined through which data collection tools are designed and developed, sample determination follows, data collection methods and analysis plan are established, tool validation is done during the pilot phase. When data tools and data collection teams are deemed appropriate, collection and processing of data is done, and trends are monitored over time. Frequency of data collection is dependent on the indicator being monitored; the data entry sheets are designed in such a way that data is collected continuously. The data is networked/mapped in an orderly manner where similar indicators are aggregated together at a higher level which leads to better monitoring (Abdi, Majdzadeh, and Ahmadnezhad 2019). For information to be useful, data gathering ought to be collected at well-defined frequency (Prennushi, Rubio, and Subbarao 2002, Guijt 1999).

Sampling

Sample design is determined in accordance with the characteristics of the population. Specifically, sample size is determined by considering factors such as the design, sampling method, the indicator/outcome being measured, design effect and variance, power, level of significance as well as the level of precision desired for the indicator estimates (Chander 2017). Drawing of sample units is done using either a simple random sampling without replacement or systematic random sampling. Microsoft Excel provides users with functions such as random number generator ($=RAND()$), $=RANDBETWEEN(x,y)$ and an add-on such as 'Data Analysis Toolpack'. Either of these are used during determination of the sample units. A sample guideline had been developed to help the users for easier implementation with assistance by a statistician.

QVR structure

Data collection tools were designed specifically to suit the measurement criteria of each indicator in a format that ensured easier entry and linkage with other indicators for results aggregation. The data entry sheets were created in user friendly formats so as to provide a platform for easier data entry, for instance, use of drop down lists where applicable, restrictions were also applied to ensure specified data were entered correctly in the cells. Customized error messages emerge if incorrect data type or format was entered. The excel functions in the data entry screens were locked for editing (using passwords that were only accessible to the M&E unit) to prevent alteration by users during data entry. Figure 3 portrays an example of a data entry sheet used to collect data on compliance towards the requirement for correct patient identification while administering treatment or when giving any other service to a patient. Columns B, G, H and J have drop down lists for easier data entry, all columns have restrictions such that only data in the specified format is entered, column E contains the medical record numbers of the patient sampled, column F provides a description of the procedure or the service

S. No	MONTH	DATE OF AUDIT (DD/MM/YYYY)	TIME OF AUDIT (HH:MM)	AK NUMBER	PROCEDURE / SERVICE GIVEN	IDENTIFIED BY FULL NAMES	CONFIRMED BY AK NUMBER ON BAND	NAME OF STAFF OBSERVED	CATEGORY OF STAFF	AUDITOR NAME
108	September	17/09/2018	8:42	Medical record number	Triage	Yes	Yes	Ibrahim	Nurse	F Name of staff
109	September	17/09/2018	12:04		consultation	Yes	Yes	Name of staff observed	Doctor	F of staff
110	September	17/09/2018	3:37		radiology	Yes	Yes		Support	F auditor
111	September	17/09/2018	4:08		consultation	Yes	Yes		Doctor	F
112	September	20/09/2018	9:35		Triage	Yes	Yes		Nurse	F
113	September	20/09/2018	10:15		consultation	Yes	Yes		Doctor	F
114	September	20/09/2018	12:00		radiology	Yes	Yes		Support	F
115	September	20/09/2018	2:00		consultation	Yes	Yes		Doctor	F
116	September	20/09/2018	4:00		admission	Yes	Yes		Nurse	F
117	September	26/09/2018	8:51		lab review	Yes	No		Doctor	F
118	September	26/09/2018	10:40		consultation	Yes	Yes		Doctor	F
119	September	26/09/2018	2:00		consultation	Yes	Yes		Doctor	F
120	September	27/09/2018	9:37		lab review	No	No		Doctor	F
121	September	27/09/2018	2:00		consultation	Yes	Yes		Doctor	F
122	September	27/09/2018	4:00		consultation	Yes	Yes		Doctor	F
123	September	28/09/2018	8:18		Triage	Yes	Yes		Nurse	F
124	September	28/09/2018	10:05		consultation	Yes	Yes		Doctor	F
125	September	28/09/2018	12:01		consultation	Yes	Yes		Doctor	F
126	September	28/09/2018	4:00		admission	Yes	Yes		Nurse	F
127	October	02/10/2018	8:00		handover	Yes	Yes		Nurse	F
128	October	02/10/2018	8:00		handover	Yes	Yes		Nurse	F
129	October	02/10/2018	10:57		Triage	Yes	Yes		Nurse	F
130	October	02/10/2018	11:00		consultation	Yes	Yes		Doctor	F

Figure 3. An illustration of a data entry template.

audited, column J the category of staff observed, name of staff observed as well as that of the auditor is also captured. The data from the sheet, in which this snapshot is obtained, is aggregated into a dashboard by use of a formula separating the numerator (the opportunities complied to) against the total number of opportunities observed and a proportion of compliance is computed.

The OVR master sheet

Colour codes configuration

Action plan tab

[illegible]

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A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
2018	Indicator	Measure	Target/Benchmark	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
	Improve the effectiveness of verbal and/or telephone Communication among care givers AND reporting of critical results of diagnostic units	IPSGR2.1 (Improve Effective Communication of critical values)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Improve Effective patient handover	IPSGR2.2 (Improve Effective patient handover)	100%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
	Improve the Safety of High Alert Medications	IPSGR3 (Improve the Safety of High Alert Medications including look-alike/sound-alike medications)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Reduce the risk of health-care associated infections	IPSGR5 (Reduce the risk of health-care associated infections - Hand hygiene)	90%	86%	85%	70%	65%	70%	65%	75%	70%	75%	70%	75%	70%	75%	70%	75%	70%	75%	70%	75%
	Reduce the risk of patient harm resulting from falls	IPSGR6 (Reduce the risk of patient harm resulting from falls)	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Unit Specific Indicators																					
	Stemi indicators	Door-Needle < 30 minutes for STEMI	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Stroke indicators	Door-Needle < 60 minutes for STEMI	100%	73%	80%	83%	50%	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Door-Needle < 60 minutes for STROKES	100%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Sepsis indicators	Time to antibiotics < 1 hour from doctor evaluation for patients admitted/transfered to critical care with infections	100%	75%	92%	75%	75%	90%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Pain management	Time to analgesia for moderate and severe pain < 30 minutes	100%	79%	94%	100%	85%	92%	94%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Holding time during admission	Proportion of patients Holding time within 4 hours in A & E after admission is declared	100%	NEW	52%	52%	84%	84%	81%	93%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Hazmat compliance	Compliance towards hazmat requirement	100%		95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%

Figure 6. Colour codes configuration.

A	B	C	D	E	F	G	H	I	J
S/NO	Month	INDICATOR (Below target/undesired)	GAPS IDENTIFIED	WHY	ACTION PLAN	TIMELINE	RESPONSIBILITY	REVIEW DATE	COMMENTS
1									
2									
3									
4									
5									
6									
7									

Figure 7. Action plan tab.

by checking the colour codes, the trends column as well as the variance columns (see Figures 5 and 6). If an indicator presents more reds compared to other indicators this suggests a gap that needs to be dealt with, similarly, if the trends column shows a poorly performing trend or a sudden change either upwards or downwards this presents an opportunity for root cause analysis. Finally, in the variance column, a greater percentage variance presents an opportunity for further action. Figure 7 portrays the components of the action plan tab. It has a serial number column, month, the indicator with undesired performance, gaps and why as identified through a root cause analysis, the action plan containing the corrective action, a timeline for closure, the individual responsible for follow-up, and review date as well as the additional comments. The process of evaluation hence takes both the quantitative component and qualitative one.

In order to ensure effective utilization of various components and features, training was provided to each new user. The previously taught users were intended to pass on the knowledge, skills, and competencies acquired to their colleagues within departmental units. Advanced training needs identified were provided by the Quality department through the M&E unit in collaboration with the ICT training unit. Gaining the right competences enhances the success of the M&E. Successful training refers to proper acquisition of competencies, skills, and knowledge which are imperative in achieving a working M&E system (Fletcher et al. 2014).

Data security and back-up

The hospital's Information Communication Technologies' (ICT) department developed a framework of maintaining back-ups daily on hard disk separate from the server hosting the SharePoint data. In addition, offsite archiving of the data happened monthly which enabled recovery of any loss, in case a user deleted an item erroneously. Every user underwent basic training on how to access and update items on the Microsoft SharePoint platform. A request for rights to access to the Microsoft SharePoint server by any new potential user was sent to the ICT in order for the access rights to be provided. This ensured coordinated control of who accessed at any time. The Microsoft SharePoint also indicates the access logs, thus the last person who accessed a certain document on the server can be determined. Once a new user was allowed access to SharePoint, passcodes for the files they need to access were provided and this ensured that only the relevant files were accessed by the appropriate SharePoint users. Access to SharePoint data was further enhanced by document-level control where each department set passwords for their own documents. The quality department M&E unit also instituted document protection passwords that prevented the structure of the QVR and the formulae contained in the worksheets from being altered. Data are not entered directly into the QVR but are fed in through primary data entry sheets with enhanced data validation restrictions ensuring only the required type of data is entered. As such, the QVR dashboards are accessible to user departments with passcodes that grant them read only rights.

Results and discussion

This section provides a review of the accomplishments observed since adoption of the QVR as a hospital quality monitoring and evaluation system.

Continuity of the Monitoring and Evaluation System: Before implementation of the QVR reporting system, there was a major challenge in regard to data collection and sharing with the M&E unit for processing. In a situation where a data provider was away, data would not be available until such a data provider resumed work and shared it. The situation was worse in cases of service interruption through either staff dismissal or resignation, since some instances, a replacement would not be available immediately or the incoming staff might have been in need of an elongated period to adapt. After implementation of the QVR system, each unit head was required to be actively involved in the entire process. In addition, they were meant to involve their staff from the determination of the indicators, design of data collection and entry sheets as well as linking to the QVR spreadsheets on Microsoft SharePoint. The unit leaders were required to ensure availability of resources for continuous data collection and entry. Appointed staff from each unit were taught how to collect and enter the data which ensured continuity enough to withstand the effects of staff turnover. Adoption of the QVR system has increased tremendously since initial implementation; the initial year of implementation was 2017 where a total of 50 departmental units had functional QVRs which increased in year 2018 and 2019 with 60 departmental units having functional QVR dashboards. The participatory approach adopted in M&E enabled communication of results which enhanced sharing of information within the departmental units, as well as across the departmental units. Guidance was provided on what information was meant to be shared during the multidisciplinary meetings, leading to increased motivation to participate due to clarity on the expectations (Guijt 1999). The QVR system having been developed through Microsoft Excel formulae and linked across related units to departmental level, several departments linked to form institutional QVR dashboard provides an essential blueprint for a customized database system. Due to flexibility of Microsoft Excel formulae which can easily be handled, this provides a framework that can be adopted by others to improve automation through customized systems.

Reduced turnaround time from data collection to analysis: the QVR's were monitored every beginning of the month i.e. by the 5th of each month to ensure that all the requisite data were collected and entered in good time hence impacting on utilization of the results. A score was allocated every month based on the availability of data as a proportion of all the KPIs in each unit/department's QVR. Similarly, utilization of various features such as determination and review of an action plan, was further considered during establishment of the best performing departmental unit of the year. Utilization of the feature of the action planning increased from <10% in 2017 to 78.4% in 2018. A similar challenge had been experienced in Iran when a framework for M&E was being set-up, many indicators were noted to have stayed for long periods having not been updated leading to many gaps in health information monitoring (Abdi, Majdzadeh, and Ahmadnezhad 2019). A well-defined frequency of data gathering promotes the usefulness of information gathered (Guijt 1999).

Standardized format of monitoring throughout the institution: prior to the implementation of the QVR system, reports were prepared on standardized PowerPoint slides by respective departments with the assistance of the statistician. This was a time consuming exercise since the data had to be provided via email and then analysed. The QVR system provided a ready and standardized format of outputs that were not alterable and enhanced aggregation, tracking and comparisons which worked throughout the year after setting up. Creation of a standardized monitoring framework promotes comparability and usability (Abdi, Majdzadeh, and Ahmadnezhad 2019). *It is also possible to obtain hospital wide trends on cross cutting indicators:* arising from the standardized format of reporting that was made possible by the QVR system it became possible to aggregate data on indicators such as compliance towards hand hygiene practice, patient identification monitoring, client feedback gathering, etc. which were monitored across many hospital departments.

Saving man hours: Prior to the deployment of the QVR system there was plenty of time spent in transcribing data from paper forms into the M&E database. There was also time lost in the collection and transportation of primary (paper) data collection sheets from the source departments to the M&E unit. The QVR system provides a platform of networked dashboards which allows continuous monitoring of performance any time, as data is continually populated. Data validation commands customized in the dashboards prevent erroneous data entry cases. Before implementation of the QVR system, a data collector would spend over three days entering monthly data which would increase the chances of erroneous entries, a situation that was rectified by the QVR system, where data entry happens every day at a proportion of an hour 10% (5 to 6 mins), this also further facilitates easier monitoring and decision making through trend analysis at any time of the month.

Ease of communication to multiple stakeholders: data on matters of quality is communicated to various stakeholders who require different levels of data granulation in order to make decisions. As described above, this was previously done

by the use of Microsoft Excel then exported into Microsoft PowerPoint slides and this lengthened the process of critical analysis and action planning. The effectiveness of this was altered dependence on extra labour force and technical knowhow in dealing with the multiple softwares involved. Currently through the use of QVR colour coded “traffic lights system” (Red, Green and Amber) trending and detection of low performing indicators has been simplified allowing decision makers to quickly focus on undesirable trends for corrective action.

Time saving in quality meetings: The use of the QVR has enabled quicker discussion and shorter quality meetings regarding monitoring of indicators. This is because the agenda gets focused around the salient results on the QVR dashboards. This improves efficiency and effectiveness in decision making (Izurieta et al. 2011).

Determination of Quality Improvement Projects: Each year the departments were meant to select a quality improvement (Q.I) project that would have a great impact on quality. The hospital departments in conjunction with the M&E unit were able to narrow down on quality improvement (Q.I) projects from a review of the trends in KPI performance. Hospital wide Q. I improvements were easily selected from the combined set of institutional indicators (institutional QVR). An example of this was the consulting clinics no-show project that sought to reduce the number of booked patients who did not appear for their scheduled clinics due to various reasons. The selected project was conducted in the year that followed in a bid to reduce chances of no-show cases.

Ease of data access: as mentioned previously, before rolling out the QVR system data were stored on local drives and accessing the same was a laborious process of sending email requests and phone call follow-ups. The QVR system made data availability easy through the Microsoft SharePoint platform; any authorised staff could access the data from the comfort of their workstations.

Data processing: through the use of built-in formulae, data are processed in real time enhancing efficiency and usability of the results. This reduces time lag of data processing as well as workload on the part of the M&E unit.

Elimination of redundancy: The previous system was rife with instances of multiple copies of reports residing with different users as the review was not centralized and the reports were forwarded from one user to their seniors for reviews which at times same wouldn't be reverted back. Often the quality reports would have variations due to editing. The QVR system now assures a single and most up-to-date copy of data sheets and reports that are widely accessible to all users.

Automatic back up: The Microsoft SharePoint server enables automatic backup of the input data as long as the internet connection remains uninterrupted.

Conclusions

Monitoring and evaluation is fundamental in quality performance of a hospital through an elaborate system of establishment, measurement and assessment of key performance indicators over time. A quality system that allows for participatory development of indicators from the smallest unit/department to the highest hierarchy in the institution ensures exhaustive coverage of scope of quality monitoring. A spreadsheet program, despite its simplicity, allows for flexible linking and computation of the chosen indicators. The Microsoft SharePoint server platform enables users to access and update indicators with ease via intranet, made possible through linked spreadsheets. Pointers such as colour codes, sparklines, and benchmark-achievement variance computation allows for identification of performance gaps. Timely identification of these gaps enhances propitious reviews coupled with a well-designed standardized root cause analysis and action plan all-inclusive in the system. Use of this system greatly enhanced quality performance monitoring in the hospital, identification of major bottlenecks that warranted hospital wide projects or departmental level projects. The QVR system enhanced efficiency and accuracy of quality monitoring from data collection through to performance reviews/evaluation. Development and setting up of the QVR system required seamless internet connectivity, a deeper understanding of Microsoft SharePoint server and spreadsheets program by the technical team, and a trained manpower for data entry and utilization of results. Due to flexibility of the spreadsheet programme and ease with which dashboards can be manipulated coupled with availability and low cost of acquiring the software, institutions mounting a framework of monitoring KPIs may adopt their use. The framework also provides an opportunity to understand how well various indicators can be measured and monitored. The system provides a blueprint for a customized M&E database system.

Limitations

1. **Knowledge gap in technology,** it took some time for some users to become acquainted with the Microsoft SharePoint access and utilization. This was overcome through continued training and having always an M&E and ICT staff member reachable to sort out any emerging issues.

2. **Limited knowledge in Microsoft Excel usage;** this was overcome through rigorous training between the quality department's M&E unit and the ICT department's training unit.
3. **Staff turnover** affected seamlessness with which data were captured. Some newly recruited staff encountered challenges before they were acquainted with the system.
4. **Server downtime** - during server downtimes access to the Microsoft SharePoint and documents saved therein was a big challenge until the server functioning was restored.
5. **Limitation to access documents** (essentially) Microsoft Excel files with data validation features or those which were password protection were not easily accessed using several browsers with the exception of Internet Explorer. This was sorted by setting the default browser to Internet Explorer for users' easier access and creation of desktop shortcuts to the SharePoint folders.
6. **Only a single user at a time could edit** a document on Microsoft SharePoint at any given time, during this time other users could only access the document on "read only" mode. For this reason we created multiple data entry sheets to allow many users to continue doing data entry seamlessly and encouraging them to close the data entry screens as soon as they completed accessing or updating.

Availability of data and materials

All data underlying the results are available as part of the article and no additional source data are required.

Acknowledgments

First and foremost we would like to thank the almighty God. Special thanks to each and every author who took part in the compilation of this paper. The quality department, ICT department as well as the entire fraternity of the Aga Khan University Hospital, Nairobi for their continued support since inception of the QVR system.

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Ahmad Aburayya

Dubai Health Authority, Dubai, United Arab Emirates

Thank you very much for this opportunity to read this research paper. The paper provides a description of a quality system that developed and implemented at the quality department of the Aga Khan University Hospital, which intends to mentor and evaluate hospital's performance indicators. While the research topic is interesting, the research objective and its question are not clear.

Furthermore, the perspective that the authors used to examine the phenomenon needs further explanation and clarification. Overall, this submission suffers from several major issues in terms of theoretical gap, theoretical contributions, research novelty, and research methodology. In addition, the paper was written as a business case study rather than a research paper.

1. Title: the study title is vague and causes confusion for the readers. In essence, the current literature in the healthcare context conceptualized M&E as the basis of further understanding the key components of M&E and M&E systems as an important public management tool used to demonstrate results. In healthcare the M&E system is a huge "comprehensive concept". Moreover, monitoring the healthcare outcomes or performance indicators "clinical and non-clinical" is considered only one part from a comprehensive quality monitoring system. Hence, I would suggest to change the study title to reflect the main aspect of the work by specifying KPI within the title.
2. Abstract: while the study problem statement was well explained at the beginning of this section, still the study abstract is uninformative in terms of providing useful or interesting information related to study objective, methodology used, data analysis tools, major study findings, and study implications. Therefore, the authors need to rewrite the whole section in a proper way.
3. Introduction: (a) Overall, I would recommend the authors use the journal instruction checklist to prepare the manuscript. (b) Although this section explained the practical need of the use of spreadsheets on a Microsoft SharePoint server, the authors need to provide more details and explanation on the study novelty, for example: "the M&E system using spreadsheets and even using more advanced systems such as IBM been tackling in the

healthcare context several times: so what is new?". (c) This section extremely suffers from lack of information related to the study theoretical gap. (d) The authors need to clearly mention the study objective and how its linked to the study gap that was found. (e) This section needs to provide more detail, background and information relevant to the study.

4. Methodology: this section is totally confused and needs to be fully rewritten. The study methods used are not clear and all the results presented do not match the methods described; for example: what is the research design used? Is this paper aimed to develop a KPIs tracking system or to investigate the effect of implementing the QVR reporting system in hospitals? What is the philosophical stand of this study "positivism or interpretivism"? Is it qualitative or quantitative? More explanation on the data collection method is needed. Moreover, further explanation on the study sampling approach is required - study sampling design, technique, target population or the unit of analysis. In addition, what were the main data analysis tools used? For example: if its a qualitative study that used interviews, did the authors use the thematic analysis to come up with the accomplishments observed since adoption of the QVR? The authors need to operationally define the determined KPIs and how they were measured. Also, more explanation on the criteria selection used to determine the indicators.
5. Results: All the results presented do not match the methods described. Indeed, the main reason of this outcome is the confusion made by the study objective. The study results are discussing the accomplishments observed since adoption of the QVR as a hospital quality M&E system which is not correlated with the study objective and its design.
6. Discussion & Conclusion: Overall, the conclusions are not correlated to the results found. In addition, the discussion section needs to be supported by several studies relevant to its findings.

Is the rationale for developing the new method (or application) clearly explained?

Yes

Is the description of the method technically sound?

No

Are sufficient details provided to allow replication of the method development and its use by others?

No

If any results are presented, are all the source data underlying the results available to ensure full reproducibility?

No

Are the conclusions about the method and its performance adequately supported by the findings presented in the article?

No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Business Management; Operation Management; Quality Management; Total Quality Management .

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 12 April 2022

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Khara M. Sauro

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Thank you for the opportunity to read this work. The authors describe the process and outcomes of implementing a quality monitoring system at their centre. The authors should be commended for a very thorough description of the monitoring approach and system, which was developed in a collaborative fashion. I have some comments to the authors regarding the details related to the indicators included, the methods for measuring their outcome variables and the flow of the manuscript.

First, I would recommend the authors use the SQUIRE reporting checklist to guide the format of the manuscript.

Indicator development: I appreciate that this system is being designed to be flexible and reflexive of the needs of the units; this is a strength. However, could the authors provide some examples of indicators and how they will be operationally defined and measured to help the reader understand potential options for the indicators? Could the authors also clarify the specific criteria required to determine the indicators? Will quality indicator or key performance indicator development methodology be used?

Outcome measures: In the results section there is some description of the outcome measures of this study (continuity of the monitoring and evaluation system, turnaround time, etc.). Could the authors elaborate on how these measures were determined to be the outcomes measures (rationale for choosing these variables) and how the data were collected for these measures?

Flow: The flow of the manuscript is challenging to follow. I appreciate the authors are trying to follow the formatting suggested by the journal, which may be the source of the issue. I wonder if might help to describe the "intervention" (the QVR) in the method section then have another section in the methods section for the outcome measures (continuity of the monitoring and evaluation system, turnaround time, etc.), then the results can be dedicated solely to the changes

in the outcome measures after implementing the QVR?

Minor comments:

- The middle 3 paragraphs of the introduction are better suited to the methods section.
- I am unclear what the sampling section refers to – is it the sampling for this study or for other studies using the dataset?

Is the rationale for developing the new method (or application) clearly explained?

Yes

Is the description of the method technically sound?

No

Are sufficient details provided to allow replication of the method development and its use by others?

No

If any results are presented, are all the source data underlying the results available to ensure full reproducibility?

No

Are the conclusions about the method and its performance adequately supported by the findings presented in the article?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Quality Improvement, Implementation Science, Health Services Research, Administrative Data Analysis, Systematic and Scoping Review

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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