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Uptake of a Dashboard Designed to Give Realtime Feedback to a Sentinel Network About Key Data Required for Influenza Vaccine Effectiveness Studies

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Abstract. Dashboards are technologies that bringing together a range of data sources for observational or analytical purposes. We have created a customised dashboard that includes all the key data elements required for monitoring flu vaccine effectiveness (FVE). This delivers a unique dashboard for each primary care provider (general practice) providing data to the Royal College of General Practitioners (RCGP) Research and Surveillance Centre (RSC), one of the oldest European surveillance systems. These FVE studies use a test negative case control (TNCC) design. TNCC requires knowledge of practice denominator; vaccine exposure, and results of influenza virology swabs carried out to identify in an influenza-like-illness (ILI), a clinical diagnosis, really is influenza. The dashboard displays the denominator uploaded each week into the surveillance system, compared with the nationally known practice size (providing face-validity for the denominator); it identifies those exposed to the vaccine (by age group and risk category) and virology specimens taken and missed opportunities for surveillance (again by category). All sentinel practices can access in near real time (4 working days in areas) their rates of vaccine exposure and swabs conducted. Initial feedback is positive; 80% (32/40) practices responded positively.

Keywords. Medical records systems, computerized, Systems Analysis, Vaccines, Vaccine effectiveness

1. Introduction

Dashboards are useful for visualising performance monitoring data derived from range of sources and presenting them for observational or analytical purposes. They are frequently used as decision making tools [1], due to their capacity to summarise information, increasing the human perceptual and cognitive capabilities [2]. There is an increased proliferation of dash board solutions [3], reflecting the increased importnace of data intensive transactions, 'big data' features emerging in many other domains and the integrated nature of most information solutions. Despite the potential role they can play in visualising key performance data and support decision making and the technical

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and data driven nature or much of its work the health care community have failed to keep pace with the developments in performance dashboards[4].

Internationally, sentinel networks monitor rates of influenza and other infectious diseases. Influenza requires surveillance because it has a different clinical pattern each year, and roughly every decade there is a pandemic The test negative case control (TNCC) method is the standard way that influenza vaccine effectiveness (FVE) is monitored and it has straightforward data requirements. The Royal College of General Practitioners (RCGP) Research and Surveillance Centre (RSC) is one of the oldest sentinel network systems in Europe, it has completed 50 seasons of surveillance. Its member practices provide data for FVE studies led by Public Health England.[5] However, missing data is significant; in the 2016/2017 analysis only 68% (2881/4251) virology swabs could be used in the final analysis. We developed a dashboard to provide practices near real time feedback as to the quality of their data, and to allow interventions to improve data quality.

2. Methods

2.1. Review of dashboard development strategies, designs and their implications

We reviewed the literature to identify the implications of dashboard formats, their design features and deployment strategies on end user adoption and effectiveness. Based on the general guidance adopted by the Information Systems domain on the three primary dashboard design considerations; (1) presentation format, (2) amount of information, (3) feedback and interactions, we wanted to establish the most effective approach for design a similar platform for the RSC network. In parallel we also reviewed the uptake and effectiveness of our current dissemination mechanisms, to ascertain the suitable presentation formats, correct amount of information load that would match the end user preferences. We have been utilising a combination of weekly PDF format newsletters and its online version to correspond with the member practices. The existing weekly RSC reporting workflow has an integrated ETL (Extract-Transfer-Load) process consisting of remote practice raw data file downloads, a data warehouse using Microsoft SQL server®, data loading process using Microsoft SSIS® (Systems Integration Service)-supported by in-house built data load scripts and a report generation process using Tableau® data visualisation applications. This setup had evolved, driven by a combination of stakeholder demands and cost-effective infrastructure elements available. It could be considered as a fit-for-purpose information architecture for a small research network. We then reviewed the available technical options to establish a suitable dashboard platform, to compliment this existing setup.

2.2. Development of the Dashboard

We created a set of wireframe models to determine most effective format for information presentation. The design was influenced by the format of information needed, their data sources and the overarching objectives of the RSC-member practice interactions. We did the design and development tasks adopting iterative and incremental approach. We evaluated a number of designs, followed by their prototype development and implementations. The final production version was then further tested for performance; we were considerate of the data linkage process i.e. how to feed data into the dashboard,

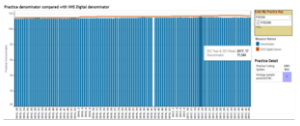
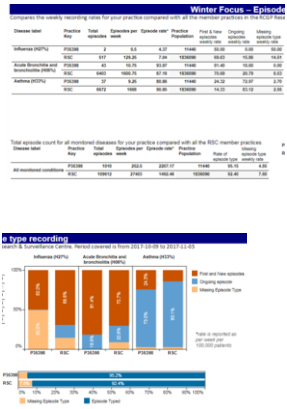
refresh time - so that practices could access data in near real-time and the demands this can make on the practice staff when interacting with the system, i.e. time taken, training or skills required, additional software requirements.

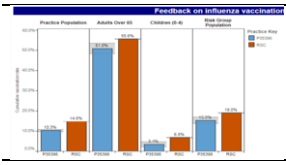
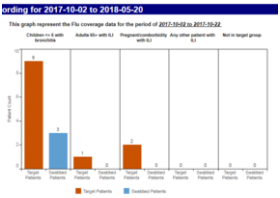
3. Results

3.1 'My practice dashboard'- design rationale

We developed the single common point of access named as 'My practice dashboard' (Table 1) using a publicly available web server space. The dashboard interface contains five key presentation areas, with combination of tabular and graph displays adopting a consistent colour scheme. Focusing on the usability and usefulness characteristics, we endeavoured to combine the 'unified whole' and effect of contextualised data suggested by the literature, by introducing the five focus areas; starting from a broader view and then to move towards more feedback oriented simulative elements.

Table 1. Summarises the purpose, presentation formats and features adopted in each of the focus areas.

Focus area	Purpose	Visual, functional features
Practice denominator and NHS digital denominator 	• Representing the denominator reported by the weekly data extraction, compared to that of the NHS digital dataset values. • Can identify significant gaps, missing data, data extraction issues and trends. • Confirms the practice upload occurred	• Graph data – bars representing each weekly data extraction denominator values, NHS digital reported values represented with a contrasting coloured line. • Hovering over a bar presented the week number and exact denominator value • Practice detail summary card
Episode type recording 	• Reporting the number of episodes reported for the key disease areas – practice values and overall RSC network values • Comparing the recorded episode types; First & new, Ongoing, Missing • Recording rates, numerators reporting for three key monitored conditions denominators- covering both practice and RSC • Improving data quality – recording accuracy, completeness – emphasising the importance of episode type recording.	• Use of two display groups; key diseases and all monitored diseases • Use of contrasting visual formats; tabular, vertical graph, horizontal graph. Graphs having high data-to-ink ratio • Presence of Contextual information: all rates reported for both the practice, and RSC network – stimulating comparison. • Hovering over a bar presents the exact data label, disease, type and rate • Numerical values in graph to support consensus
Influenza vaccination rates and recording	• Presentation of cumulative vaccination rates – practice population, adults over 65, children 0-4 and risk group • Reporting cumulative and weekly rates and counts	• Use of two display groups; Vaccine recording rates and recording • Use of two formats for recording rates to support contextualisation and consensus; tabular and

	• Vaccine recording data quality improvements– event only, prescription and batch data s, denominators- covering both practice and RSC	vertical graph with grouping, for practice and RSC • Separate horizontal graph to compare recording data completeness
Virology swabbing rate 	• Swabs taken, received, tested and incomplete status – weekly counts, and the total for the current flu season • Flu coverage data for the completed period; comparing the target patient counts with actual swabbed counts: improving swabbing and recording	• Drilled down data in tabular format– detailed view representing the performance data • Graph to visualise targets and achievements • Grouping within graphs to provide clarity; expected and actual values grouped based on age and diseases
Adverse event recording 	• Presentation of weekly recording rates for adverse events, for individual practice and RSC overall • Detailed presentation of coded data for adverse events; use of preferred codes and other code - improving data quality by promoting the use of preferred codes.	• Graph representing the weekly practice and RSC rates – horizontal graphs and rate values • Hovering over bars presents exact numerator values • Drilled down view in tabular format, with grouping – to present the use of preferred and other codes for reporting

3.2 Deployment and evaluation

We adopted a unique technical setup to create the data feed for the dashboard. In contrast to dashboard creation tools adopted by software engineers or resources available in other technical domains, as a small research team with primary care data focus, we wanted to converge the existing data sources and link them to the dashboard with minimal disruption to the existing workflow. However, the cost effective solution we opted for; the use a free public reporting server – Tableau public (http://public.tableau.com) meant, we had to create supplementary mechanisms for data aggregation, cleansing and validation. The free public server we used did not have features to link with multiple data sources. We resolved this by creating an additional data processing layer to merge multiple data sources into a single 'virtual data view' .

The new dashboard, supplements the weekly newsletters sent as emails. Within the first 6 months since the deployment, *My practice dashboard* has recorded 1056 views, with monthly view count averaging closer to 175. We have deployed an online questionnaire to collect more specific feedback. Out of the 40 responses received, 32 practices have acknowledged the dashboard as useful and influential information source while the remainder have cited restricted network access, data loading issues and lack of awareness as concerns. Main positive features acknowledged include the single view layout, weekly data summary, rates and values grouped into key performance areas and the comparative data representing overall RCGP RSC recording levels. The feedback available on swabbing, episode type recording and use of preferred read code were notes as having a positive influence on the data recording quality. Reduction of the number of

emails or phone calls received, availability of the dashboard for access anytime and the feature to download the content or project during meetings were also noted as positive contributions. Feedback for future improvements suggested the need for additional guidance for interpreting the graphs, inclusion of referral data, information about regional trends and having a separate layout for printing.

4. Discussion

This is the first time a performance dash board based platform has been used to provide near real-time feedback to a sentinel network. Despite the popularity of dashboards, there is no clear consensus on suitable design strategies, deployment rationale and functional or visual features that can be readily adapted to health care domains. Static nature of the traditional reporting approaches adopted in healthcare sector has contributed to poor and inconsistent decision making. The complex nature of the clinical information, variations in data recording and their implications on decision making mean despite the potential benefits, performance visualisation using dashboards has been explored little. Cost of dashboard deployment and the infrastructure concerns are also challenges [3,4]. Further evaluation is needed to establish the impact of the specific presentation formats, grouping and the deployment platform have on the end user satisfaction.

5. Conclusion

Dashboards are useful data driven decision support tools that can play a key role in improving clinical competence, evidence based practice and performance monitoring within the health sector. This study reports the viability of establishing cost-effective feedback platform using performance dashboard to enhance feedback dissemination and improve the quality of FVE studies in this sentinel network.

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References

[1] O.M. Yigitbasioglu, O. Velcu. A review of dashboards in performance management: Implications for design and research. *International Journal of Accounting Information Systems.* (2012) 13(1):41-59.

[2] H. Kerzner. *Project management metrics, KPIs, and dashboards: a guide to measuring and monitoring project performance*. John Wiley & Sons; (2017).

[3] H. Lempinen. Constructing a design framework for performance dashboards. *Nordic Contributions in IS Research.* (2012):109-30

[4] M. Ghazisaeidi, R. Safdari, M. Torabi, M. Mirzaee, J. Farzi, A. Goodini. Development of Performance Dashboards in Healthcare Sector: Key Practical Issues. *Acta Informatica Medica,* (2015). 23(5): 317–321

[5] S. de Lusignan, A. Correa, G.E. Smith, I. Yonova, R. Pebody,F. Ferreira, A.J. Elliot, D. Fleming. RCGP Research and Surveillance Centre: 50 years' surveillance of influenza, infections, and respiratory conditions. *Br J Gen Pract*. 2017 Oct;67(663):440-441