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Will social media banish the bleep? An analysis of hospital pager activity and instant messaging patterns

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BACKGROUND

Pagers or 'bleeps' have been used for intra-hospital communication for over 30 years but are time inefficient and antiquated. To investigate how social media has affected the use of pagers we compared pager activity with instant messaging patterns over a 6-month period in a large, UK, teaching hospital.

In 2017, it was estimated that 10% of the world's pagers were used in the UK National Health Service at an estimated cost of £6.6 million/year (a figure which does not include network costs or cost incurred by inefficiency).[1]

This antiquated technology is associated with a number of issues. Pagers are typically associated with substantial time inefficiency,[2] a quarter of pager messages are unnecessary[3] and 65% interrupt patient care.[4] Understandably, therefore, pagers are not popular with doctors.[2] In response to these shortcomings, the UK Health and Social Care Secretary has called for the health service to '#purgethepager'.[5]

Instant messaging on the wards either takes the form of informal, non-condoned usage via social media platforms such as WhatsApp (which are not designed for communication of patient information), or hospital-provided applications that are specifically tailored for clinical use. In 2018, a large university hospital introduced one such application, Medxnote, a mobile encrypted instant messaging application. After initial pilots, Medxnote was made available to all employees of the Trust in 2018. Pagers continue to be in use which provides a unique opportunity to assess the impact of a new technology on traditional patterns of hospital communication.

METHODS

Data collection

Message logs between 12 November 2018 and 30 April 2019 were provided by Medxnote. Logs included a unique, anonymised identifier for the sender and recipient(s) of each message and a date-time stamp. The hospital switchboard provided logs of all pager messages sent during the same time period including pager number and date-time stamp.

Analyses

Changes in total number of messages and number of users were calculated from Medxnote logs and compared with pager activity logs. Association was assessed using the Pearson correlation coefficient and Student's t-distribution was used to assess deviation from the null hypothesis of zero correlation between the platforms. An elementary social network analysis of the Medxnote network in the month of April 2019 treating users as nodes and messages as edges was conducted. All analyses were performed using Matlab V.2018b.

RESULTS

The total number of registered Medxnote users increased from 221 in November 2018 to 715 in April 2019. The total number of available pagers was 1176 throughout the monitored period.

As can be seen in figure 1A, there was a weekly pattern to both Medxnote and pager activity, with clear peaks of activity through the middle of the week and troughs of activity at the weekend. Although Medxnote activity was generally lower than pager activity (mean number of Medxnote messages was 1897.9 (SD=809.8) per weekday and 638.3 (SD=245.1) per day at the weekend; mean number of pager messages was 4752.6 (SD=866.6) per weekday and 2653.6 (SD=203.3) per day at the weekend), there was a high correlation between Medxnote messaging and pager activity (Pearson correlation coefficient 0.73; $p<0.001$), suggesting that Medxnote is potentially being used for clinical, rather than purely social, purposes.

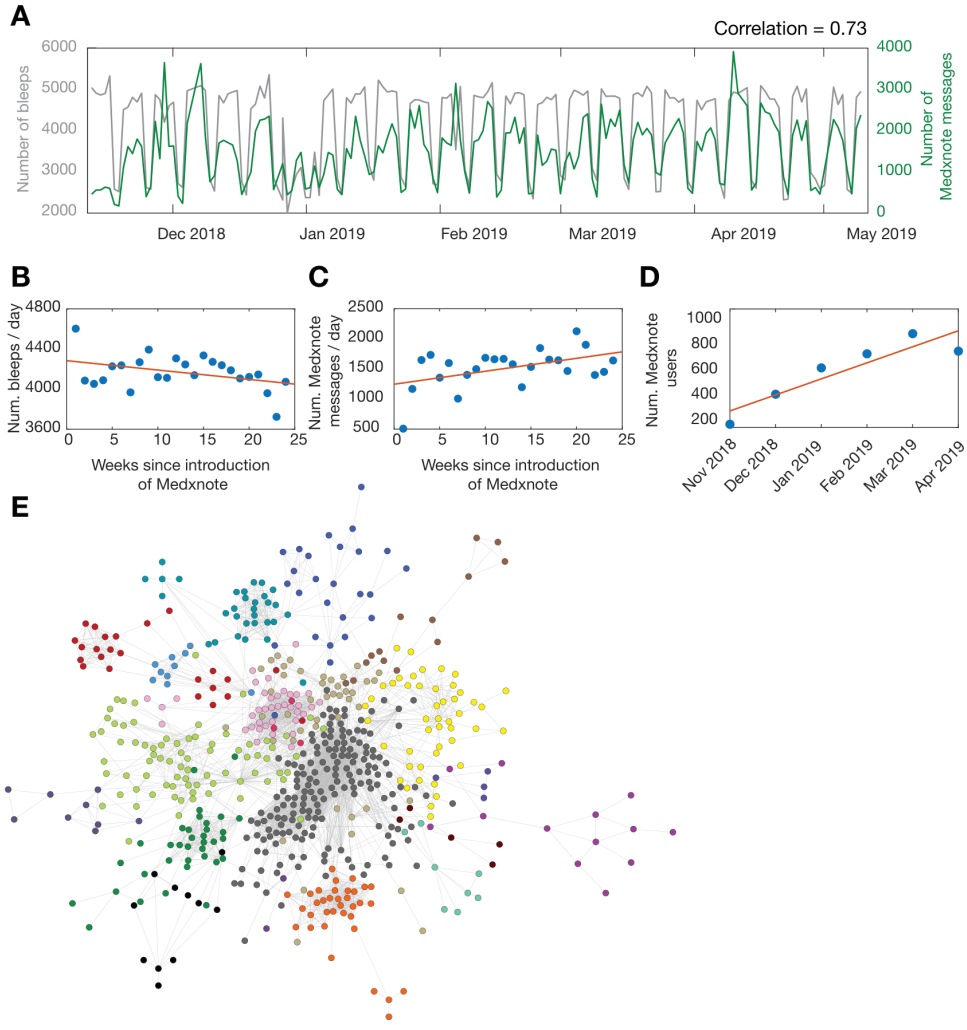

Figure 1 (A) Time series of the number of pager messages (in grey) and Medxnote messages (in green). A weekly pattern of peaks of activity during weekdays and troughs of activity at weekends is clearly seen in both data sets. (B) Pager activity declined modestly from November 2018 to April 2019. (C, D) Activity on Medxnote increased from November 2018 to April 2019. (C) Shows the total number of Medxnote messages per week since introduction; (D) shows the total number of Medxnote users per month. (E) The Medxnote social network in April 2019. Each node represents an individual user and each edge represents at least one message between a pair of users. Nodes are coloured by natural clusters using the edge-betweenness clustering algorithm of Girvan and Newman.

Pager activity showed a modest decline over the monitored period (see figure 1B), while Medxnote activity increased both in terms of number of unique users and number of messages sent per day (see figure 1C,D). This association was not significant ($p>0.05$ for Student's t-test), suggesting that users were not using Medxnote to send messages instead of the pager, but rather were using both systems concurrently.

The use of a social media platform such as Medxnote for hospital communication also provides an opportunity to study patterns of clinical communication from a social network perspective. We conducted a summary analysis of the structure of the Medxnote communication network for the period 1–31 April 2019 (ie, when it was at its largest over the monitored period). The social network for this time period contained a total of 610 nodes, representing individual Medxnote users active on the platform, and 3428 edges representing at least one message sent between users during April 2019.

Figure 1E shows the April 2019 Medxnote network. In this figure, nodes are coloured by natural clusters in the network using the edge-betweenness clustering algorithm of Girvan and Newman.[6] Only the largest connected component is shown excluding the Medxnote chatbot (which is connected to most nodes in the network). The network has a clear structure, indicating the existence of distinct, presumably clinical, communities. Some of these communities communicate intensively via Medxnote (eg, dark grey, light pink and yellow nodes) while some communicate more sparsely (eg, purple, black, mint green, dark blue and brown nodes). Furthermore, just as there were highly active and less active communities, so there were also highly active and less active individuals. Particularly, some individuals used Medxnote only

sporadically (these users correspond to nodes with low degree; ie, with few edges emanating) while others were heavy users (these users correspond to nodes with high degree; ie, with a large number of edges emanating). Such disparity is common in social networks, and imparts useful information concerning the spread of information through a community. Of particular importance to information transmission are 'bridge-users' who relay information between different clinical communities. For instance, the nodes coloured in dark grey and light pink often communicated with users from other communities, whereas the nodes coloured in red, orange, cyan and light blue had intensive yet localised patterns of communication. We anticipate that understanding these communication patterns in more depth could be of significant use in improving hospital management.

An important limitation is that data on methods of communication beyond Medxnote and pagers were not collected, and there may have been uncondoned usage of alternative forms of social media (including WhatsApp).

DISCUSSION

This summary analysis suggests that, while popular and potentially of significant benefit to hospital communication, instant messaging will not naturally displace pager activity. Rather, the removal of pager technology from hospital communication will require a more direct, proactive approach. Further work is required to analyse of differing usage across demographics and further explore the clinical role played by 'bridge-users'. We suggest that a more detailed understanding of patterns of communication within and between clinical communities on instant messaging platforms will be crucial to the management of this transition, has the potential to improve clinical communication and ultimately will be essential if we are to '#purgethepager'.

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Contributors NRF: conceptualisation, investigation, writing, project administration. HH: data acquisition, investigation, writing, project administration. BM: conceptualisation, data analysis, writing, supervision.

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