

Moving from non-emergency bleeps and long-range pagers to a hospital-wide, EHR-integrated secure messaging system: an implementer report

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To cite: Ercole A, Tolliday C, Gelson W, *et al.* Moving from non-emergency bleeps and long-range pagers to a hospital-wide, EHR-integrated secure messaging system: an implementer report. *BMJ Health Care Inform* 2023;**30**:e100706. doi:10.1136/bmjhci-2022-100706

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bmjhci-2022-100706>).

Received 21 November 2022
Accepted 12 April 2023

ABSTRACT

Introduction Obsolete bleep/long-range pager equipment remains firmly embedded in the National Health Service (NHS).

Objective To introduce a secure, chart-integrated messaging system (Epic Secure Chat) in a large NHS tertiary referral centre to replace non-emergency bleeps/long-range pagers.

Methods The system was socialised in the months before go-live. Operational readiness was overseen by an implementation group with stakeholder engagement. Cutover was accompanied by a week of Secure Chat and bleeps running in parallel.

Results Engagement due to socialisation was high with usage stabilising approximately 3 months after go-live. Contact centre internal call activity fell significantly after go-live. No significant patient safety concerns were reported.

Discussion Uptake was excellent with substantial utilisation well before cutover indirectly supporting high levels of engagement. The majority of those who previously carried bleeps were content to use personal devices for messaging because of user convenience after reassurance about privacy.

Conclusion An integrated secure messaging system can replace non-emergency bleeps with beneficial impact on service.

INTRODUCTION

In 2019, the UK Health and Social Care Secretary announced that the National Health Service (NHS) should remove bleeps and pagers for non-emergency communication by the end of 2021.^{1 2} While this technology is now in costly obsolescence and pilot studies have shown efficiency saving³ using smartphone messaging, legacy equipment remains firmly embedded in the NHS. Optimal strategies for adoption have received little attention⁴ and barriers to adoption have been identified.⁵

Cambridge University Hospitals (CUH) NHS Foundation Trust has used a comprehensive Electronic Health Record (EHR, Epic

Systems Corporation, Verona, Wisconsin, USA) since 2014. An information-governance compliant messaging solution (Epic Secure Chat) allows for messaging from smartphones, tablets or from within the EHR itself (desktop). The system is fully integrated with the patient chart so that messages and all read/reply times become part of the patient record. Large-scale implementation of an EHR-integrated messaging system to replace non-emergency bleeps/long-range pagers in an NHS organisation has not been previously described.

Setting

CUH is a large, tertiary referral centre in the East of England. It offers a diverse range of services with over 1100 beds and approximately 16000 staff. A significant EHR upgrade (from Epic 2017 to the November 2020 version) was undertaken during the implementation period bringing additional Secure Chat functionality. The implementation period also coincided with a major Wi-Fi infrastructure upgrade to give full coverage across the estate.

Our aim was to replace all bleeps/pagers apart from 'cardiac arrest', 'major trauma' and 'fire' with Secure Chat (online supplemental S1).

METHODS

Secure Chat was made available at our organisation in July 2021. A go-live date in early 2022 was initially chosen due to ongoing COVID-19 pandemic disruption and to leverage additional necessary Secure Chat functionality that would only become available after an Epic version upgrade planned for November 2021.

An implementation group with executive responsibility was formed with



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representation from the hospital's divisional structure to oversee the project. Socialisation was achieved by a network of 'clinical champions' and through regular communications including trust bulletin items, face-to-face and online question and answer events as well as information on screensavers and posters and offering at-the-elbow support in clinical settings. An etiquette guide was published to define appropriate use of different methods of communication. Our safety surveillance is described in (online supplemental S5).

Contact centre (online supplemental S2) workload was a key concern at the time of cutover since any communications difficulties would likely result in a call to an agent for help. For safety a transition period where contact centre

operatives would send messages both to Secure Chat and to existing bleeps for 1 week post go-live was planned. Secure Chat would not be available during (un)planned Epic outages for which the contingency was to fall back on an internal directory of alternative contacts securely maintained by the contact centre and this was widely publicised.

Secure Chat allows for various groups to enable team and role-based messaging. Because of system limitations at the time of the original implementation, our hospital had not fully implemented a sign-in system which we could leverage for automatic group creation. Instead, we created 'opt-in' groups to replicate existing roles, relying on staff to opt-in (out) at the beginning (end) of their duties (online supplemental S3).

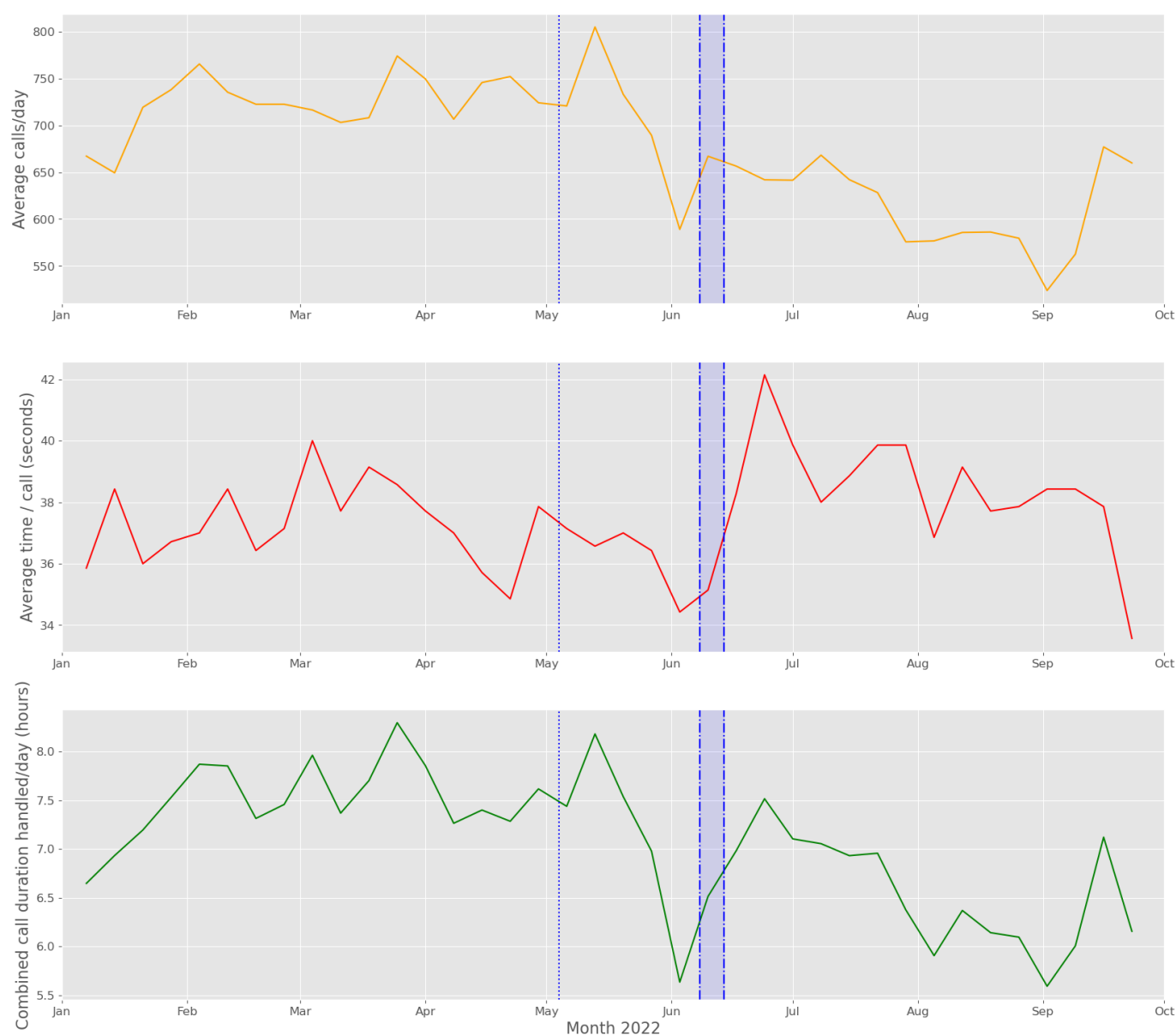


Figure 1 Uptake and organisational impact of Secure Chat implementation. Top panel: internal calls handled per day. Middle panel: average contact centre time spent per call (seconds) Bottom panel: total call time (hours). Dotted line represents date of delayed initial go-live. Data are averaged by week to remove fluctuations from weekends.

Mean comparison was with *t*-tests; structural breaks were examined using the Chow test. Statistical significance was taken at $p < 0.05$.

RESULTS

Technical

Secure Chat access was enabled for all members of staff with an Epic login. Non-clinical users, (such as contact centre agents, were not given security to view patient charts). Users who would previously have used bleeps were strongly encouraged to use their own personal devices although mobile phones (or pool phones) were provided in a relatively small number of cases where staff did not have a suitable device or were unwilling.

Workflow

For the mobile app, onboarding involved installation of a CUH-specific profile and a website was set up for this. An initial manual batch activation step was subsequently automated using Blue Prism robotic process automation software (Blue Prism group, Warrington, UK) so that registrations could be completed day and night.

The creation of opt-in groups was a major undertaking and had to be done centrally as no reliable list of baton bleep roles existed. An initial list of some 220 groups was compiled from information from clinical champions and existing bleep lists. After some local user acceptance testing, these groups were made available in December 2021. Inevitably creation, editing and deletion of groups was necessary, and this needed to be done centrally: a review process was set up to ensure consistency.

Outcomes

Adoption through socialisation in the months before go-live across all staff groups was rapid (online supplemental figure S2,S3) across all staff groups with pharmacy (and pharmacy technicians) proving to be an unexpected early adopter. The original 4 May 2022 go-live date was pushed back at a final go/no-go meeting to 8 June 2022 due to isolated specialty-specific readiness concerns. Gross total messages sent plateaued at over 600 000 by 3 months after cutover. Opt-in group maintenance peaked before go-live (online supplemental figure S4) although a significant maintenance burden occurred after the original 4 May date.

Internal call data handled by contact centre operatives is shown in figure 1. The average number of internal calls handled by contact centre operatives fell from 720 to 614 per day ($p < 0.0001$) after implementation. While average time/call increased marginally from 37 s to 38 s ($p = 0.014$), the total call duration per day fell overall by nearly an hour from 7.4 hours to 6.5 hours per day ($p < 0.0001$). There was evidence of significant structural

breaks for call numbers and average call time, but not for overall call time ($p = 0.01$, 0.0003 and 0.06 respectively).

No significant risk events attributable to the Secure Chat implementation were reported (online supplemental S5).

DISCUSSION

We demonstrate that secure messaging can be implemented in a tertiary NHS hospital without significant incident or negatively impacting on contact centre activity. This was possible even without physically retiring the legacy system: bleep counts dropped to negligible levels (online supplemental figure S3) which is important as multiple coexisting communication methods risk overload.⁵

It is anticipated that the bleep system will be decommissioned in due course depending on a future resilience analysis.

While a minority of staff expressed reservations before go-live citing privacy concerns we were able to provide assurances; most were ultimately content to use their personal devices which offered convenience advantages. The largest complaint received from users concerned inappropriate use of Secure Chat for non-urgent messaging. This is a known issue³ but the etiquette guide which set out clear expectations was key central to empowering staff to challenge inappropriate messaging.

A number of short (1–2 hours) routine Epic upgrade outages have subsequently taken place (scheduled at weekends and night-time) during which time Secure Chat was not available. Concerns that the contact centre could be overwhelmed at these times have not materialised.

CONCLUSIONS

We were able to effectively replace non-emergency bleeps/long-range pagers with a messaging system integrated with the patient chart in a large NHS academic hospital by the soft approach of socialisation before cutover. Discounting the time before our EHR upgrade in November 2021, we were able to do this in 7 months with message numbers and support needs stabilising within approximately 3 months of go-live using existing infrastructure and without significant incident.

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Acknowledgements The authors thank the CUH eHospital team and Management Executive for support and engagement with this initiative. The authors also thank Joseph Scott, Richard Wallis, Benjamin Stylianou, Rose Cormie and Olivia Bentham for their help in obtaining implementation data.

Contributors All authors were involved in the implementation of the project. AE wrote up the project with approval from all other authors.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None at the time of implementation however AC will be leaving the role of Director of Digital at Cambridge University Hospitals in February 2023 to take up a post with Epic Systems Corporation. (This is not a conflict of interest as per the COI form but we include it for complete transparency.)

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data sharing is not applicable as no data sets were generated and/or analysed for this study.

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SUPPLEMENTARY MATERIAL

Moving from non-emergency bleeps and long-range pagers to a hospital-wide, EHR-integrated secure messaging system: an implementer report

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S1 Definitions and scope

Two legacy forms of unidirectional numeric pager communication remain prevalent in the NHS. The most ubiquitous are short-range messaging pagers which rely on local telecommunication equipment maintained by the institution with signal extending only over the campus. We refer to these as 'bleeps'. Only numeric messages (entered by telephone key-pad) are supported. A much smaller number of long-range pagers are also used. These are provided by national telecommunications providers and are used for messaging staff who need to be contactable both on and off the campus.

Historically we have two parallel bleep systems at CUH: Zetron and Blick. Replacement of both bleeps and long-range pagers was in scope for this project. Of note, a subset of (Blick system) bleeps with voice announcements are also used at CUH for 'emergency' communication (for adult / paediatric / obstetric cardiac arrest, major trauma and fire). These were not in scope since emergency communication does not form part of the national mandate.

S2 Hospital communication and call centre workflow

The bleep systems at CUH were numeric systems. Usual internal workflow was for staff within the hospital to dial the bleep number on dual-tone multi-frequency internal phones and then key in their extension for call-back.

Additionally, the hospital call centre (CUH 'contact centre') provides a hub to facilitate both internal and external calls. The contact centre is on-site and manned 24/7 by CUH agents. The contact centre also maintains a (voluntary) database of staff mobile phone / alternative contact details: calls may be connected if appropriate but such numbers are never disclosed. It also manages rota software which provides detail of which providers are on duty (either by name or by role) and their primary mode of communication, making this available on the hospital intranet for self-service.

S2.1 Historical workflow

Rota database: the database contains the default contact mode for on-duty personnel. This may take the form of on-call bleep numbers (either bleeps for named individuals or 'baton' bleeps) are published for self-service on the hospital intranet. A few Trust mobile phones are also in use and these details are published. Some on-call specialties (e.g. intensive care consultants for admissions) require a phone call as a primary form of communication and this is listed as 'mobile phone, via contact centre.

Internal calls: users may also call the contact centre and ask to speak to providers. The contact centre operative puts the caller on hold and bleeps / pages the requested provider as appropriate with a call-back number. The two calls are then connected if and when they answer.

External calls: external callers may also call the contact centre and ask to speak to providers or to be put through to a specific bleep number. Again, the contact centre operative puts the caller on hold and bleeps / pages the requested provider as appropriate. The calls are then connected if and when they call back.

S2.2 replacement workflow prior to introduction of Secure Chat

Rota database: only provider names or opt-in group names are published so that users can secure chat directly. Other phone workflows remain the same.

Internal calls: users may also call the contact centre and ask to speak to providers. The contact centre operative puts the caller on hold and sends a Secure Chat message to the provider or opt-in group. The message contains a call-back number and, optionally, a brief message. The contact centre operative is able to see if the message has been read. The calls are then connected if and when the requested provider calls back.

External calls: external callers may also call the contact centre and ask to speak to providers or to be put through to a specific bleep number where this is externally known. Again, the contact centre operative puts the caller on hold and sends a Secure Chat message to the requested provider or opt-in group as appropriate. The message contains a call-back number and, optionally, brief details of the caller. The contact centre operative is able to see if the message has been read. The calls are then connected if and when they call back.

S2.3 cutover period workflow

For one week after go-live, the contact centre ran both systems in parallel. I.e. as well as sending a secure chat message, the agent would also send a bleep message with a call-back number.

S3 Secure chat description

Secure chat works similarly to other messaging applications. Any number of users can participate in a chat. Within a chat, it is possible to see when a message has been read and by whom. We have chosen to permanently store all patient related messages in the patient's chart with send / read times. Non-patient related chats are erased after a month. The app is sandboxed and does not track users or access the users phone (except that clinical photographs may also be securely sent if the user grants permission to access the camera).

Secure chat is a user-to-user messaging system. Epic also offers the concept of opt-in groups. We have created these groups centrally so that names are curated (e.g. "Cardiology ward doctor (ward xyz)", "Surgery urology clinical fellow", "Physiotherapy (surgery)". One or more staff may then opt in to these groups when in these roles. Staff outside the groups can message the group rather than the individual. In this way it was possible to replicate 'baton bleeps'.

S4 Etiquette guide

We compiled an etiquette guide from best practice acquired by Epic from various customers. We do not reproduce it in full for copyright considerations however, in essence the key elements are as follows:

- Allowed modes of communication.
 - Emergency communication (e.g. cardiac arrest, major trauma, fire: voice notification pager).
 - Urgent patient-related communication: Secure chat or phone call (depending on clinical area).
 - Urgent non-patient related messaging: Secure chat or phone call (depending on clinical area).
 - Non-urgent, patient-related messaging: Epic in basket (EHR integrated 'email-like' system for results and general messaging).
 - Non-urgent, non-patient related messaging: NHS email.
- Messaging platforms other than Secure Chat must not be used.
- Where secure chat messages are not responded to in an appropriate timescale, users should try a different means of communication escalate to another member of staff.
- Sending a message without obtaining receiving an urgency-appropriate acknowledgement does not in itself constitute discharge of duty.

S5 Safety surveillance

We created a specific Secure Chat incident type in our Quality Surveillance information System (QSiS). This is a central portal for logging of all quality and safety events for reporting and is culturally well-embedded at CUH. At the time of writing there had been only 15 QSiS tickets raised. 8 of these came from a single service and related to perception that they had been messaged inappropriately. The remaining tickets concerned reports of medical personnel not responding in a timely way to Secure Chat messages. There were no reports of harm to patients.

The implementation group also acted as a conduit for concerns from clinical areas across all divisions of the hospital. There was feedback from sporadic incidents similar to those submitted to QSiS. Again, no harms were reported. There were two second-hand reports of decreased mobile phone battery life which has been cited in [5] as an adoption barrier however these could not be substantiated.

The implementation team is not aware of any incidents where Secure Chat has been found to be a causative factor to date.

S6 Message volumes over time

Figure S1 shows mean messages per month per provider for the organisation as a whole and for selected provider types. Indicative numbers for each provider type were taken to be the number of active employer ('EMP') records in Epic at the time of writing which may marginally overestimate numbers depending on timeliness of offboarding processes. A plateau seems to be apparent some 3 months post-implementation.

It is noteworthy that large volumes of messages were seen as early as January 2022. This was well before cutover and before strong messaging that bleeps and pagers were to be retired. This suggests a high level of user engagement in a number of groups.

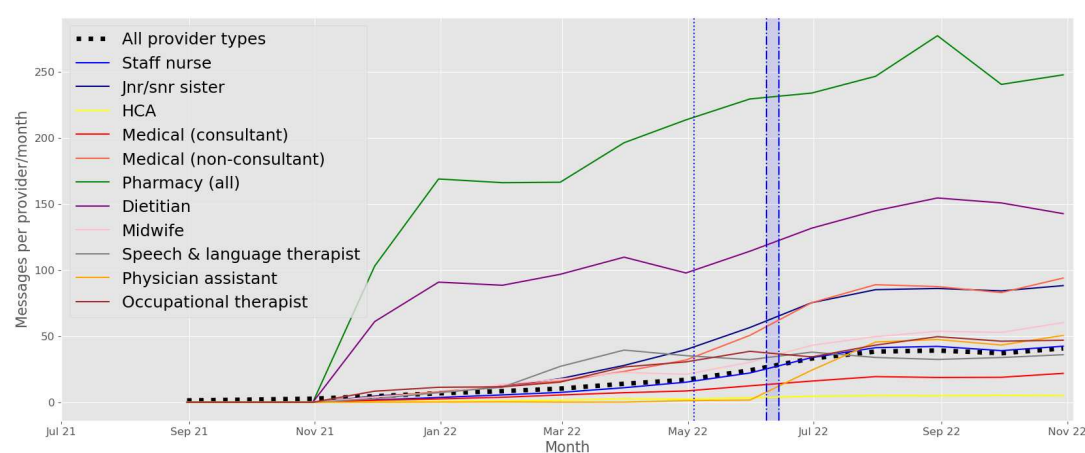


Figure S1 Messages per provider per month, for selected provider types. A plateau seems to be apparent some 3 months post-implementation. Shaded blue area represents post-go live parallel bleep/secure chat period. Dotted line represents date of delayed initial go-live.

The equivalent gross number of messages is shown in Figure S2 and reaches approximately 600,000 messages / month across the organisation.

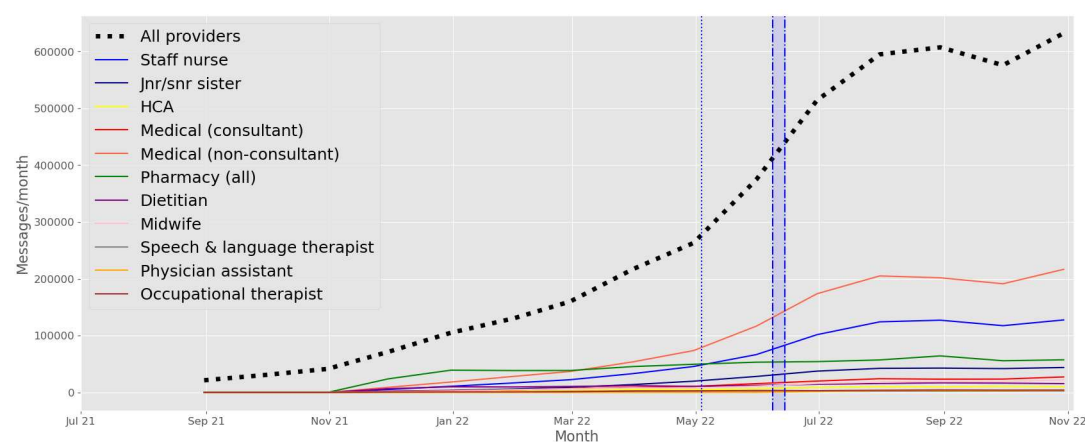


Figure S2 Gross messages per month (total for the organisation and by selected provider types). Shaded blue area represents post-go live parallel bleep/secure chat period. Dotted line represents date of delayed initial go-live.

Whilst our bleep system has not been physically retired today, Figure S3 shows a substantial reduction in bleep count for our Zetron system. Whilst we did not capture specific metrics of staff engagement, this is supportive of the notion that staff were content to change from the old system to the secure messaging solution.

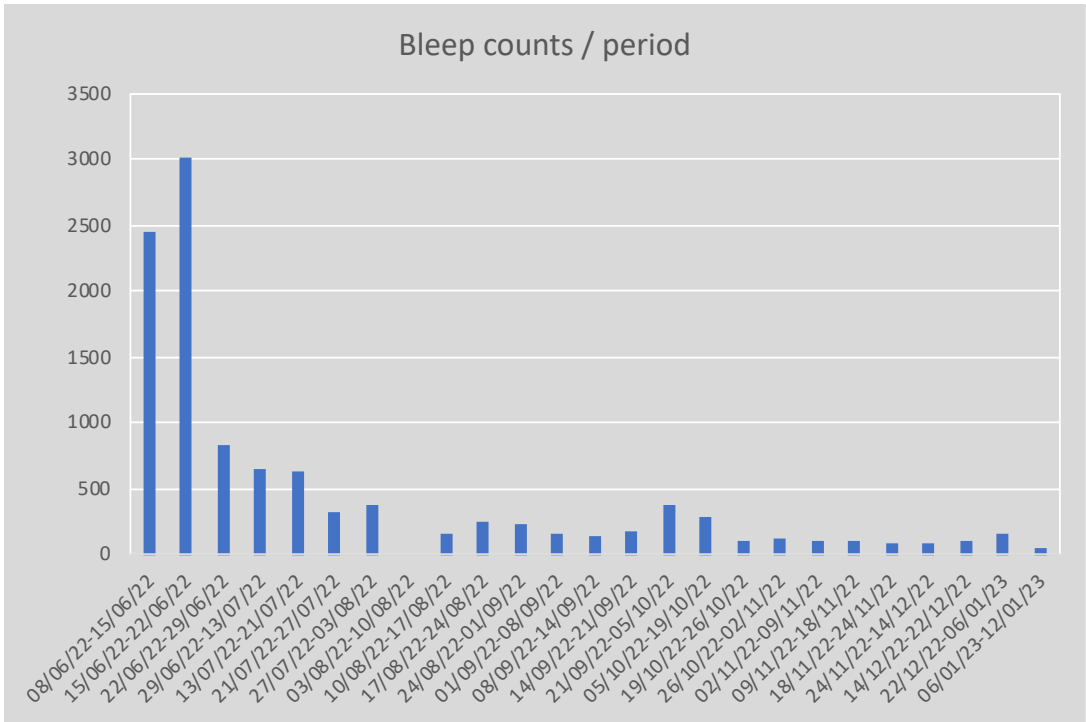


Figure S3 Bleep counts from our Zetron paging system over time (data for our Blick system were not available). A snapshot audit of the most frequently messaged devices suggested that they were, in fact, largely no longer being actively answered.

S7 Service desk impact over time

Opt-in groups need to be created centrally by our EHR team. Figure S2 shows opt-in group maintenance activity over time as a proxy for technical maintenance demand.

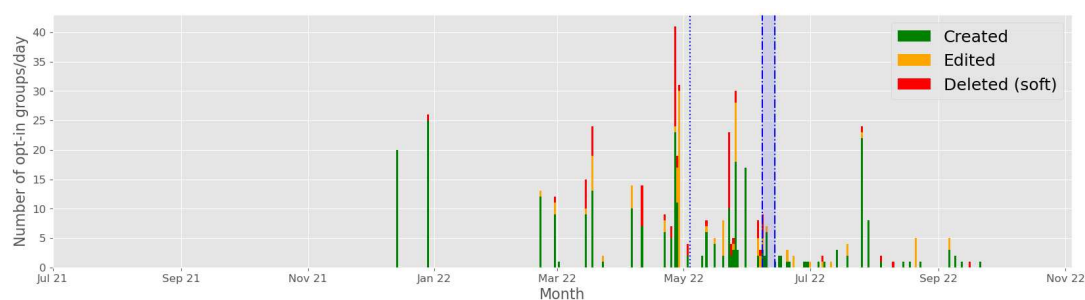


Figure S4 Opt-in group maintenance activity as a proxy for technical maintenance demand. Shaded blue area represents post-go live parallel bleep/secure chat period. Dotted line represents date of delayed initial go-live. Most of the activity occurred before go-live although spiked after the initial aborted date suggesting that some areas had not properly considered this at that time.