

Original Article

Rahul Ghelani

MBBS¹*

Edd Maclean

MBBS²*

Myra Adra

MBBS¹

Sarah Anderson

MBBS¹

Anshu Arora

MBBS¹

Charlotte Aylward

MBBS¹

Harmit Bindra

MBBS¹

Christine Carter

MBBS¹

Max Denning

MBBS¹

Naim Dib

MBBS¹

Sile Egan

MBBS¹

Laura Ganis

MBBS¹

Heather Illing

MBBS¹

Doaa Rajab Kerwat

MBBS¹

Megan Knight

MBBS¹

Samantha Maden

MBBS¹

Mark Murphy

MBBS¹

Sam Myers

MBBS¹

Ganesha Mootein

MBBS¹

Hannah Penicott

MBBS¹

Marie-Claire Rooney

MBBS¹

Harpiar Seehra

MBBS¹

Farzad Shams

MBBS¹

Daniel Yauwan

MBBS¹

Ragave Yogarajah

MBBS¹

Hongguang Zhu

MBBS¹

(The SWITCH Investigators)

Affiliations

¹ The Royal London Hospital (Barts Health NHS trust), Whitechapel Rd, Whitechapel, London E1 1FR

² William Harvey Research Institute, Queen Mary University of London, Mile End Road, Bethnal Green, London, E1 4NS

* These authors take joint responsibility as first author

Correspondence

Edd Maclean

William Harvey Research

Institute

Queen Mary University of

London

Mile End Road

Bethnal Green

London

E1 4NS

Email: e.maclean@nhs.net

Identifying avoidable switchboard delays in England's NHS hospitals: phase one of the national SWITCH project

R Ghelani, E Maclean, M Adra, S Anderson, A Arora, C Aylward, H Bindra, C Carter, M Denning, N Dib, S Egan, L Ganis, H Illing, DR Kerwat, M Knight, S Maden, M Murphy, S Myers, G Mootein, H Penicott, MC Rooney, H Seehra, F Shams, D Yauwan, R Yogarajah & H Zhu

Abstract

Background: Inter-hospital communication frequently requires mediation via a switchboard. Identifying and eliminating switchboard inefficiencies may improve patient care.

Methods: All 175 acute hospital switchboards in England were contacted six times. Call contents and duration were recorded. No clinician calls or bleeps were connected.

Results: The mean delay before contacting a switchboard operative was 55±46 seconds. 115 hospitals (66%) used automated switchboards; 34 of these (30%) had infection control messages. Robot operators introduced an additional 40 second delay versus humans (mean 70.3±28 versus 29.8±23 seconds, $p<0.0001$). Multivariate analysis identified robot operators (HR 5.1, $p<0.0001$) and infection control messages (HR 2.9, $p=0.003$) as predictors of delays over 60 seconds.

Conclusions: There are significant avoidable delays in contacting switchboard operatives across England. Quality improvement is underway.

Keywords

switchboard response times, robot operators, infection control messages, delay, quality improvement

Key points

- There are significant avoidable delays encountered when using hospital switchboards throughout England
- Inefficient automated triage and mandatory infection control messages delay contact with the target clinician
- Human operators outperform their robot counterparts
- Quality improvement work is required

Introduction

The Organisation for Economic Co-operation and Development (OECD) recently reported a high prevalence of wasteful healthcare spending amongst its member countries, including the UK.¹ Accordingly, the efficiency of the UK's National Health Service (NHS) is frequently discussed in both the political sphere and the national media. Rising costs are required to maintain the expected high standards of care, with The NHS Five Year Forward View predicting a funding gap of £30 billion by 2020/21 based on a mismatch between available resources and increasing patient needs.² A target to save £22 billion by 2020 has consequently been established, however analysis suggests that this is unlikely to be achieved without extensive efficiency savings.³

In addition to their obvious fiscal ramifications, NHS inefficiencies can be deleterious to both public

opinion and staff morale. For example, it has been reported in national surveys that junior doctors commonly feel “stretched” with their workload being “unmanageable” at times.⁴ Improving efficiency is therefore likely to be critical for the survival of the NHS, both as a cost-saving measure and as a tool for improving the working conditions of healthcare professionals.

Quality improvement work is an important vehicle for identifying suboptimal practices and delivering change. This continues to develop as a culture in healthcare and is now a mandated component of postgraduate training for doctors.⁵

The hospital switchboard: a target for improving efficiency?

In order to identify areas for improvement, it is necessary to examine the disparate roles of a healthcare professional. Communicating with other specialist

Identifying avoidable switchboard delays in England's NHS hospitals: phase one of the national SWITCH project

clinicians for expert guidance is a routine task. In the NHS, specialist services are increasingly centralized into tertiary referral centres; this often obliges healthcare professionals to contact other hospitals for their input. Such inter-hospital communication frequently requires mediation via a telephone switchboard. However, inefficient automated triage or mandatory recorded messages, for example those regarding infection control policy, can delay contact with the target clinician and disrupt patient care. This delay may have significant ramifications, particularly in time-critical emergencies such as acute myocardial infarction and stroke. Even in less acute scenarios, the cumulative effect of these delays is likely to waste time in a busy environment, contributing further to healthcare professionals feeling “stretched”.

Several measures to try and reduce these delays are already in place. For example, in some NHS trusts, services dealing with life-threatening conditions such as interventional cardiology and stroke medicine are contacted through direct dial phones. There are also mobile phone applications, such as ‘Induction,’ which provide the contact numbers and bleeps of other healthcare professionals working in the same NHS trust, allowing users to bypass the switchboard system.⁶ However, despite these measures, the use of a hospital switchboard and its associated potential delays remains a daily necessity for many NHS staff.

To our knowledge, there is minimal data on the duration and nature of NHS switchboard delays, however Sothinathan et al have previously reported the average response time of NHS hospital switchboards to be 48 seconds.⁷ To identify targets for improvement, more detailed analysis is required, and hence we established the national SWITCH (Stop Waiting In This Country's Hospitals) project.

Aims

Our principal aim was to measure the time taken to reach a switchboard operator capable of delivering bleeps (i.e. the ‘bleep operator’) for every acute hospital in England. From this data we would analyze sources of avoidable switchboard delays for each hospital, with a view to identifying trends as targets for future quality improvement. We hypothesized that factors such as time of day, day of the week, catchment area population and the various use of human or robotic operators – in particular the duration and content of any recorded messages – would affect switchboard response times.

If clear trends in avoidable switchboard delays could be identified, subsequent remedial work to reduce these on a national scale may lead to significant improvements in inter-hospital communication, and consequently in patient care and healthcare professionals' working conditions.

Methods

Ethics

Our project was registered with the local Clinical Effectiveness Unit, and Healthcare Quality Improvement Partnership (HQIP) guidelines were consulted for ethical advice. As no patients were directly involved in our data collection, the need for formal ethical approval was waived.

Data collection

The nhs.uk service directory was used to identify all NHS trusts in England.⁸ From these, we identified all hospitals who provided emergency medical, surgical, paediatric or obstetric services, and may therefore need to be contacted urgently via their hospital switchboard at all hours. We excluded community trusts that did not make use of hospitals with acute services, and also excluded Ambulance trusts and standalone Psychiatric institutions. We identified 175 acute hospital switchboards in England.

All included switchboards were contacted externally on 6 occasions between July–September 2018: twice on a weekday morning (0800–1100 – excluding Monday), twice on a weekday evening (1800–2000) and twice on a weekend (1000–1200). Monday mornings were excluded to avoid the potential skew produced by a ‘Monday morning rush’ in switchboard traffic. The evening timings were chosen to examine responses after the traditional working day but before the start of the nightshift. The duration and contents of each call – including any recorded messages or switchboard options – were documented electronically. No clinician calls or bleeps were connected.

Statistical Analysis

Statistical analysis was performed using R and XLSTAT. Categorical group parameters were compared using Chi square tests. The Shapiro-Wilk test identified whether or not data were normally distributed. Subsequently, continuous data were analysed either with t tests (two groups) or one-way ANOVA (three groups) for normally distributed data, or with the Mann-Whitney U test (two groups) or the Kruskal-Wallis test (three groups) for non-normally distributed data. Multivariate analysis was performed in R; hazard ratios for significant factors are provided. Correlation was assessed via Pearson's coefficient. The level of significance was set at $p < 0.05$.

Results

Across England, the mean delay before speaking with a bleep-capable switchboard operative was

Identifying avoidable switchboard delays in England's NHS hospitals: phase one of the national SWITCH project

Table 1. Mean switchboard response times according to time of day and day of the week (p value according to one-way ANOVA)

Time of call	Mean delay (seconds) before contact with switchboard operative	p value
Tuesday-Friday (0800-1100)	60.1 (±44)	0.003
Tuesday-Friday (1800-2000)	57.1 (±54)	
Saturday-Sunday (1000-1200)	48.1 (±37)	

55(±46) seconds (range 3–248 seconds). Variations in switchboard response times according to time of day and day of the week are shown in table 1.

115 (66%) of switchboards used a robotic operator. Of the robotic switchboards, 45 (39%) did not offer contact with another clinician as the first keypad option. 34 (30%) robotic switchboards had mandatory recorded messages regarding infection control policy. On average, use of a robotic switchboard introduced an additional 40 second delay in response time over human operators (mean 70.3 ±28 seconds versus 29.8 ±23 seconds, $p<0.0001$). The comparative performance of human and robotic operators is shown in figure 1. A single outlier (mean 248 seconds) was excluded for graphical purposes.

Geographical variation in switchboard performance was examined using population density data from the 2011 UK census and a standard cartographic division of England into nine regions

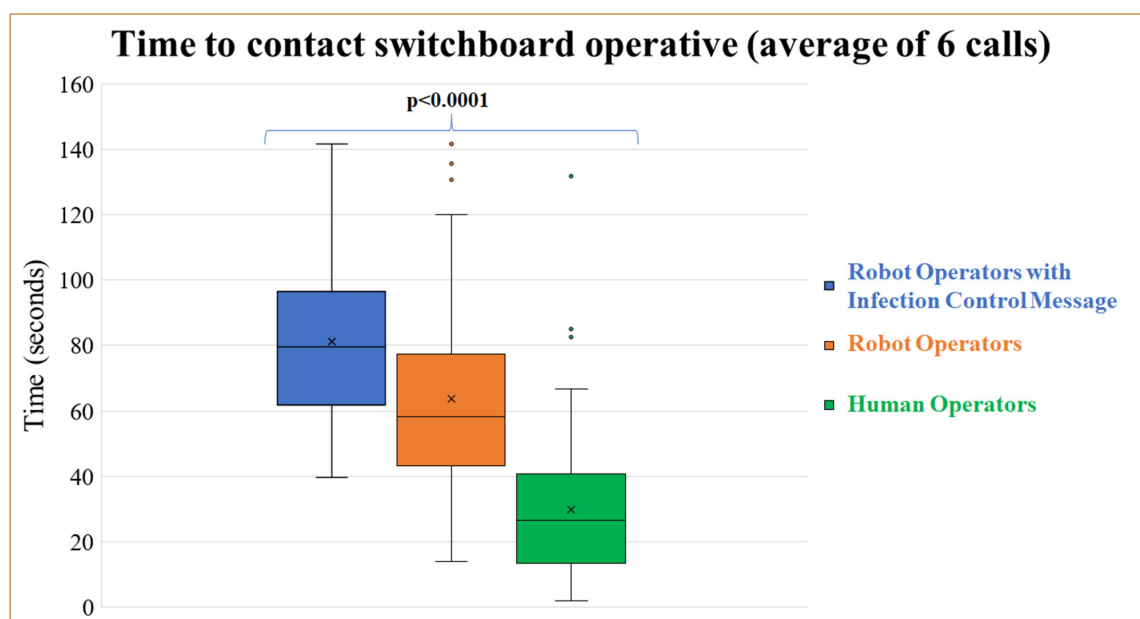


Figure 1. Box plots showing mean (x), median and IQR of switchboard response times for human operators (n=60, mean 29.8 seconds), robot operators without infection control messages (n=81, mean 63.7 seconds), and robot operators with infection control messages (n=34, mean 81.2 seconds)

Table 2. Geographical region, population density and associated switchboard response times (p value according to whole group one-way ANOVA of response times)

Geographical region (number of switchboards)	Population density (people per km ²)	Mean switchboard response time (seconds)	p value
London (n=31)	5200	79.8 (±49)	0.0006
South East (n=30)	452	56.4 (±20)	
East of England (n=10)	306	51.7 (±28)	
South West (n=20)	222	50.4 (±25)	
North West (n=24)	498	40.5 (±32)	
East Midlands (n=19)	302	64.4 (±34)	
West Midlands (n=13)	430	64.2 (±33)	
Yorkshire and the Humber (n=21)	343	40.9 (±26)	
North East (n=7)	290	34.5(±18)	

Identifying avoidable switchboard delays in England's NHS hospitals: phase one of the national SWITCH project

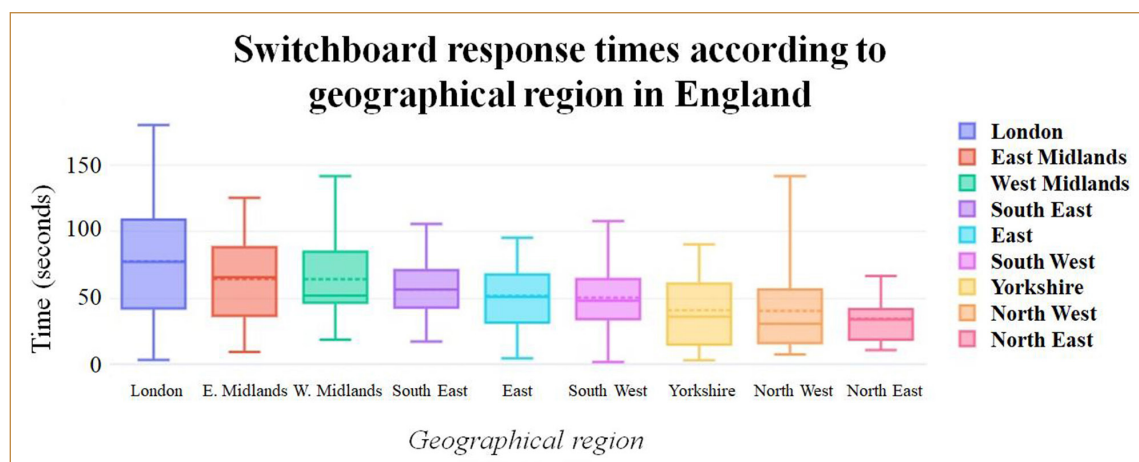


Figure 2. Box plots showing switchboard response times (mean: dotted line, median: solid line, and IQR) according to geographical region

(table 2). A positive correlation was identified between mean switchboard response time and regional population density was identified ($R=0.31$, $p<0.0001$). Box plots showing this distribution are seen in figure 2.

To further investigate the impact of robotic operators, recorded messages and geographical variation, logistic multivariate regression analysis was performed against the binary outcome of a phone call lasting over 60 seconds. Adjusting for geographical area, this analysis identified use of a robot operator (HR 5.1, $p<0.0001$) and mandatory infection control messages (HR 2.9, $p=0.003$) as powerful predictors of switchboard delays over 60 seconds.

Discussion

Our findings show there are significant but potentially avoidable delays in contacting switchboard operatives – and therefore target clinicians – across England. These delays are likely to have a considerable cumulative effect on healthcare

professionals' working output, and also have the potential to obstruct patient care in emergency scenarios. Figure 3 demonstrates key sources of delayed response times.

The finding that the longest delays are encountered on weekday mornings could be explained by several factors. Inter-hospital communication may be required to assist with decisions from the morning ward round or deferred from overnight. Staffing numbers are also likely to be higher during the working week, and relatives are more likely to contact hospital switchboards during daylight hours, all contributing to a demonstrable 'peak' time.

The majority of hospitals made use of an automated – or 'robotic' – switchboard; this was associated with markedly longer delays when compared with human operators. If an automated switchboard also included a recorded infection control message, there was a significant – and independent – additional delay. The high prevalence of robotic switchboards is likely to represent a cost-saving measure for trusts by reducing the number of employed human operators; whether the associated inefficiency of robotic switchboards annuls these savings has not been investigated.

These findings present targets for quality improvement. Clearly, the removal of mandatory infection control messages would streamline interhospital communication, but the projected impact of doing so on the incidence of seasonal viruses is uncertain. In the case of influenza, important public health measures – such as vaccination and patient cohorting – have been found to reduce the burden of infection on the community and the inpatient population, however, the impact of recorded switchboard messages has not been assessed.¹⁰ Using data from Public Health England's surveillance of influenza in England,¹¹ we analysed the relationship

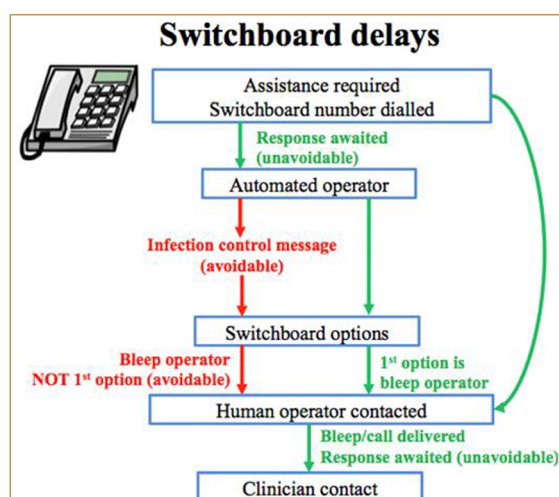


Figure 3. Schematic demonstrating sources of avoidable switchboard delays in a typical inter-hospital telephone call

Identifying avoidable switchboard delays in England's NHS hospitals: phase one of the national SWITCH project

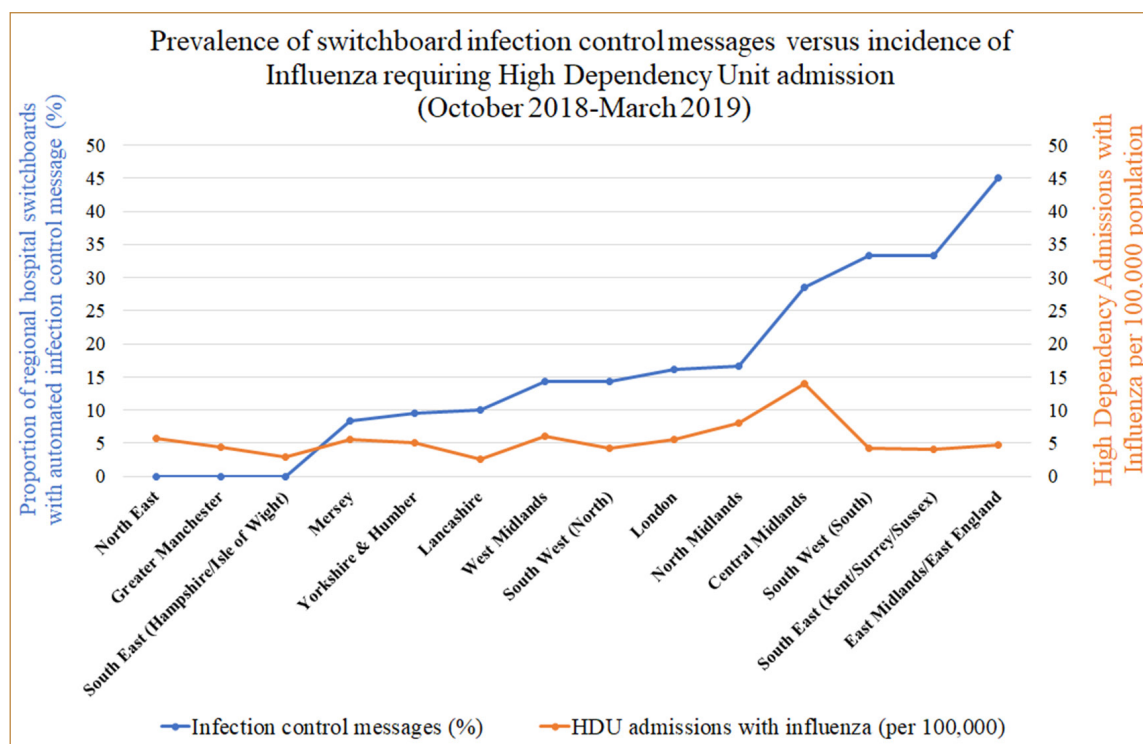


Figure 4. Relationship between the prevalence of switchboard infection control messages (%) and the incidence of influenza requiring HDU admission according to geographical region (Influenza data: Public Health England)

between the prevalence of switchboard infection control messages and the incidence of influenza requiring admission to the High Dependency Unit (HDU) or Intensive Care Unit (ICU) of regional sentinel surveillance hospitals (Figure 4).

There was no clear evidence of an association between the use of infection control messages and reduced HDU admissions for influenza; indeed, paradoxically, by Pearson's coefficient only a very weak positive correlation was identified ($R=0.22$, $p=0.45$). In addition, all healthcare professionals receive mandatory training on infection control, and as such recorded messages provide redundant information for these switchboard users. Consequently, whilst further research on a per hospital basis may be necessary to determine the precise impact of infection control messages, we recommend as a minimum that trusts provide healthcare professionals with the option to skip through these recordings and make contact with the operator directly.

We also found that 39% of robotic switchboards did not provide contact with the target clinician as the first keypad option, and instead listed alternative choices such as parking information or instructions on how to cancel outpatient appointments. By re-routing their switchboards to provide the option for the bleep operator as the first choice, valuable time could be saved for the healthcare professional.

Geographical analysis demonstrated an expected correlation of switchboard response times with local population density. New trusts may wish to consider this data in switchboard workforce planning. Importantly, delays associated with robotic operators and mandatory infection control messages were independent of these geographical differences.

Our key limitation pertains to whether six samples from each hospital switchboard is sufficient to provide a meaningful average. We propose that the scarcity of outlier data points suggests that our sample size was sufficient, and also believe that more intense data collection would present an unwelcome increase in switchboard traffic for NHS trusts. There may also have been additional confounders not included in the multivariate analysis, such as variation in switchboard traffic according to month of the year.

Future directions

Improved switchboard efficiency would be assured by the imposition of a national standard for robotic operators. As with the instigation of "2222" as a national in-hospital number for cardiac arrest (9), if automated hospital switchboards were obligated to provide a brief recorded welcome message followed by the option for healthcare professionals to skip directly to the switchboard operator, substantial time-savings could be achieved.

Identifying avoidable switchboard delays in England's NHS hospitals: phase one of the national SWITCH project

Phase 2 of the national SWITCH project will look to establish these improvements. All NHS trusts will be sent their individual performance data, together with our recommendations on how to improve switchboard efficiency. Repeat data collection will take place later in 2019.

Conclusions

There are significant but avoidable NHS switchboard delays throughout England. This is predominantly mediated by the use of robot operated switchboard

systems with inefficient automated triage, and also through mandatory infection control messages. Human operated switchboards were found to outperform their robot counterparts. The cumulative time wasted by healthcare professionals across England as a result of these avoidable delays should be considered a key target for efficiency savings, and quality improvement work is ongoing to facilitate this.

Declaration of interests

The authors have no conflicts of interest to declare

References

1. OECD (2017), Tackling Wasteful Spending on Health, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264266414-en>
2. NHS England, NHS Five Year Forward View, October 2014 <https://www.england.nhs.uk/publication/nhs-five-year-forward-view/>
3. Gainsbury S (2016) Feeling the crunch: NHS finances to 2020. Nuffield Trust
4. Royal College of Physicians, Hospital workforce: fit for the future? London: RCP, 2013 <https://www.rcplondon.ac.uk/guidelines-policy/hospital-workforce-fit-future>
5. Joint Royal College of Physicians Training Board, Speciality Training Curriculum for Core Medical Training, June 2015 <https://www.jrcptb.org.uk/>
6. <https://induction-app.com/>
7. Sothinathan R, T.Hampton T Smith K *et al.* Are the Junior Doctors Idle? A National Assessment of NHS Hospital Switchboard Response Times, *International Journal of Surgery*, Volume **47**, Supplement **1**, November 2017, Page S72
8. <https://www.nhs.uk/service-search>
9. Gabbott D, Smith G, Mitchell S *et al* Cardiopulmonary resuscitation standards for clinical practice and training in the UK *Resuscitation* Volume **64**, Issue **1**, January 2005, Pages 13-19
10. Youngs J, B.Marshall B, Farragher M *et al.* Implementation of influenza point-of-care testing and patient cohorting during a high-incidence season: a retrospective analysis of impact on infection prevention and control and clinical outcomes *Journal of Hospital Infection* Volume **101**, Issue **3**, March 2019, Pages 276-284
11. Public Health England: Surveillance of influenza and other respiratory viruses in the UK Winter 2018 to 2019; May 2019