

Evaluation of a national surveillance system for mortality alerts: a mixed-methods study

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Disclaimer: This report contains transcripts of interviews conducted in the course of the research and contains language that may offend some readers.

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Scientific summary

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Background

Since 2007, the Dr Foster Unit at Imperial College London has generated monthly mortality alerts. These are based on statistical process control charts using routinely collected hospital administrative data on 122 diagnoses and procedures for all English acute NHS hospital trusts, and they are triggered after sustained higher-than-expected monthly mortality exceeds a given threshold set to minimise the false alarm rate (estimated at < 0.1% over a 12-month period of monitoring). The mortality alerts are sent to the originating NHS hospital trust and are followed up by the Care Quality Commission (CQC). We assume that, when a trust is notified of a higher-than-expected death rate, efforts to investigate the alert will be undertaken that may result in changes to processes within the trust, potentially improving outcomes. However, how trusts react to these alerts and whether or not mortality improves as a consequence have not yet been studied.

Objectives

Workstream 1 (quantitative):

1. to describe the findings and impact of a national mortality surveillance system as a feedback mechanism for quality improvement
2. to determine the relationship of alerts to other potential indicators of quality
3. to determine the temporal patterns of alerts and whether or not they are associated with subsequent changes in mortality rates at trusts.

Workstream 2 (qualitative):

4. to describe trusts' responses to receiving mortality alerts and the impact on safety/quality improvements, including organisational and staff behaviour
5. to determine whether there are differences in the delivery of care at frequently alerting trusts compared with trusts that alert rarely, for two conditions commonly generating mortality alerts – acute myocardial infarction (AMI) and sepsis
6. to determine whether trusts in which mortality decreased after alerts were more likely to apply common safety/quality interventions than trusts that repeatedly alert.

Methods

We applied multiple methods across two workstreams. We investigated all alerts and subsequently focused on two conditions commonly attributed to mortality alerts: AMI and sepsis.

Workstream 1

We carried out a descriptive analysis of all Imperial College mortality alerts generated between April 2007 and December 2014 (objective 1). We assessed investigations by the CQC, the regulator of health and social care in England, into alerts between 2011 and 2013. This was achieved by systematically reviewing documents generated by the CQC on alerting trusts, the trusts' responses to requested information and the summarised CQC findings. We extracted information that identified the reasons for an alert, the consequences of an alert (an action plan) and the trust's assessment of whether or not the findings were associated with the increased mortality. We compared findings for sepsis with those for other conditions.

A CQC investigation sometimes identifies coding as an issue in mortality alerts; we assessed the impact of changes in coding after AMI and sepsis alerts.

We explored the relationship of alerts, comparing alerting with non-alerting trusts, with publicly available indicators of care quality (objective 2): acute bed occupancy, nurse-to-bed ratios, overall hospital mortality (summary hospital-level mortality indicator and hospital-standardised mortality ratio), trust financial data, the National Inpatient Survey data, NHS Litigation Authority risk assessment data and the Patient Safety Thermometer. In relation to AMI alerts, we also extracted information from the Myocardial Ischaemia National Audit Project, looking at 'PCI [percutaneous coronary intervention] within 90 minutes' as a quality indicator for AMI alerting trusts. We used regression techniques with robust standard errors and controlled for false discovery rate (a practical approach when multiple testing).

Analysing the association of an alert with trends in subsequent risk of death (objective 3), we investigated diagnosis- and procedure-specific alerts between January 2012 and December 2013. We examined the first alert for a trust, over the study period, and ignored any alerts for the trust that occurred in the follow-up period. We matched the diagnosis/procedure of the outcome with the diagnosis/procedure of the alert for 12 months before an alert and 24 months after an alert. We used an interrupted time series design, which estimates a trend before an intervention, the impact of an intervention and the change in trend after the intervention, assuming a 9-month lag. We carried out sensitivity analyses with no lag, and with 3-month, 6-month and 12-month lag periods.

Workstream 2

Workstream 2 employed mixed methods to investigate the mechanisms by which mortality alerts were assimilated at local trust level and the resulting organisational behaviour, drawing on institutional theory and a realist perspective that would account for the effects of institutional context on mechanism–outcome interactions.

Eleven institutional case studies were undertaken in English acute care trusts. Trusts were selected and approached to participate in the study according to two sampling strata: (1) the receipt of an alert in either sepsis or AMI in the 2011–14 period and (2) the receipt of single or multiple alerts. The final research sample comprised four AMI sites (three multiple and one single alert site) and seven sepsis sites (five multiple and two single alert sites).

Workstream 2 qualitative case study data from the 11 included trusts were collected between February and December 2015, representing a total of 22 site visits and 72 separate face-to-face interviews with 73 informants. The interviews typically lasted between 50 and 60 minutes and were recorded with the permission of the respondent for later transcription. An interview schedule was used as a guide, which included 24 individual questions with prompts linked to the research questions. NVivo software (QSR International, Warrington, UK) was used to support initial inductive and hierarchical coding, with some elements of the later stages of iterative deductive coding undertaken in Microsoft Word® (Microsoft Corporation, Redmond, WA, USA).

Individual case narratives were produced that represented a historical narrative concerning the institutional response to the target alert(s). Subsequently, a thematic analysis was undertaken for each case followed by an integrative analysis that took two principal forms: (1) a cross-case comparative analysis and (2) the development of an evaluative framework for institutional capacity to respond to signals in mortality data.

A national cross-sectional survey study was undertaken. The survey instrument contained subsections including (1) organisational arrangements for mortality; (2) coding, data and information; (3) mortality review; (4) responding to imperial/CQC mortality alerts; (5) institutional capacity to respond to signals in the data; and (6) evaluation of the mortality alerting and surveillance system. Survey data were collected between 11 May and 10 June 2016. Only one response was required from each invited trust and the

target respondent was the trust mortality lead or medical director. A total of 78 survey responses were received, which represented a 65% response rate.

Results

Workstream 1

Between April 2007 and December 2014, 690 alerts were generated and, of these, 532 were sent to trusts. Sepsis accounted for 11.5% ($n = 61$) and AMI accounted for 3.4% ($n = 18$) of all alerts. The number of alerts generated annually has been falling year on year. The CQC investigated 75% (154/206) of a subset of alerts generated (January 2011–December 2013). The outcome of CQC investigation identified three main reasons for an alert. These were factors related to coding, case mix and quality of care within the trust. Quality of care was cited as a factor in 70% (108/154) of all investigations but was particularly an issue in sepsis alerts (89%, 17/19); quality of care was judged internally to have contributed to elevated mortality in 27% (42/154) of alerting trusts. Full action plans were created in 64% (98/154) of trusts that were investigated, rising to 77% (118/154) by the time the cases were closed. When quality of care was identified as an issue, 85% of cases (92/108) resulted in an action plan.

Apart from the CQC findings on quality of care, mortality alerts were associated with other indicators of quality that we assessed. Bed occupancy and hospital mortality were higher in hospitals that had a mortality alert, while nurse-to-bed ratio and patient and trainee satisfaction were lower. For example, although bed occupancy, between 2011 and 2013, was high (median 90%), it was, on average, 2.3 percentage points higher (95% confidence interval 0.9 to 3.7 percentage points) in alerting trusts than in non-alerting trusts. Alerting trusts were also more likely to be in financial deficit than non-alerting trusts.

On average, the relative risk of death fell by 58% during the 9-month period immediately following an alert, and then levelled to a slow decline, on average reaching the level of expected risk within 18 months of the alert.

Workstream 2a: qualitative institutional case studies

Integrative analysis across the reported case studies focused on developing insight into the ways trusts responded to AMI and sepsis alerts, and the institutional contextual and behavioural processes that support or regulate the response. Common processes observed across the case study sites include:

- Alerts are considered useful in providing focus for trust intervention in addressing mortality.
- Case note review was the common response to alerts across all 11 sites.
- A forensic approach that completes the circle of problem identification, problem analysis, triangulation of data, identification of solutions and implementing new ways of working.
- Use of innovative techniques to improve connectivity and knowledge sharing across trusts focused on tackling mortality (boundary spanners, boundary objects and electronic information sharing).
- The importance of clinical involvement in responding to alerts for sepsis and AMI.
- Senior clinicians identifying problems in the coding of sepsis and AMI diagnosis.

Alerts for both AMI and sepsis instigated institutional responses across all of the case study sites.

Responses were characterised as the alert served as a trigger for action; a universal case note review response; a forensic approach to identifying problems, identifying solutions and implementing actions; the development of some innovative techniques in developing sepsis and AMI awareness; and senior clinical involvement in case note review, coding of deaths and diagnosis identification. It was reported that these responses resulted in the following outcomes: case note review and coding improvements; specific changes in patient pathways; changes in diagnosis of sepsis and AMI; training of clinical staff in case note write-up and coding; greater transparency in patient deterioration; and resourcing of some infrastructure changes. It was noted that this slow movement was often boosted by intervention from the regulator,

and it was these combined interventions, information and regulation that appeared to link with a turnaround in how mortality was tackled.

A qualitative framework analysis of testimony across the 11 case study sites elicited nine evaluative dimensions for understanding variance in institutional capability to respond to signals in mortality data, which subsequently were used to structure the evaluative survey measure:

1. organisational structure for mortality governance
2. coding
3. use of information, monitoring and reporting
4. local investigation and mortality review process
5. local improvement mechanisms
6. organisational culture
7. senior leadership and sponsorship
8. interprofessional collaboration
9. external environment.

Workstream 2b: national survey of alerted trusts

A total of 86% of responding trusts had a dedicated trust-level lead for mortality reduction and 92% had a dedicated trust-level mortality group or committee in place. Over half of the mortality committees were chaired by a senior clinical member; this was the trust medical director in 56% of cases. On average, 60% of deaths were reviewed in local mortality reviews, with 69% of responding trusts reporting that they routinely reviewed all deaths. Across the sample, high agreement was recorded for the trust priority assigned to mortality reduction and senior leadership support for mortality monitoring. The weakest areas reported concerned accuracy of coding, the quality of specialty-level mortality data, understanding trends in specialty level mortality data and the provision of protected time in people's job plans for mortality-related work.

The overall institutional capability scale achieved moderate positive correlations with the length of time that current arrangements for mortality have been in place, the percentage of specialties within the trust that reliably review all deaths and the overall percentage of deaths that are reviewed by the trust in any given period. The percentage of deaths reviewed in any given period within a trust was positively associated with the capacity for local investigation and mortality review processes, robustness of improvement mechanisms and senior leadership support.

When respondents were asked to evaluate the current arrangements for mortality alerting and surveillance directly, responses were positive both overall and for the vast majority of individual evaluative items. The highest level of agreement was achieved for statements concerning willingness to invest staff and resources in responding to alerts and the role of mortality alerting in regulatory processes and public assurance. Overall, respondents agreed that continuous alerting and surveillance focused trusts on avoidable mortality in a constructive way. Respondents felt, to a modest degree, that mortality alerts led to improvements in local review processes, data monitoring and reporting and multiprofessional engagement in mortality reduction. The only area that received a slightly negative response, on average, was the perception that mortality alerts represented valid and reliable signals of problems in care delivery. When considering the barriers to reduction of avoidable mortality, respondents indicated that resource availability was a primary concern, followed by coding accuracy, risk adjustment adequacy, specificity and recency of mortality data. Respondents identified CQC involvement in mortality alerting and involvement in national programmes and campaigns in related areas as moderately strong motivating factors, followed by external reporting on mortality alerts received by the trust.

Conclusions

Care Quality Commission investigations concluded that the quality of care of patients is a factor in alerting trusts, particularly for sepsis. Action plans to change practice were created in the majority of cases. However, although the creation of action plans may suggest that mortality alerts are having an impact, this finding should be interpreted with caution. A judgement of whether or not care contributed directly to increases in mortality is variable across investigations.

Our findings suggest that mortality alerts are also associated with aspects of poor-quality care such as high occupancy, understaffing and poor patient satisfaction. Sepsis alerts were strongly associated with nurse staff levels. Immediate falls in mortality risk after an alert suggest that the alerting trusts are monitoring patient mortality and often action these before they are notified by an alert letter.

Our case study findings suggest that mortality alerting, viewed as a means of mortality reduction, is a complex intervention with multiple context-specific and locally determined elements. This study has described the nuanced behavioural responses of institutions to intelligence on potentially avoidable mortality. A key message from our work is that it is important to understand the local preconditions for effective responses and how maturity in institutional mortality monitoring, review and action processes can be achieved.

An important developmental step towards enhancing local capability to generate, understand and respond to signals in mortality data is to provide guidance and evidence to promote adaptive institutional responses that are in the best interests of patient safety.

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