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Interface design recommendations for computerised clinical audit and feedback: Hybrid usability evidence from a research-led system

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ABSTRACT

Background: Audit and Feedback (A&F) is a widely used quality improvement technique that measures clinicians' clinical performance and reports it back to them. Computerised A&F (e-A&F) system interfaces may consist of four key components: (1) Summaries of clinical performance; (2) Patient lists; (3) Patient-level data; (4) Recommended actions. There is a lack of evidence regarding how to best design e-A&F interfaces; establishing such evidence is key to maximising usability, and in turn improving patient safety.

Aim: To evaluate the usability of a novel theoretically-informed and research-led e-A&F system for primary care (the Performance Improvement plaN GeneratoR: PINGR).

Objectives: (1) Describe PINGR's design, rationale and theoretical basis; (2) Identify usability issues with PINGR; (3) Understand how these issues may interfere with the cognitive goals of end-users; (4) Translate the issues into recommendations for the user-centred design of e-A&F systems.

Methods: Eight experienced health system evaluators performed a usability inspection using an innovative hybrid approach consisting of five stages: (1) Development of representative user tasks, Goals, and Actions; (2) Combining Heuristic Evaluation and Cognitive Walkthrough methods into a single protocol to identify usability issues; (3) Consolidation of issues; (4) Severity rating of consolidated issues; (5) Analysis of issues according to usability heuristics, interface components, and Goal-Action structure.

Results: A final list of 47 issues were categorised into 8 heuristic themes. The most error-prone heuristics were 'Consistency and standards' (13 usability issues; 28% of the total) and 'Match between system and real world' (n = 10, 21%). The recommended actions component of the PINGR interface had the most usability issues (n = 21, 45%), followed by patient-level data (n = 5, 11%), patient lists (n = 4, 9%), and summaries of clinical performance (n = 4, 9%). The most error-prone Actions across all user Goals were: (1) Patient selection from a list; (2) Data identification from a figure (both population-level and patient-level); (3) Disagreement with a system recommendation.

Conclusions: By contextualising our findings within the wider literature on health information system usability, we provide recommendations for the design of e-A&F system interfaces relating to their four key components, in addition to how they may be integrated within a system.

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1. Introduction

Audit and feedback (A&F) is an established and widely used technique in quality improvement, employed in health care systems across the world. It consists of measuring a clinician or health care team's clinical performance over a specified period of time (audit), and reporting it to them (feedback), with the intention of rais-ing awareness and helping them take corrective action [1]. Audit data are obtained from medical records, computerised databases, or observations from patients, and feedback may include recommendations for improvement action [2].

In A&F, clinical performance is measured by adherence to recommended clinical practices (e.g. patients with hypertension receiving regular blood pressure measurements) or the occurrence of particular patient outcomes (e.g. acceptable blood pressure control) [1,2]. A&F relates to care provided to multiple rather than individual patients, and is used to inform improvements at an individual, team, and service level [3,4]. Feedback relating primarily to individual patients, particularly intended for use at the point of care,

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does not count as A&F, and is classified as a different intervention such as clinical decision support (CDS) [1,2].

A&F is traditionally undertaken using paper medical records, which is laborious and time-intensive. However, widespread use of electronic health records (EHRs) has spawned a variety of computerised A&F systems (e-A&F). These systems usually feed audit results back to provider employees via interactive interfaces such as intranet browser-based portals (e.g. [5]) or desktop applications (e.g. [6]). Users of e-A&F systems are generally clinicians whose performance is being assessed, though may also include managers or administrators [7]. e-A&F systems are distinct from systems where an audit is generated using a computerised infrastructure but feedback is provided on paper, verbally or via a static computerised form such as a screensaver or electronic document (e.g. [8]). Often e-A&F systems are not explicitly termed 'audit and feedback', and instead may be called 'dashboards', 'scorecards', 'business intelligence', 'visualisation tools' or 'benchmarking tools' amongst other names [9]. Conversely, many systems with these names may also *not* be A&F: for example, many dashboards only provide information regarding individual patients (e.g. clinical dashboards [10]) or may focus on multiple patients but are intended for use solely at the point of care (e.g. [11]); and business intelligence or information visualisation tools may focus primarily on non-clinical performance data such as costs, patient waiting times, or disease epidemiology surveillance (e.g. [12]).

Despite their prevalence, there has been relatively little research into the requirements for designing usable interfaces for e-A&F systems. Prior work has largely focused on the effectiveness of e-A&F systems for improving patient care (e.g. [13]) or their levels of adoption (e.g. [14]). Some studies have explored factors related to their acceptance and use (e.g. [15]), however, we are aware of only one study that has explicitly focused on usability [16]. Consequently little is known about how best to design e-A&F interfaces.

Ongoing work by our group has identified four key components of e-A&F system interfaces [17]: (1) Summaries of clinical performance; (2) Patient lists; (3) Patient-level data; and (4) Recommended actions. All e-A&F interventions have some combination of these elements; indeed, to qualify as A&F the system must have at least a summary of clinical performance or provide patient lists [1–4]. However, we are unaware of a system reported in the literature that incorporates all four components. Below, we discuss each interface component, and what is currently known about their usability.

1.1. Summaries of clinical performance

A&F interventions generally summarise clinical performance using quantitative measures variably termed 'quality indicators', 'performance measures' or similar. They usually report the proportions or absolute numbers of patients who have (or have not) received a recommended clinical practice, or experienced a particular outcome [18]. These metrics are the core component of A&F, and are commonly presented either as tables (e.g. [19]), bar plots (e.g. [20]), pie charts (e.g. [21]), or line graphs (e.g. [15]). Sometimes colour coding (e.g. [22]) or comparison with peers (e.g. [23]) are used to highlight progress towards desirable levels of performance (termed targets or goals). In terms of usability, the use of line graphs to monitor trends in performance in an e-A&F system have been found to be useful, in addition to the ability to interactively explore aggregated patient data, and compare performance between departments within an organisation [16]. However, it is unclear how these functions should be optimally designed, or integrated with other formats of data presentation.

1.2. Patient lists

Some e-A&F systems provide lists of patients who have (e.g. [24]) or have not (e.g. [15]) received the recommended clinical practice, or experienced the particular outcome of interest. This is generally supplemental to the summary of clinical performance (e.g. [20]), though occasionally may act as its proxy (e.g. [19]). The intention in providing patient lists is that they can be used to further investigate the care of individual patients and take corrective action where necessary [25]. Patient lists have been identified as a key driver of success in some non-computerised A&F interventions [26], and their absence as a reason for failure [27]. They may simply contain patient names or identifiers, or additional summary data such as demographics or physiological measurements (e.g. [20]). We are unaware of any published studies of e-A&F interventions that have assessed the usability of patient lists, so evidence regarding their optimal design is lacking. For example, it is unclear how they should be integrated with the summary of clinical performance, or how (and whether) they should include patient-specific summary data as a means of improving information processing and cognitive load during interpretation tasks.

1.3. Patient-level data

e-A&F systems may occasionally further supplement patient lists with more detailed information about each patient (e.g. historic glycated haemoglobin readings for diabetic control [28]). Access to these data, whether within the e-A&F system itself or the EHR, is key so that individual patients' care can be reviewed, and action taken where necessary [27]. In e-A&F systems, such information may be presented in tables (e.g. [15]) or graphically (e.g. [16]). From a usability point of view, integrating patient-level with population-level data in an e-A&F system has been demonstrated as desirable to users, and that functionality should support information visualisation over predefined time periods in addition to interactive exploration [16]. Similarly, a usability evaluation of a primary care epidemiological visualisation tool found that providing these data within the system was advantageous as clinicians may not have time to check each patient's EHR [29]. However, it is unknown how best to present such detailed patient-level data within an e-A&F system, or how much data to present without overwhelming the user and increasing cognitive load during task performance [30].

1.4. Recommended actions

The definition of A&F states that recommended actions for improvement may accompany clinical performance feedback [2]. There is both theoretical [31] and empirical evidence [1] that providing recommended actions increases the effectiveness of A&F. Often A&F recipients do not have the time, capacity or skills to interpret feedback and formulate what improvement action is necessary [27], so providing recommendations increases the likelihood that action is taken [31]. User-needs assessments for e-A&F systems often find that recommended actions are desirable [23]), and some systems provide links to educational materials such as best practice guidelines (e.g. [28]) or templates for users to formulate their own action plans (e.g. [32]), however we are only aware of one e-A&F system in which improvement actions are actually recommended to users (the LPZ Dashboard [23]). The recommendations in this system are generic and target organisational changes only, which the user derives themselves using a decision tree [23]. The usability of this system was not evaluated, so it is unclear how best to present recommended actions within an e-A&F system.

In addition to the knowledge gaps regarding each of the four interface components described above, there is also little insight