Understanding and optimising electronic audit and feedback to improve quality of care

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Chapter 12

General discussion
This thesis aimed to advance the science of audit and feedback (A&F) through better understanding and optimising its ability to improve quality of care. To achieve this we explored the current theory and evidence of A&F (Part I) and performed empirical studies in the context of A&F interventions in cardiac rehabilitation (Part II), intensive care pain management (Part III), and primary care medication safety (Part IV). In this final chapter we answer the three research questions stated in the introductory chapter, discuss their implications, and provide future perspectives. Figure 12.1 summarises our conclusions.

**Figure 12.1:** Conclusions drawn from this thesis, mapped onto the feedback cycle (adapted from Control Theory), to advance the science of audit and feedback.

1. **What is the theory and evidence underpinning A&F and the use of clinical performance comparators in A&F interventions?**

The use of theory has been urgently recommended for the design and evaluation of complex interventions, including A&F, to better understand their generalisability and replicability [47, 353–355]. The literature offers many theories relevant to A&F, yet until now, few studies explicitly reported their use [31, 356]. Particular challenges to the use of theory include choosing from the multitude of theories of individual and organisational behaviour change [357, 358], which often contain conceptually overlapping constructs and have seldom
been tested robustly in healthcare settings [359–361]. Also applying the constructs to the intervention often appears challenging [362].

Chapter 2 poses that Control Theory provides a useful framework for explaining A&F [100]. The theory describes a feedback cycle where a “self-regulating agent” continuously compares the perception of its current state against a goal state and will strive to reduce perceived discrepancies by modifying behaviour. We translated this to healthcare settings by arguing that health professionals who perceive discrepancies between their current clinical performance and a target will develop intentions and subsequently undertake action (i.e. behaviour) to improve practice, and will continue to do so until the target is achieved.

Several alternative theories resonate with elements of Control Theory (e.g. Goal-setting Theory [105] and Social Cognitive Theory [106]), or have built on it (e.g. Feedback Intervention Theory [104] and Clinical Performance Feedback Intervention Theory [127]). Yet, goal-setting theorists have challenged the ability of Control Theory to explain human behaviour, as it has its origin in cybernetics and was intended to explain behaviour in mechanical systems [363, 364]. For example, human feedback recipients may compare their performance with internal standards or goals which are based on beliefs about past performance, expectations, norms, or an ideal goal [104]. Furthermore, the wider social and organisational context in which A&F interventions take place is not part of what Control Theory aims to describe. Nevertheless, we argue that it captures the core of A&F by explaining how information about clinical performance is translated into action to improve quality of care. Throughout this thesis, Control Theory [100] helped to answer our second and third research question by improving the design of A&F interventions (Chapter 5, 6, and 8), explaining why interventions were or were not successful (Chapter 4, 9, and 11), and increasing the understanding of A&F mechanisms in clinical practice (Chapter 4 and 7).

A&F often includes clinical performance comparators to help health professionals identify discrepancies and progress through the feedback cycle. In Chapter 3 we found across 146 published trials of A&F that recipients’ performance was compared against the performance of others (benchmarks); the recipients’ own historical performance (trends), expected standards of achievement (explicit targets), or a combination of these. The choice of comparator was poorly informed by theory and did not explicitly account for mechanisms reported in qualitative studies. We distilled mechanisms of each comparator from 12 behavioural theories, 5 randomised trials, and 42 qualitative studies of A&F, and found that there is considerable opportunity to improve the design of performance comparators by (1) providing tailored comparisons rather than benchmarking everyone against the mean, (2) limiting the amount of comparators being displayed while providing more comparative information upon request to balance the feedback’s credibility against its actionability, (3) providing performance trends but not trends alone, and (4) encouraging feedback recipients to set personal, explicit targets guided by relevant information. Development of theory and evidence-based A&F interventions requires practical guidance for designers. Part of this guidance is increasingly emerging from systematic reviews, expert interviews, and experience from leaders in the field [21, 37, 131]. Chapter 3 added to this by offering four generic practical recommendations to inform the choice of which clinical performance comparators should be used [365]. Although a one-size-fits-all solution to comparators may not exist [365], A&F designers should explicitly consider the mechanisms we presented and offer justification for their comparator choice [28, 355]. Yet, comparators concern only one of many A&F design elements for which choices need to be made [33]. We encourage similar approaches to inform other A&F design choices; e.g. how to formulate feedback messages under particular circumstances or to
2. What is the impact of three state-of-the-art, theory and evidence-based electronic A&F interventions across different settings on the quality of care?

The effectiveness of the three electronic A&F interventions varied markedly. Chapter 5 (Part II) reports results from a cluster-randomised controlled trial of A&F with outreach visits in 18 Dutch cardiac rehabilitation centres (14,847 patients), and found a modest improvement in data completeness, but no effect on the quality of care. Chapter 8 (Part III) describes findings from a head-to-head, cluster-randomised trial comparing A&F with and without action implementation toolbox in 21 Dutch intensive care units (25,234 patient admissions), which found a moderate absolute improvement in intensive care unit (ICU) pain management of 4.8% (95% CI, 4.2 to 5.5) in the group without toolbox, and 14.8% (95% CI, 14.0 to 15.5) in the group with toolbox. ICUs with toolbox achieved larger improvements than those without (p=0.049). Chapter 11 (Part IV) presents an interrupted time-series analysis in 43 general practices (53,068 patients) in England and found that the prevalence of potentially hazardous prescribing reduced by 27.9% (95% CI, 20.3 to 36.8) at six months and by 40.7% (95% CI, 29.1 to 54.2) at twelve months after the introduction of the interventions compared with a pre-intervention downward trend. The rate of inadequate blood-test monitoring reduced by 22.0% (95% CI, 0.2 to 50.7) at six months and 23.5% (95% CI, -4.5 to 61.6) at twelve months.

All three interventions were explicitly informed by theory and evidence [120, 121, 366]. This enabled us to increase the possibility to achieve larger effect sizes, as well as learn across studies to identify specific implications to advance the A&F science [28, 45].

The first implication, drawn from Part III (Chapter 8 and 9), is that providing A&F in combination with a toolbox with pre-defined suggestions for improvement, an action plan template, and telephone reminders, is a feasible and low-resource-intensive approach to enhancing A&F effectiveness. In other parts of the thesis, we described delivery of other co-interventions alongside the A&F: quarterly outreach visits to local cardiac rehabilitation teams in Part II; and external change agents in the form of clinical pharmacists based at general practices in Part IV. These co-interventions particularly increased intervention uptake by addressing recipients’ busy practice and competing priorities (Chapter 9 and 11). However, despite studies demonstrating benefits of toolboxes [39, 367, 368], outreach [246, 369] and change agents [218, 370, 371], findings on whether and which co-interventions increase A&F effectiveness remained inconclusive in the most recent Cochrane review [21] and warranted further comparative trials [28]; Chapter 8 adds to this. Furthermore, change agents are highly resource-intensive and could thereby reduce interventions’ long-term sustainability [370]; to a lesser extent, this may also apply to outreach visits. Designers of A&F should therefore weigh the added cost of co-interventions against their uncertainty of enhancing effectiveness.

The second implication is that A&F should address a limited set of quality indicators, about both care processes and patient outcomes. We learned from Part II that A&F interventions with a relatively high number of indicators increase the cognitive load for busy health professionals [372, 373] and intensifies competing priorities [212, 213]. A wide range of indicators also makes it less likely that professionals target the same aspects of care quality for improvement, thereby potentially diluting the intervention’s overall impact [54]. In Part III and Part IV we found improvement on care processes, but not on patient outcomes, which seems a consistent finding in the literature [37, 127, 215, 282]. Care processes were prioritised by feedback recipients because they were considered more controllable and actionable (Chapter 4 and 9), yet are of lesser “value” for patients compared to outcomes [51].
The third implication is that A&F should support recipients to achieve, and sustain, organisation-level practice change. Because in Part IV feedback concerned medication safety for patients in primary care, pharmacists and general practitioners were able to respond with immediate remedial actions for specific patients (e.g. discontinuing medication; ordering laboratory tests) [157, 257, 374]. These patient-level actions led to a rapid reduction in potentially hazardous prescribing and inadequate blood-test monitoring (Chapter 11). In contrast, patient-level change was not possible in intensive care and cardiac rehabilitation settings (Part II and III) because patients had typically already been discharged at the time of feedback delivery. Despite the rapid reduction in existent medication safety issues in Part IV, however, the intervention did not induce a reduction in new cases [120]. This indicates that sustaining patient-level change over time eventually also requires organisation-level change (e.g. redesigning clinical workflows) to achieve a “learning effect” that prevents future patients from receiving inadequate care or failing to meet target outcomes [127]. However, in all three interventions, we found that organisation-level change was slow and more difficult to achieve. This emphasises the importance of further increasing the actionability of A&F to facilitate immediate response by recipients [260]; new techniques are emerging that can be used to achieve this. For example, A&F can adopt prediction models to warn health professionals about which patients (e.g. recently admitted but not yet discharged) are likely to meet or not meet particular performance targets, based on observations from similar patients in the past [375].

3. What are the mechanisms through which A&F affects clinical performance perceptions, improvement intentions, behaviour, and, ultimately, quality of care?

We opened up the “black box” of A&F to explore and understand its underlying mechanisms; using the feedback cycle as proposed by Control Theory [100] as a theoretical basis. In accordance with the theory, we found in our laboratory experiments and process evaluations for all three interventions, that health professionals’ intentions to improve practice were driven by low performance scores and benchmark comparisons (Chapter 4, 7, and 11). However, health professionals lacked improvement intentions up to half of the times because they disagreed with the benchmark, did not consider the clinical issue important enough, or did not know what improvement actions to take; despite performance being marked by the feedback as below the benchmark (Chapter 4 and 7). Intentions varied strongly between individual professionals, and to a lesser extent between teams, independent of the feedback, which indicates that they had their own views of what constitutes quality of care (Chapter 4). Notably, many of health professionals’ improvement intentions before receiving feedback were already consistent with actual gaps in performance. This consistency increased further after receiving feedback; in part because professionals had often overestimated their own clinical performance prior to receiving feedback (Chapter 7). Those who were supported by suggested actions from an action implementation toolbox developed more improvement intentions and across a wider range of practice determinants, whilst without the toolbox, professionals tended to remain longer in earlier processes of the feedback cycle (Chapter 9). Instead of prioritising improving quality of care, however, health professionals often prioritised verification and improvement of the data quality (Chapter 4 and 11). In addition, many of the intended actions were not completed before the study end, particularly due to barriers in the organisational context, which inhibited improvement in quality of care (Chapter 4 and 9). Over time, active improvement efforts by feedback recipients transitioned towards less frequent performance monitoring (Chapter 10).
These findings shed important new lights on how and why A&F may or may not lead to improvements in quality of care, and carry a number of implications for future A&F practice and research. The first implication is that A&F interventions should focus less on further optimising the extent to which they increase health professionals’ motivation to change, but more on addressing barriers to clinical practice change. Although many studies have focused on exploring and improving the uptake and acceptance of feedback [124, 157, 376–379], our research demonstrates that health professionals often have an abundance of improvement intentions in line with the feedback recommendations. We argue that these aspects, while they should be addressed appropriately (e.g. by choosing performance comparators guided by Chapter 3) and are essential to successful A&F, do not currently represent the biggest challenge to enhancing the effects of A&F. Rather, health professionals often fail to translate those intentions into actual change in clinical practice because they may lack time or knowledge to identify which actions they can take to improve, or experience barriers in the organisational context. While we found that a toolbox containing suggested improvement actions addresses professionals ability to take action [282, 380], the current evidence about how organisational barriers can be overcome remains scarce [27, 260, 381–383].

The second implication is that A&F should facilitate rapid verification and exploration of the data underlying the feedback by recipients. Health professionals’ first response to receiving feedback often involved verification of the data accuracy; even when various precautions had been undertaken to maximise this accuracy. Moreover, those who wanted to improve their performance started by exploring the data to understand which actions could be effective, e.g. through the identification of patient groups that were particularly at risk. These steps take up a lot of valuable time and resources; thereby reducing the effects observed during study periods [37, 54, 121, 127]. The availability of performance stratified for a set of predefined patient subgroups (e.g. surgical vs medical ICU admissions; Part III) and patient lists (Part III and IV) in the electronic A&F interventions anticipated these responses and allowed health professionals to progress through the feedback cycle more rapidly. Finally, we suggest that laboratory experiments and quantitative process evaluations are deployed in future A&F interventions to tailor feedback to recipients’ individual needs and preferences rather than providing “one-size-fits-all” feedback. In this thesis, our laboratory experiments (Chapter 4 and 7) demonstrated that recipients are often confronted with performance being (far) below their own expectations, and that recipients differ in which clinical topics they consider important (enough). These phenomena result in defensive response, data verification, and a lack of improvement intention and behaviour; all of which take up valuable time and dilute the effects achieved by interventions during study periods. We argue that part of these phenomena could be prevented by conducting laboratory experiments before intervention start to inform the ultimate A&F design. This enables interventions to become tailored to (individual) recipients’ preferences and needs [384]; e.g. by optimising clinical performance comparators (Chapter 3), positive or negative framing of the feedback message, and quality indicators to be reported. This thesis also showed that quantitative or mixed-methods process evaluations, as in Chapter 4, 9, and 10, can provide valuable explanations for the observed effects of electronic A&F interventions by harnessing data that were a by-product of intervention use in clinical practice: in particular dashboard interactions and action plans contents. We argue that these methods, when adopted as part of the delivery of A&F interventions to monitor recipients’ progression through the feedback cycle as in Chapter 8 and 9, can help identify and resolve any obstructions in the cycle in a timely fashion to maximise A&F effects.
Conclusion and future perspectives

Figure 12.1 summarises the conclusions drawn from this thesis. It shows how we used Control Theory as a generic framework to explain and explore the mechanisms through which audit and feedback (A&F) leads to better care. A&F helps because it guides health professionals to work on those quality aspects for which improvement is recommended, particularly through communicating low performance scores and making explicit performance comparisons to benchmarks, trends, or targets. However, professionals may not accept feedback, causing the feedback cycle to stop, if they: perceive the accuracy of the underlying feedback data to be low; disagree with benchmarks; or do not consider the clinical topic a relevant aspect of care quality. Health professionals who are confronted with performance feedback nevertheless often intend to reduce any indicated gaps between actual and recommended practice, but lack knowledge about improvement actions they could take, or they experience organisational barriers which inhibit translation of their intentions into actual change in clinical practice. By identifying these mechanisms we have contributed to better understanding of A&F. The findings in this thesis furthermore suggest that, to optimise the effectiveness of A&F interventions, providers and researchers should (1) make explicit use of theory and evidence to guide their design and evaluation, (2) tailor performance comparators, (3) provide suggested actions for improvement, (4) target a limited set of indicators about both care processes and outcomes, (5) support recipients to achieve and sustain organisation-level change, (6) focus on addressing barriers to practice change rather than on health professionals’ motivation to change, (7) facilitate rapid verification of the underlying feedback data, and (8) deploy laboratory experiments and quantitative process evaluations in future A&F interventions to tailor feedback to recipients’ individual needs and preferences rather than providing “one-size-fits-all” feedback.

With A&F being a key component of healthcare systems to facilitate continuous and systematic quality improvement, there will be a continued need for optimising A&F to advance the science. In addition to more head-to-head trials comparing different variations of A&F, an important part of advancing the A&F science will have to come from mixed-methods process evaluations and laboratory experiments. In the recent years, understanding and optimising A&F has been prioritised by the A&F research community. However, the lessons learned often fail to reach healthcare system partners providing A&F at scale; such as governments or national clinical audits [385]. The audit and feedback meta-laboratory (www.ohri.ca/auditfeedback) has been recently established to facilitate communication and collaboration between A&F providers and researchers around the world [386]. By supporting healthcare system partners to optimise their own A&F initiatives and researchers to efficiently advancing the scientific basis of A&F, the meta-laboratory provides a mutually beneficial approach that can reinvigorate the science of A&F.