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BRIEF COMMUNICATION

Improving health care efficiency one click at a time

Stephen Bacchi,[1,2,3,4,5] Joshua Kovoor,[3,4,5] Aashray Gupta,[3,5,6] Sheryn Tan,[3] Tony Sherbon,[1] Andrew Bersten,[1,2] Patrick G. O'Callaghan[3,4] and Weng O. Chan[3,4]

[1]Flinders Medical Centre, [2]College of Medicine and Public Health, Flinders University of South Australia, [3]University of Adelaide, [4]Royal Adelaide Hospital, and [5]Health and Information, Adelaide, South Australia, and [6]Gold Coast University Hospital, Gold Coast, Queensland, Australia

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Correspondence
Stephen Bacchi, Neurology Department, Flinders Medical Centre, Flinders Drive, Adelaide, SA 5042, Australia.
Email: stephen.bacchi@sa.gov.au

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Abstract

Computers are an integral component of modern hospitals. Mouse clicks are currently inherent to this use of computers. However, mouse clicks are not instantaneous. These clicks may be associated with significant costs. Estimated costs associated with 10 additional clicks per day for 20 000 staff exceed AU$500 000 annually. Workflow modifications that increase clicks should weigh the potential benefits of such changes against these costs. Future investigation of strategies to reduce low-value clicks may provide an avenue for health care savings.

Computers are ubiquitous in contemporary health care, as are the numerous accompanying tick-boxes and alerts that must be clicked through on a daily basis. 'Click fatigue' has previously been described as a significant barrier to aspects of effective health care.[1,2] Research has demonstrated that, during a 10-h shift, an emergency physician may complete up to 4000 mouse clicks.[3] The computer-based systems that contribute to this tally are not limited to electronic medical records but include video meetings, emails, inboxes, in-baskets and calendars. The deliberate design of efficient workflows to minimise unnecessary low-value clicks may help to improve efficiency and productivity. Conversely, when even minor modifications are made to existing workflows that create additional clicks, the potential downside of such interventions must also be considered. Additional clicks, as with any health care intervention, come with costs.

The costs associated with additional clicks must be weighed against the potential benefits provided by such clicks. It is important to note that not all clicks within a health care system are equal with respect to potential utility. For example, a tick-box prompt may provide a critical safety check, such as when a medication is prescribed to a patient with a known allergy. Conversely, many clicks within health care systems may add low or no value. Such clicks may be referred to as 'junk clicks'. Examples of low-value clicks may include unnecessary email login and logout tick-boxes.

We herein model and discuss the costs of mouse clicks in a typical tertiary hospital in Australia.

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Discussion

Performing a mouse click is not instantaneous. Accordingly, there is a time, financial and opportunity cost associated with every click performed in a health care institution every day. The precision of such estimates may be limited. However, considering such analyses remains important.

The time that each mouse click takes may vary depending on multiple factors. For example, the visual characteristics of the target (e.g. how apparent the target

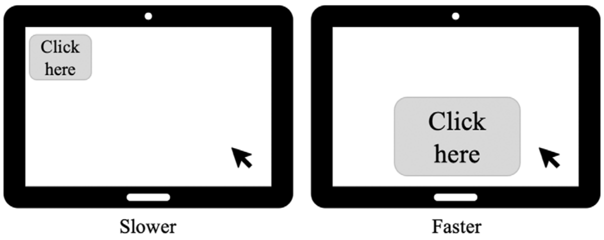

Figure 1 Graphical representation demonstrating how target size and distance may influence the time it takes a cursor to reach a target as described in Fitts law.

is visually) may influence the time taken to perform one click. Additionally, the proximity of the target to be clicked to the previous resting position of the cursor may influence the duration of time of a click. Fitts law describes that the amount of time that is required for an individual to move a cursor to a target is a function of the distance to the target and the size of a target (see Fig. 1).[4] Similarly, whether an individual is required to move their hand from a keyboard to the mouse (as opposed to resting on the mouse prior to the click), may influence the duration of time taken for the task. The working status and environment of the equipment may also influence the duration of one click. In particular, if a mouse has previously been damaged (as may be the case with computers in busy clinical areas), the time lost during attempted clicking may be substantially increased. The time for a computer system to load a subsequent screen after a click is performed may contribute to the time involved in the click. Additionally, time spent during clicking may conceivably be influenced by environmental factors such as concurrently being on the phone or manoeuvring a mobile workstation. Modification of these factors may present efficiency gains in addition to changes to software workflows.

Allowing for these uncertainties, for cost estimates it is assumed that each mouse click takes 1 s. While the time to physically press a button on a mouse is less than 1 s, the definition of mouse click used here also encompasses the duration of time required to identify an on-screen target and manoeuvre a cursor to the target, including instances in which the hand of an individual may not have been on the mouse prior to this task. For this hypothetical example, an institution of 20 000 employees is used. Two scenarios are employed, one with a working calendar of 260 days per year and one with a working calendar of 365 days per year. If a workflow change is created that causes an additional 10 clicks per day for every employee, this change would result in a total cost of 14 444 person-hours per year for a 260-day year (602 person-days per year) or 20 278 person-hours per year for a 365-day year (845 person-days per year).

Simulations can be performed to conceive this cost in other forms. For example, with varying hourly rates, the financial time–cost of such a workflow change in the above scenarios can be calculated (Table 1). Similarly, estimates can be made for workflow changes that either cause greater or fewer additional clicks. These costs could alternatively be seen as savings should these numbers of clicks be reduced, and these clicks represent low-value junk clicks. However, it should also be noted that, while cost-based modelling may be conducted, real-world improvements in throughput seen with interventions to reduce low-value clicks may be limited by other aspects of health care systems in which interventions take place (e.g. access block and overcrowding).

Table 1 Time–cost estimates for institution-wide workflow changes in low-value click numbers

Additional clicks per day	Hourly rate of staff (AU$/h)	Number of working days per year	Net financial cost per year (AU$)
5	30	260	216 666.7
		365	304 166.7
	35	260	252 777.8
		365	354 861.1
	40	260	288 888.9
		365	405 555.6
	45	260	325 000.0
		365	456 250.0
10	30	260	433 333.3
		365	608 333.3
	35	260	505 555.6
		365	709 722.2
	40	260	577 777.8
		365	811 111.1
	45	260	650 000.0
		365	912 500.0

In the majority of cases, there would be significant variation in the influence of any given workflow change on different elements of the workforce of an institution. For example, a change to calendar, scanning or emailing systems would likely have significantly greater impact on the number of clicks performed by administrative staff than clinicians. Changes in the workflow of recording observations or marking medications as administered may have a significant impact on the number of clicks completed by nursing staff. Similarly, additional clicks in the processes involving the moving of patients or equipment or food preparation would all affect different staff. Changes in electronic medical record prescribing or mandatory field completion would influence the number of clicks of doctors.

These varying effects also present alternative ways to conceptualise the time–cost associated with such clicks by domain. For example, the time–cost could be estimated in terms of the number of 30-min outpatient appointment equivalents. In an institution with 200 doctors seeing outpatients on any given day, for 260 days per year, the cost of 10 additional clicks per day would be the equivalent of 289 30-min outpatient appointments per year. It can be seen that this change conveys more than one additional 30-min outpatient appointment per working day in this scenario. In other words, for such a scenario, saving 10 clicks per day across the outpatient workforce would convey the time it takes to see one additional patient per day.

The costs of additional clicks include the impact of those additional clicks on the effectiveness of staff. Some of these costs may be mediated through attention. Additional clicks may both disrupt attention and impair the dedication of attention.

The importance of undisrupted work has been highlighted in recent psychological writing, including the popular *Deep Work*.[5] This body of research describes that periods of uninterrupted focus facilitate improved productivity, particularly when compared with multitasking, which may be associated with attention residue.[6] Workflow changes that generate the requirement for additional clicks may promote activities such as multitasking because of the perceived ability to navigate additional clicks while simultaneously considering other tasks, such as listening to patients or colleagues. This type of multitasking may be the consequence of staff attempting to offset the time–cost associated with additional clicks.

Performing clicks accurately typically requires attention dedicated to screen visualisation. This requirement lends itself to the undesirable situation of performing computer-oriented tasks in a health care setting while listening to a patient, rather than maintaining eye contact. Eye contact is an important component of the body language required to establish and maintain a therapeutic relationship.[7]

Additional clicks may have consequences for the health of health care professionals. While alert fatigue constitutes a broader issue than additional clicks alone, alerts may also be a source of additional clicks. Alert fatigue, along with other aspects of electronic medical record use, has been shown to be associated with increased physician burnout.[8,9] Additionally, clicks may have consequences for physical health. Namely, mouse use may be associated with repetitive strain injuries.[10] Alternative ergonomic mouse designs may help to manage this issue.[11]

Health care systems are complex. Small changes, particularly when they influence large numbers of staff or patients, can have significant consequences. While the focus of this discussion is in recognising the potential costs of clicks, particularly those with low or no value, in some instances, making workflow changes that require extra clicks may add substantial value. When considering how best to utilise clicks in a rational fashion for optimal efficiency, it is necessary to consider the benefits that additional clicks may convey in the correct circumstances (Table 2). For example, medication alert systems and novel applications of artificial intelligence are possible areas in which new computer-based workflows may present additional clicks as well as additional value. In some instances, clicks may also present an advantage over alternative methods of computer engagement, such as the typing of free-text. The use of tick-boxes in some cases may also help to improve clarity and standardise communication, such as with not-for-resuscitation orders. Additional clicks may also provide benefits in the form of audit and quality improvement data collection devices.

Table 2 Examples of costs and benefits that may be associated with additional clicks

Potential costs	Potential benefits
Staff time	Reducing free-text entry
Staff attention disruption	Standardisation of communication
Staff mental health/ satisfaction	Acknowledging review of information
Repetitive strain injury	Increasing reproducibility of data categorisation

However, the cost of the clicks involved should at least be considered when planning such changes. Furthermore, following such changes, there should be a period of evaluation during which the potential costs and benefits can be measured and compared. Conversely, strategies proactively to reduce low-value junk computer clicks may provide health system benefits. Therefore, low-value junk click reduction may provide a useful focus for ongoing research to improve health care efficiency.

Further work in this area may seek to reduce low-value junk mouse clicks through several avenues. In the first instance, the number of clicks associated with given processes should be characterised. These figures will inherently vary by task, software and institution. The number of clicks associated with different tasks may also vary between sites with similar software because of different patterns of use.

Nontechnical approaches may be used to reduce the costs associated with clicks. Staff may already have identified avenues for efficiency gains, and survey or interview studies could leverage preexisting institutional knowledge. These data may inform approaches that involve adopting efficient strategies already in use by subsets of an institution, which are not widely practised (e.g. different clinics may record the same information in different ways). Similarly, nontechnical interventions may include optimising environmental and usage factors that reduce mouse click inefficiency (such as the use of trackpads and keyboard shortcuts).

Along with nontechnical interventions, computer software–based interventions may be investigated. An initial intervention that may not require significant software modification includes setting defaults for commonly used pathways, which only require additional clicks should an alternative to that default be required. For clicks associated with user authentication, appropriately cautious use of personal device password storage functions may reduce clicks. Similarly, enabling login functions that allow users to specify not to be rechallenged on a given personal device may improve efficiency. Providing users with the option to compile lists of 'Favourites' for commonly used orders may reduce clicks. The use of 'swipe-on' card access may facilitate the use of personally optimised user environments while obviating clicks required to log in. Automating repetitive tasks, such as sending predictable recurring emails, can also reduce click requirements. As guided by descriptive data, modifications to software workflows, such as strategically designed interventions targeting the user interface and user experience, may provide a means to reduce low-value junk clicks and provide gains in efficiency.

Computer clicks have costs and benefits. Modifications to workflows with the addition of clicks should weigh the potential benefits of such changes against these costs. Reduction of low-value junk clicks may provide an avenue for future health care savings. Proactive research seeking to optimise the use of clicks as a means of improving health care efficiency is warranted.

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