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Dual computer monitors to increase efficiency of conducting systematic reviews

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Abstract

Objective: Systematic reviews (SRs) are the cornerstone of evidence-based medicine. In this study, we evaluated the effectiveness of using two computer screens on the efficiency of conducting SRs.

Study Design and Setting: A cohort of reviewers before and after using dual monitors were compared with a control group that did not use dual monitors. The outcomes were time spent for abstract screening, full-text screening and data extraction, and inter-rater agreement. We adopted multivariate difference-in-differences linear regression models.

Results: A total of 60 SRs conducted by 54 reviewers were included in this analysis. We found a significant reduction of 23.81 minutes per article in data extraction in the intervention group relative to the control group (95% confidence interval: −46.03, −1.58, $P = 0.04$), which was a 36.85% reduction in time. There was no significant difference in time spent on abstract screening, full-text screening, or inter-rater agreement between the two groups.

Conclusion: Using dual monitors when conducting SRs is associated with significant reduction of time spent on data extraction. No significant difference was observed on time spent on abstract screening or full-text screening. Using dual monitors is one strategy that may improve the efficiency of conducting SRs.

Keywords: Evidence-based medicine; Systematic reviews; Research design; Efficiency; Validity; Technology

1. Introduction

In 1979, Archie Cochrane [1] urged the medical community to have critical summaries adapted periodically for all relevant randomized controlled trials. This call for systematic reviews (SRs) acknowledged that these summaries increase precision and applicability of evidence and should be always sought for clinical and policy decision makings. However, we are very far from this goal. Most published SRs are outdated and for some, they become outdated on the day they were published [2,3]. Arguably, most decisions made in health care—from policy, benefits, coverage, guidelines, quality of care, to clinical decisions at every level of care—are not based on SRs of the best available evidence.

Why do not decision makers—patients, clinicians, policy makers—have access to the high-quality SRs necessary to make better choices despite the plenty of primary studies? Time is one of the barriers impeding SRs. A typical SR, adequately resourced and using state-of-the-art methods, takes between 6 and 18 months; wider scope projects taking even more time [4]. Shortening this time is essential and strongly required [3]. Until sophisticated software can do SRs, this process remains to be heavily dependent on human factors and skills [5].

Screening studies and extracting data in SRs involve typical computer operations, including cut-and-paste operations, text and spreadsheet editing, tracing, and recording keywords, and so on. These tasks require constantly switching among different computer windows and changing focus from actual work. Dual monitors (ie, two screens for each computer) have been shown to improve productivity in tasks similar to those involved in conducting SRs [6–9]. One study, by James A. Anderson at University of Utah, found that productivity among people working on editing tasks was higher with two monitors than with one [6]. More monitors cut down on toggling time among windows on a single screen, which saved about 10 seconds for every 5 minutes of work. Microsoft researchers conducted several

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What is new?

- Using dual computer monitors was associated with a significant reduction of time spent on data extraction when conducting systematic reviews (SRs).
- No significant changes were observed in abstract screening, full-text screening, or inter-rater agreement.
- Using dual monitors is only one strategy for expediting the process of SRs.
- Other methods are also greatly needed.

studies evaluating the effect of multiple monitors [8]. Users were asked to complete several different tasks, switching from one task to another. They found that the users' productivity increased by 9% on average and at times up to 50% for tasks, such as cutting and pasting. Realizing these benefits, software manufacturers came up with multiple applications and innovations to support multiple monitors. In medicine, dual-monitor views were found to improve laparoscopy outcomes perform by reducing errors and improving visualization of surgical fields [9].

In this study, we evaluated the effectiveness of using dual monitors (ie, two screens for each computer) on the efficiency of conducting SRs. To our knowledge, this is the first study of this topic on SRs.

2. Methods

This study was considered exempt by the Mayo Clinic Institutional Review Board.

2.1. Study design and setting

The study was conducted at an evidence synthesis center specialized in conducting SRs and meta-analyses. The study subjects are the investigators conducting SRs. The investigators consist of a core group with expertise in methodology, evidence-based medicine, and evidence synthesis (10−15 investigators) and external collaborators with either methodology or topic (content) expertise. The center produces 10−20 SRs per year that are supported by intramural and extramural fundings.

This study used a convenience sampling in which we included all systematic reviewers and all SRs conducted between January 2009 and April 2013. In March 2012, all the core members started using two computer screens (dual monitors). Before that date, they were only provided with single monitors. Outside, collaborators continued their normal practices and were queried via e-mail about whether they used a single or dual monitor during the SR process.

Using a quasi-experimental design, we adopted a difference-in-differences approach to compare changes in efficiency and accuracy of conducting SRs for reviewers who used dual monitors (the intervention group) vs. reviewers who did not (the control group). Specifically, this approach compares the change (pre/post) in the intervention group to the change (pre/post) in the control group. The cutoff time defining pre- and postperiods was January 3, 2012 (the date during which the intervention group started using dual monitors). The same date was used as a cutoff to define pre- and postperiods in the control group. This design with a counterfactual control can potentially control for unobserved treads in efficiency and accuracy over time.

2.2. Data source

We retrieved data accrued between January 2009 and April 2013 for both groups from DistillerSR (Evidence Partners Incorporated, Ottawa, Ontario, Canada). DistillerSR is a web-based system specifically designed to conduct and manage reference screening and data extraction. Supported by centralized databases, it automatically records time each reviewer spent on each reference at each stage and summarizes performance data per SR per reviewer.

Reviewers with mixed usages (using single monitor and dual monitors at different locations or in the same project) or unable to report were excluded from the analysis. SRs that started before March 2012 and completed after March 2012 were also excluded.

2.3. Variables definition

Experience of the systematic reviewers was defined as the number of SRs the reviewers had conducted before the investigated SR and categorized as substantial experience if he or she participated in more than 10 SRs. A systematic reviewer was considered to have content knowledge of study topic if they had specialized clinical or research training in the topic of the SR (eg, a vascular surgery resident and a vascular surgeon were considered to have content expertise in an SR about aortic transection). We defined the simple questions in data extraction as those only needing to be filled with numbers or simple text (eg, what is the number of patients in the intervention group? What is the geographic location of a study?). We defined complicated questions as those requiring judgment or inference (eg, was the allocation concealed? Were the two groups balanced at baseline?).

2.4. Outcome measures

The primary outcome of interest was the efficiency of conducting SR, measured by the average minutes per article during abstract screening, full-text screening, and data extraction. The secondary outcome is chance-adjusted inter-rater agreement (measure of accuracy and possible adverse effect of speed).