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Design, application and testing of the Work Observation Method by Activity Timing (WOMBAT) to measure clinicians' patterns of work and communication☆

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ABSTRACT

Background: Evidence regarding how health information technologies influence clinicians' patterns of work and support efficient practices is limited. Traditional paper-based data collection methods are unable to capture clinical work complexity and communication patterns. The use of electronic data collection tools for such studies is emerging yet is rarely assessed for reliability or validity.

Aim: Our aim was to design, apply and test an observational method which incorporated the use of an electronic data collection tool for work measurement studies which would allow efficient, accurate and reliable data collection, and capture greater degrees of work complexity than current approaches.

Methods: We developed an observational method and software for personal digital assistants (PDAs) which captures multiple dimensions of clinicians' work tasks, namely what task, with whom, and with what; tasks conducted in parallel (multi-tasking); interruptions and task duration. During field-testing over 7 months across four hospital wards, fifty-two nurses were observed for 250 h. Inter-rater reliability was tested and validity was measured by (i) assessing whether observational data reflected known differences in clinical role work tasks and (ii) by comparing observational data with participants' estimates of their task time distribution.

Results: Observers took 15–20 h of training to master the method and data collection process. Only 1% of tasks observed did not match the classification developed and were classified as 'other'. Inter-rater reliability scores of observers were maintained at over 85%. The results discriminated between the work patterns of enrolled and registered nurses consistent with differences in their roles. Survey data ($n = 27$) revealed consistent ratings of tasks by nurses, and their rankings of most to least time-consuming tasks were significantly correlated with those derived from the observational data. Over 40% of nurses' time was spent in direct care or professional communication, with 11.8% of time spent multi-tasking. Nurses were

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interrupted approximately every 49 min. One quarter of interruptions occurred while nurses were preparing or administering medications. This method efficiently produces reliable and valid data. The multi-dimensional nature of the data collected provides greater insights into patterns of clinicians' work and communication than has previously been possible using other methods.

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1. Introduction

Evidence regarding how health information technologies influence patterns of clinical work and support efficient work practices is limited. A systematic review [1] published in 2005 uncovered 23 studies since 1984 which examined the impact of system use on clinicians' (doctors' and nurses') time. These studies in general adopted either work sampling or time and motion methods. Only six (26%) examined work on general wards, all in US hospitals, while the remainder focused on specialized settings (e.g. ICU and general practice). Overall, studies which compared electronic with paper systems and calculated task time per patient or consultation, reported that computer use increased time required to complete tasks. Studies which examined task time across multiple patients or working shifts found computer use was more time efficient than paper-based systems [1]. Lo et al. [2] more recently observed specialists using either paper or computer systems within outpatient clinics and reported no significant difference in time spent per patient visit. A similar but smaller study [3] measuring time taken for hand-written and computer prescriptions in an ambulatory setting in the US also found no significant difference in average time per task for physicians.

Studies of changes in work distribution and communication patterns following system use are less prevalent, but do include evidence of changes. For example in the US, where nurses usually transcribe hand-written medication orders, CPOE eliminates this task [4,5]. Following the introduction of a CPOE system clinicians may sequence work differently. As Callen [6] found, clinicians reported "if you are waiting for something on the computer you go and do something else". This may result in, for example, batching the ordering of patients' tests to one time of the day. Shu et al. [7] found interns in a US hospital spent more time alone and less time with other doctors after system introduction. A French hospital study [8] of doctor–nurse communication around medications showed that a CPOE system, in comparison with paper-based medication records, resulted in a move from synchronous communication to asynchronous. This introduced opportunities for misunderstandings and increased the extent to which nurses had to make assumptions about orders. Carpenter and Gorman [9] also reported a tendency for doctors in a US hospital to talk with nurses less about medication orders following system implementation.

Understanding these shifts in patterns of communication between clinicians are important as poor communication wastes time, threatens patient care and may be one of the major causes of preventable adverse events in clinical practice [10]. Any potential negative consequences of changes in communication patterns may be more than offset by the improvements in information exchange provided by having legible, easily accessible information which computerized systems afford clinicians. However until we have better quality data about how systems enhance or disrupt existing patterns of clinical work and communication we cannot move to redesign work practices or systems in ways which avoid any possible negative outcomes.

This research agenda needs to continue to progress beyond answering the question, does use of a computer save a clinician time, to questions about how patterns of work are re-arranged in response to the introduction of health technologies. Where time is released, or additional time consumed, how do clinicians re-distribute their time among work tasks? What amount of variation exists among different clinical sub-groups and do work tasks get re-distributed across groups? For example, if senior clinicians are found to spend less time in patient ordering following computerization is this because the system is efficient or because they have re-allocated this task, either explicitly or implicitly, to their junior colleagues? We need to examine how system use interferes with communication processes and as Gorman et al. [11] suggest, ensure that such systems "*... facilitate care without interfering with or eliminating aspects of the process that are essential to high reliability performance in the face of urgency, uncertainty and interruptions*" (p. 383).

We require studies which investigate whether changes in patterns of clinical work result in improved care delivery, patient outcomes and the work experiences of health professionals. These questions require a multi-method approach [12], and work measurement studies form an important component of such investigation. Researchers should be able to build upon previous work undertaken in different settings and countries. This requires standardization of measurement approaches and the adoption of valid and reliable measurement tools. Major factors identified for the paucity of evidence in this area are the limitations and varieties of methods used [1,13,14], the difficulties of capturing the non-linear and interruptive nature of clinical work [15,16], and the lack of consistency in the application of rigorous research methods.

Our objective was to design, apply and test an observational method for capturing clinician work and communication patterns which incorporated an electronic data collection tool. The purpose of the tool was to allow efficient, accurate and reliable data collection, while also capturing a greater level of work complexity than previous paper-based methods have allowed. Results from a small number of previous studies [2,17–19] suggest that the use of handheld computers (including personal digital assistants—PDAs) may be useful for this task, but researchers have presented minimal information about application and reliability issues relating to these tools. Building upon our previous work designing a paper-based, multi-dimensional work classification tool for nurses [14], we sought to investigate how much additional detail and task

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