

# Systematic Review of Time Studies Evaluating Physicians in the Hospital Setting

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**BACKGROUND:** Time studies, first developed in the late 19th century, are now being used to evaluate and improve worker efficiency in the hospital setting. This is the first review of hospital time study literature of which we are aware.

**PURPOSE:** We performed a systematic review of the literature to better understand the available time study literature describing the activities of hospital physicians.

**DATA SOURCES:** We searched MEDLINE, EMBASE, EMBASE Classic, PsycINFO, Cochrane Library, CINAHL, and Web of Science. We also manually reviewed the reference lists of retrieved articles and consulted experts in the field to identify additional articles for review.

**STUDY SELECTION:** We selected studies that used time-motion or work-sampling performed via direct observation, included physicians, medical residents, or interns in their study population, and were performed on an inpatient hospital ward.

**DATA EXTRACTION:** We abstracted data on subject population, study site, collection tools, and percentage of time spent on key categories of activity.

**DATA SYNTHESIS:** Our search produced 11 time-motion and 2 work-sampling studies that met our criteria. These studies focused primarily on academic hospitals (92%) and the activities of physicians in training (69%). Other results varied widely. A lack of methodological standardization and dissimilar activity categorizations inhibited our efforts to summarize detailed findings across studies. However, we consistently found that activities indirectly related to a patient's care took more of hospital physicians' time than direct interaction with hospitalized patients.

**CONCLUSIONS:** Time studies, when properly performed, have a great deal to offer in helping us understand and reengineer hospital care. *Journal of Hospital Medicine* 2010;5:353-359. © 2010 Society of Hospital Medicine.

**KEYWORDS:** academic medical centers, hospitalist, hospitals, medical staff, physicians, systematic review, systems analysis, task performance and analysis, time and motion studies, time management, work sampling, work simplification.

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Time-motion studies, introduced by Frederick W. Taylor in the 1880s,<sup>1</sup> have been widely implemented across the business world; a Google search of "time-motion study" returns approximately 32 million results. Such studies continuously document how workers spend their time and then use this information to identify and eliminate inefficient practices. Work-sampling is a similar methodology introduced by L.H.C. Tippett in 1935.<sup>2</sup> Work-sampling utilizes a trained observer to document activities at predetermined or random intervals of time. Given a large enough number of observations, this method can be comparable to the continuous observation method used in time-motion studies.<sup>3</sup>

Healthcare has begun to utilize these time-study methodologies to evaluate the activities of physicians and nurses. Researchers have successfully used time-study methodology in the emergency department, intensive care unit, and ambulatory and surgical settings in the U.S. and around the world to better understand physician activities and to design and assess interventions to improve efficiency.<sup>4-9</sup> Hospitals are also eager to enhance efficiency in the inpa-

tient setting given the current economic environment. Hospitalizations account for over a third of healthcare costs in the United States, making them an attractive target for cost-cutting measures.<sup>10</sup> Acknowledging that healthcare expenditures cannot continue to rise,<sup>11</sup> insurers, particularly the Centers for Medicare and Medicaid Services (CMS), increasingly seek to reduce payments to hospitals.<sup>12</sup> Compounding these pressures, a major supply of relatively inexpensive labor shrank with the decision by the Accreditation Council for Graduate Medicine Education (ACGME) to restrict the number of hours residents are allowed to work. Efficiency concerns gain new urgency as hospitals scramble to cover their patient loads with reduced physician availability.<sup>13</sup>

We undertook a systematic review of time-motion and work-sampling studies performed in the hospital setting to better understand the available literature describing the activities of physicians caring for hospitalized patients. An additional goal of this review was to determine the extent of available time-flow literature describing the activity of hospitalists. The hospitalist movement provided one viable

solution to the gap between demand for hospital patient care and the reduced supply of available physicians—typically primary care physicians in community hospitals and residents in teaching hospitals.<sup>14</sup> Hospital medicine is the fastest-growing specialty in the history of American medicine.<sup>15</sup> More than half of American hospitals now have hospital medicine programs with a total of greater than 25,000 hospitalists in the U.S.<sup>15</sup> This popularity has been driven by hospitalists' ability to increase efficiency through decreasing overall cost and length of stay for patients without increasing readmission rates or reducing primary care physician satisfaction.<sup>16–19</sup> However, exactly how hospitalists accomplish this increase in efficiency is still the subject of debate. One time-motion study provides a glimpse into the activities of hospitalists at an academic urban hospital,<sup>20</sup> but may not be applicable to many other hospitals.

## Methods

### Data Sources

With assistance from a medical librarian, we searched for English-language articles published between 1965 and June 2009 using the MEDLINE (<http://medline.cos.com/cgi-bin/search>), EMBASE (<http://www.embase.com/>), EMBASE Classic (<http://www.info.embaseclassic.com/>), PsycINFO (<http://www.apa.org/psycinfo/>), Cochrane Library (<http://www3.interscience.wiley.com/cgi-bin/mrwhome/106568753/HOME>), CINAHL (<http://www.ebscohost.com/cinahl/>), and Web of Science ([http://thomsonreuters.com/products\\_services/science/science\\_products/a-z/web\\_of\\_science](http://thomsonreuters.com/products_services/science/science_products/a-z/web_of_science)) databases. The search was conducted using the following combinations of Medical Subject Heading (MeSH) search terms and keywords: (“Academic Medical Centers” OR “Hospitals, Teaching” OR “Hospital Units” OR “Hospitals” OR “Medical Staff” OR “Physicians” OR “hospitalist”) AND (“Task Performance and Analysis” OR “Time and Motion Studies” OR “Work Simplification” OR “time flow” OR “time analysis” OR “time utilization” OR “work flow” OR “work patterns” OR “work pattern”). Databases that did not allow MeSH term searches were queried using the same terms in topic, keyword, or title fields. We also manually reviewed the bibliographies of retrieved articles and consulted experts in the field to identify additional articles for review.

### Study Selection

We selected articles that met the following criteria: (1) explicit use of time-motion methodology or work-sampling performed via direct observation; (2) study populations including physicians, medical residents, or interns; (3) performance sites on an inpatient hospital ward (ie, not outpatient within the hospital, emergency room (ER), or operating room (OR)); and (4) observation of at least half of a shift. Titles and abstracts of the retrieved citations were first reviewed to identify studies that could potentially meet our criteria. Full-text versions of the selected articles were then retrieved and analyzed by at least 2 of 4 authors (V.F., K.E.,

D.M., and M.T.) to determine the final list of articles. Articles that failed to provide sufficient information for one or more criteria were excluded.

### Data Extraction

Each article was independently reviewed by at least 2 of 3 authors (V.F., D.M., and M.T.) using a standardized data abstraction form. The form included the following categories: sample population, sample size, hospital type, data collection tool type, time-motion/observation duration, key categories of activity, and key results. If an article included additional data beyond the scope of this review (eg, data from surgical residents in the OR as well as internal medicine residents) only the qualifying portion of the study was included. Disagreements were resolved through discussion and consensus. Data were then compiled into tables.

## Results

Our database search yielded 4270 potential articles. We then reviewed the title and abstract of each of these articles to identify studies that evaluated physicians, were performed on a hospital ward, and explicitly used time-motion or direct-observation work-sampling methodology. For articles lacking an abstract but having a relevant title, we obtained the full text to determine eligibility for additional review. Sixty-eight articles from this original search were selected for full-text review. Ten of these articles met the selection criteria. Most of the articles excluded in this step were either conducted in an outpatient OR or ER setting, or used self-report data instead of direct-observation data. A secondary search using the reference lists of all obtained articles as well as consultation with experts in the field yielded 11 additional articles of interest. Three of these 11 articles were found to meet our criteria, bringing the total to 13 articles for review (Fig. 1).

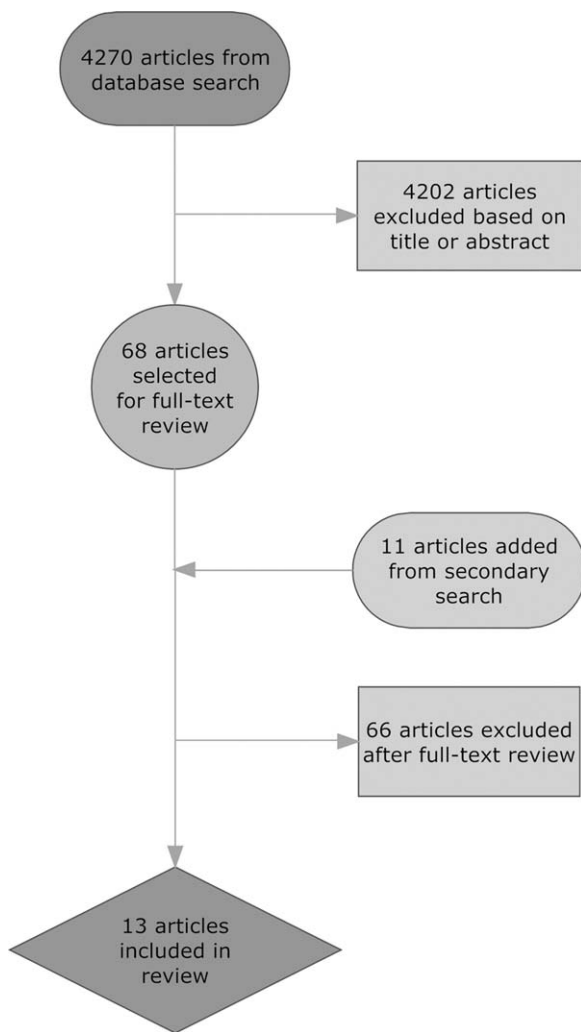
These 13 articles included several types of physicians in their samples. Eleven included interns,<sup>21–31</sup> 7 included residents,<sup>21–23,26–28,31</sup> and 4 included attending physicians<sup>20,23,26,32</sup> (Table 1). Six articles included more than 1 type of subject.<sup>21–23,26,28,31</sup> The main focus of these articles also varied. Nine of the 13 studies were designed to simply describe how residents, physicians and nurses spend their time.<sup>20,22–27,29,31</sup> Three studies were primarily concerned with comparing groups from different intern programs, residency rotations, hospital types, or shifts.<sup>28,30,32</sup> The remaining study attempted to quantify the amount of time physicians spent on tasks that could be performed by non-physician staff.<sup>21</sup> Only 2 articles evaluated hospitalists,<sup>20,32</sup> and we found no articles studying hospitalists in a community, non-teaching setting. The studies were performed as early as 1961 and as recently as 2009. Just 5 of the 13 articles were published within the last 10 years.

Methodological quality also varied. Of the 11 time-motion studies, the total amount of time subjects were observed in the studies ranged from 48 to 720 hours, with a mean of 254 hours. The number of subjects observed varied

**TABLE 1. Sources Included**

Reference (Year)	Type of Hospital	Data Collection Tool	Direct/Indirect Care Estimates	Key Activities Reported and Percentage of Time Spent on Each, and Other Results
Ammenwerth and Spottl (2009)	Academic	Work sampling: paper and stopwatch	Direct care 27.5%; indirect care 62.8%	Documentation tasks 26.6%; direct care 27.5%; communication 36.2%; other tasks 9.7%. Approximately 16% of documentation time was administrative documentation.
Arthurson et al. (1976)	Academic	Paper and stopwatch	Direct care 40.8%; indirect care 45.5%	Medical intern: patient care 40.8%; clerical 25.5%; telephone 10%; professional discussion 10.5%; transit/waiting 6.5%, personal 7%
Gabow et al. (2006)	Academic	Paper and stopwatch with pedometer	Direct care 19.5%; indirect care: 32%	Attend to/assess patient 17%; charting 9.5%; consult with MD/nurse 9.5%; downtime 6.5%; educational activity 2.5%; family interaction 0.5%; paging/phone 3.5%; procedure 1.5%; review films/laboratory results 9%; rounds 15.5%; sleep 21.5%; travel 3.5%
Gillanders et al. (1971)	Academic	Paper and stopwatch	Direct care 19%; indirect care 42.5%	Individual interaction 14.5%; nonverbal communication 20.5%; procedures 10.0%; laboratory work 3.5%; interpersonal communication 18.5%; rounds 9%; direction and supervision 0.5%; nonmedical talk 2%; education 8.5%; ancillary activities 5.5%; personal 7%
Knickman et al. (1992)	Academic	Paper and stopwatch	Direct care 8.5%; indirect care 37.7%	Education 20.7%; information gathering 13.7%; personal 13.3%; testing 12%; consulting 12%; documenting 9.8%; transit 8.2%; procedures 5.4%; interacting with patients 3.1%; administration 1.8%. 46.7% of residents' time was spent on tasks that required a physician.
Lurie et al. (1989)	Academic	Paper and stopwatch	Direct care 17.4%; indirect care 39.3%	Procedures 3%; patient evaluation 20%; communication 27%; basic 40%; miscellaneous 10%. On average, doctors were interrupted 9 minutes into an H&P, got 230 minutes of sleep per night, and slept 59 minutes before being woken up by some interruption.
Magnusson et al. (1998)	Academic	Paper and stopwatch	Could not be determined	Clinical 54%; education 28%; personal 18%. The 3 specialties did not differ significantly in time spent on these categories except for education time: emergency 24%; internal 28%; surgery 18%.
Malkenson (unpublished data)	1 Community; 1 Academic	Paper and stopwatch	Academic: direct care 19%; indirect care 56%. Community: direct care 25%; indirect care 55%.	Direct patient care (25% community, 19% academic); indirect patient care (55% community, 56% academic); personal time (4% community, 6% academic); travel time (10% community, 10% academic); other activities (10% community, 13% academic)
Nerenz et al. (1990)	Academic	Work sampling: paper and stopwatch	Direct care 18.9%; indirect care could not be determined	Interns averaged 21 pages over 30 hours of observation, and slept an average of 2.5 hours with 2 interruptions. Attending physicians interacted with the interns for an average of 139 minutes per shift.
O'Leary et al. (2006)	Academic	Paper and stopwatch	Direct care 18%; indirect care 69%	Indirect patient care occupied 69% of hospitalists' time. Indirect care included: documentation 37%; communication 35%; reviewing results 21%; orders 7%. Direct care occupied 18%, and included: history and physical 18%; follow-up visits 53%; family meetings 13%; discharge instructions 16%. Remaining time was spent on personal activities 4%; professional development 3%; education 3%; travel 3%.
Parenti et al. (1993)	Academic	Paper and stopwatch	Interns: direct care 39%; indirect care 51%. Residents: direct care 40%; indirect care 47%.	Interns: procedures 4%; patient evaluation 35%; communication 42%; basics 11%; miscellaneous 8%. Residents: procedures 2%; patient evaluation 38%; communication 35%; basics 12%; miscellaneous 13%.
Payson et al. (1961)	Academic	Paper and stopwatch	Could not be determined	Communication with staff took up the largest amount of time. Remaining time was evenly distributed between the categories of personal activities, ancillary duties, patient and relative contact, and intravenous therapy. Overall percentages of time were not reported.
Westbrook et al. (2008)	Academic	PDA	Attending physicians: direct care 18.0%; indirect care 63.5%. Residents: direct care 16.0%; indirect care 66.7%. Interns: direct care 11%; indirect care 85%.	Communication 33%; social activities 17%; indirect care 17%; direct care 15%; documentation 9%; medication tasks 7%; supervision or education 7%; transit 6%; discharge summary 5%; administrative tasks 2%; answering pager 0.8%

Abbreviations: H&P, history and physical; PDA, personal digital assistant.



**FIGURE 1.** Article selection flow chart.

between 1 and 35, with a mean of 12 subjects. Average time observed per subject ranged from 8 hours to 113.5 hours, with a median of 26 hours. Six of the 11 studies observed subjects continuously for an entire shift.<sup>22,25,28–31</sup> Four studies covered an entire shift over the course of several days, using shorter observation periods.<sup>20,21,26,27</sup> One study observed subjects for only part of a shift.<sup>32</sup> Ten of the time-flow articles reported collecting data with a stopwatch and paper-and-pencil form<sup>20–22,25,27–32</sup> and 1 used a handheld computer system.<sup>26</sup> Two studies utilized work-sampling techniques, both using paper-and-pencil forms to collect data during a full shift. Ammenwerth and Spotl<sup>23</sup> studied 8 physicians for a total of 40 hours, collecting 5500 observation points. Nerenz et al.<sup>24</sup> studied 11 interns for a total of approximately 330 hours, and collected 7858 observations. Both of these studies collected sufficiently large samples to satisfy the power requirements described by Sittig.<sup>3</sup>

Study sites were relatively uniform. Only one study evaluated physicians at both a teaching community hospital and an academic hospital.<sup>32</sup> The remaining 12 observed physicians only in academic hospitals. Two studies were

conducted in Australia,<sup>25,26</sup> 1 in Austria,<sup>23</sup> and the remaining 10 were conducted in the United States.

To provide a rough estimate of the amount of time physicians spend on direct care activities at the patients' bedside vs. indirect care activities, we attempted to calculate these figures for each article using a common definition. For the sake of consistency and to allow us to include as many studies as possible, we used the broadest definition of indirect care found among the articles, which included activities such as professional communication, medication review, documentation, and reviewing test results. Three articles did not provide enough information to calculate these values.<sup>24,27,29</sup>

All 10 articles that did provide sufficient information found that indirect care activities consumed the greater portion of time. Indirect care occupied an average of 50% of physicians' time, ranging from 32% to 69%. Direct care, on the other hand, accounted for an average of 23% of physicians' time, and ranged from 8.5% to 41%. Three articles that included data specific to attending physicians or hospitalists demonstrated an even larger disparity between direct and indirect care.<sup>20,26,32</sup> In these articles, physicians spent an average of 19% of their time on direct care and 64% on indirect care, suggesting that senior physicians in the academic setting spend less time with patients and more time on care activities away from patients.

Four studies recorded various forms of interruptions of work flow.<sup>20,24,26,31</sup> Lurie et al.<sup>31</sup> found that interns and residents were interrupted approximately 9 minutes into the performance of every history and physical (H&P). Westbrook et al.<sup>26</sup> found that residents were interrupted on average every 21 minutes regardless of the task being performed. Nerenz et al.<sup>24</sup> reported that interns received an average of 21 pages over the course of a 30 hour shift. They also noted that, on average, 12 of these pages were merely "transient distractions," but 9 pages required some action on the part of the intern.<sup>24</sup> Finally, O'Leary et al.<sup>20</sup> found that hospitalists received an average of 3.5 pages an hour and that 7% of their day was spent returning pages. Two articles recorded events of multitasking. Westbrook et al.<sup>26</sup> found that 20% of physicians' time was spent performing more than one activity. Similarly, O'Leary et al.<sup>20</sup> reported that 21% of hospitalists' time was spent multitasking. Neither study reported the types of activity performed during multitasking.

One article considered the amount of time physicians spend performing tasks that could be performed by non-physician staff. Knickman et al.<sup>21</sup> reported that in the traditional physician-centered model of care, approximately 19% of a resident's time is spent on tasks that could be performed by non-physician staff. They suggested that switching to a mid-level provider model of care could significantly reduce the impact of resident work hour restrictions.<sup>21</sup>

Parenti and Lurie<sup>28</sup> examined internal medicine residents on both day and night shifts.<sup>31</sup> These authors concluded that residents on the night shift have an easier time because they see fewer patients and have more down time than residents on day shifts.<sup>28</sup> Additionally, Lurie et al. found that

**TABLE 2. Suggested Categories of Activity**

Primary	Secondary	Tertiary
Direct patient care	Daily rounds	Evaluation Education
	Admission history and physical Consultation history and physical Discharge	Evaluation Education
	Procedures	
Indirect care	Reviewing test results Documentation	Orders History and physical Progress notes Discharge paperwork
	Communication	Paging Patient relatives Other physicians Nurse Ancillary staff
Other	Education Transit/travel Personal (eg, eating, restroom) Miscellaneous	

residents got an average of 230 minutes (3.8 hours) of sleep per night and slept, on average, 59 minutes before being awakened by an interruption.<sup>31</sup> However, these studies preceded work hour regulations.

## Discussion

This systematic review of time studies set in the hospital, the first of which we are aware, revealed a sizable number (13) of articles evaluating physicians. However, the studies almost exclusively focused on academic hospitals (92%) and the majority (69%) analyzed only the activities of physicians in training. The studies were diverse in their methodology, subject populations, and, not surprisingly, their results. Even those studies designed simply to document the activities of physicians in the hospital report widely varying findings. For example, the percentage of time physicians spent on direct-care activities varied from 8.5% to 41%, while indirect-care time varied from 32% to 69%. These results likely reflect the heterogeneity of the hospital environment and differences among hospitals, as well as variations in the design and quality of the studies.

Despite this variability, a few observations appear consistent. Physicians perform many tasks that may be readily accomplished by less costly staff. This could partly explain why far more time is spent on activities indirectly related to a patient's care (eg, documentation and coordinating tests), instead of directly interacting with hospitalized patients. Additionally, physicians caring for hospitalized patients experience multiple interruptions and must regularly multitask. Unfortunately, very little research in the hospital set-

ting has evaluated the impact of these interruptions on work efficiency, medical errors, or adverse events.

With the intense national interest in improving the value of healthcare by both enhancing quality and reducing costs, further efforts to optimize the efficiency of hospitalists will be needed.<sup>33</sup> As hospitals and hospitalists aim to enhance the efficiency of care delivery to hospitalized patients, and also are increasingly asked to expend time to optimize the hospital discharge process to reduce readmissions,<sup>34,35</sup> time-motion and work-sampling studies can provide guidance.

One of the principal difficulties in aggregating data from time studies is the variety of approaches used to analyze activities. Lack of standardization in the approach to assessing physician activities (eg, use of a stopwatch with paper documentation vs. computer) and dissimilar categorizations inhibit efforts to summarize the findings across studies. Categories of activity were generally selected with the specific goals of the study in mind, instead of utilizing a readily available standardized approach. Moreover, the lack of detailed definitions of categories and sub-categories, along with data for each, produces a significant barrier to comparison. Based on this review of available literature and our own experience conducting time-motion evaluation of hospitalists, we propose the basic activity categorization in Table 2. Future researchers would be able to more readily compare their findings to other time-motion studies by utilizing such a standardized approach to categorizing physician activities. Adding custom sub-categories within this basic set would allow researchers to explore more specific time-flow questions while maintaining comparability of most data. Electronic data collection tools (eg, handheld or tablet computers) could also facilitate the collection of more detailed and accurate data to increase study reliability.

Our systematic review is limited in its scope, as we focused only on the activities of physicians working in the hospital. Our exclusion criteria also eliminated several more focused time studies that evaluated only one small part of a physician's workflow, such as Amusan et al.'s<sup>36</sup> evaluation of EMR and CPOE implementation during morning rounds. The available literature itself is also lacking in several important ways. Much of the literature is now limited by its age. The constant advance of medical technology, changes in work hour regulations, and new reimbursement structures have all affected physician workflow, and likely contributed to the variability of time study findings. Additionally, the available literature focuses almost exclusively on academic hospitals and teaching services. All but 1 of the studies collected data exclusively in academic hospitals, despite the fact that more than 90% of hospital care delivery in the U.S. occurs in a non-academic hospital setting.<sup>20,37</sup> Just 1 study evaluated the activity of hospitalists directly caring for patients without assistance from residents.<sup>20</sup> The significantly different workforce composition in community hospitals could mean that most findings are not relevant to the vast majority of U.S. hospitals. For example, the studies documenting that physicians in training (ie, residents)

perform many activities that could be performed by a non-physician are likely not applicable to the community hospital setting. Thus, additional research is needed to better understand how hospitalists can deliver care more efficiently, particularly in the community hospital setting and in the current technological and structural environment of healthcare.

This systematic review of the literature provides insight into published studies attempting to evaluate physician activities in the hospital through time-motion and work-sampling studies. Published research to date appears extremely variable in quality, limiting our ability to draw firm conclusions. However, it appears that hospital-based physicians spend most of their time not interacting with patients, and non-physician staff could readily complete a sizable portion of their tasks. Given the necessity for multitasking by hospitalists, better documentation of its frequency and impact is needed, as well as information about the types of tasks performed while multitasking, which has yet to be reported. Additionally, the effect of interruptions (including, but not limited to paging) needs further evaluation.

When properly performed, time-study methodology represents a powerful approach to understanding the activities of hospitalists and how we might reengineer hospital care delivery to be more efficient. Efforts to standardize healthcare delivery and integrate health information technology could benefit dramatically from detailed information regarding physician activities and empirical testing of quality improvement initiatives. Future research using time-motion or work-sampling methodology should be careful to define and report categories of activity with enough detail that comparisons with other studies are possible.

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