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Allocation of Internal Medicine Resident Time in a Swiss Hospital: A Time and Motion Study, the Médical Day (MeDay) Study

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Wenger Nathalie, 2017, Allocation of Internai Medicine Resident Time in a Swiss Hospital: A Time and Motion Study , the Médical Day (MeDay) Study

Originally published at : Thesis, University of Lausanne

Posted at the University of Lausanne Open Archive http://serval.unil.ch
Document URN : urn:nbn:ch:serval-BIB_1377E4B5F2775

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FACULTÉ DE Biologie et Médecine

[INSTITUT/SECTION/DEPARTEMENT DE Médecine]

Allocation of Internal Medicine Resident Time in a Swiss Hospital : A Time and Motion Study, the Medical Day (MeDay) Study

THÈSE DE DOCTORAT

présentée à la

Faculté de Biologie et Médecine
de l'Université de Lausanne

pour l'obtention du grade de

Docteur en Médecine

par

Nathalie Wenger

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Jury

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LAUSANNE
2017

UNIL | Université de Lausanne

Faculté de biologie
et de médecine

Ecole Doctorale
Doctorat en médecine

Imprimatur

Vu le rapport présenté par le jury d'examen, composé de

Directeur de thèse	*Monsieur le Professeur* ***Gérard Waeber***
Co-Directeur de thèse	*Monsieur le Professeur* ***Pedro Marques-Vidal***
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la Commission MD de l'Ecole doctorale autorise l'impression de la thèse de

Madame Nathalie WENGER

intitulée

Allocation of Internal Medicine Resident Time in a Swiss Hospital: A Time and Motion Study , the Medical Day (MeDay) Study

Lausanne, le 23 mai 2017

pour Le Doyen
de la Faculté de Biologie et de Médecine

Monsieur le Professeur John Prior
Vice-Directeur de l'Ecole doctorale

Annals of Internal Medicine

Allocation of Internal Medicine Resident Time in a Swiss Hospital: A Time and Motion Study of Day and Evening Shifts

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Background: Little current evidence documents how internal medicine residents spend their time at work, particularly with regard to the proportions of time spent in direct patient care versus using computers.

Objective: To describe how residents allocate their time during day and evening hospital shifts.

Design: Time and motion study.

Setting: Internal medicine residency at a university hospital in Switzerland, May to July 2015.

Participants: 36 internal medicine residents with an average of 29 months of postgraduate training.

Measurements: Trained observers recorded the residents' activities using a tablet-based application. Twenty-two activities were categorized as directly related to patients, indirectly related to patients, communication, academic, nonmedical tasks, and transition. In addition, the presence of a patient or colleague and use of a computer or telephone during each activity was recorded.

Results: Residents were observed for a total of 696.7 hours. Day shifts lasted 11.6 hours (1.6 hours more than scheduled). During these shifts, activities indirectly related to patients accounted for 52.4% of the time, and activities directly related to patients accounted for 28.0%. Residents spent an average of 1.7 hours with patients, 5.2 hours using computers, and 13 minutes doing both. Time spent using a computer was scattered throughout the day, with the heaviest use after 6:00 p.m.

Limitation: The study involved a small sample from 1 institution.

Conclusion: At this Swiss teaching hospital, internal medicine residents spent more time at work than scheduled. Activities indirectly related to patients predominated, and about half the workday was spent using a computer.

Primary Funding Source: Information Technology Department and Department of Internal Medicine of Lausanne University Hospital.

Ann Intern Med. doi:10.7326/M16-2238 **www.annals.org**

For author affiliations, see end of text.

This article was published at www.annals.org on 31 January 2017.

The practice of hospital medicine is constantly evolving with the increasing complexity of patients (1–4). During training, residents in internal medicine are educated to manage this complexity and to summarize a wide array of medical information. The structure of a resident's workday has also changed dramatically in recent decades, with limitations on hours worked per week, wide implementation of electronic medical records (EMRs), and a growing volume of clinical data and administrative tasks (5). Many new scheduling paradigms have been proposed and implemented to address duty hours; these include the separation of inpatient and outpatient rotations (mandatory clinics) (6) and the use of advanced practitioners (nurse practitioners and physician assistants) (7).

Information technologies have increasingly been used in health care because they allow better sharing and availability of medical data. However, negative effects of EMRs have also been described, as they increase the time physicians spend performing administrative tasks and writing notes (8). Similarly, Alkureishi (9), Ratanawongsa (10), and Asaro (11) and their respective colleagues reported that EMRs reduce communication between patients and physicians and the time they spend together. Recently, Sinsky and associates (12) described the allocation of physicians' time in ambulatory practice and confirmed that they spend up to 50% of their time using EMRs.

In hospital practice, only 9% to 22% of residents' time is spent with patients, and more than half is dedicated to activities indirectly related to patients (13–17). This trend is worrying because less time spent with patients decreases physician satisfaction (18) and patient education and health promotion (19) and increases inappropriate prescribing and medical malpractice (20). Although information technologies are improving, EMRs have thus far failed to fulfill their promise in hospital practice (21).

Few time and motion studies have focused on how computer use affects residents' time allocation. We therefore aimed to objectively assess the type and duration of activities performed by internal medicine residents throughout the day. The primary focus was to estimate the time spent with patients and using a computer. The secondary focus was to identify individual factors influencing the residents' allocation of time to different activities and contexts.

METHODS

Study Design, Setting, and Participants

We conducted an observational study between May and July 2015 in the Department of Internal Medicine of Lausanne University Hospital, 1 of 5 teaching hospitals in Switzerland, with more than 1400 beds and 47 300 patients hospitalized in 2015 (www.chuv.ch). The hospital implemented its current EMR (Soarian, Cerner Corporation) in 2009; it compiles medical documentation, laboratory results, radiographs and providers' views, an electronic prescription system, and

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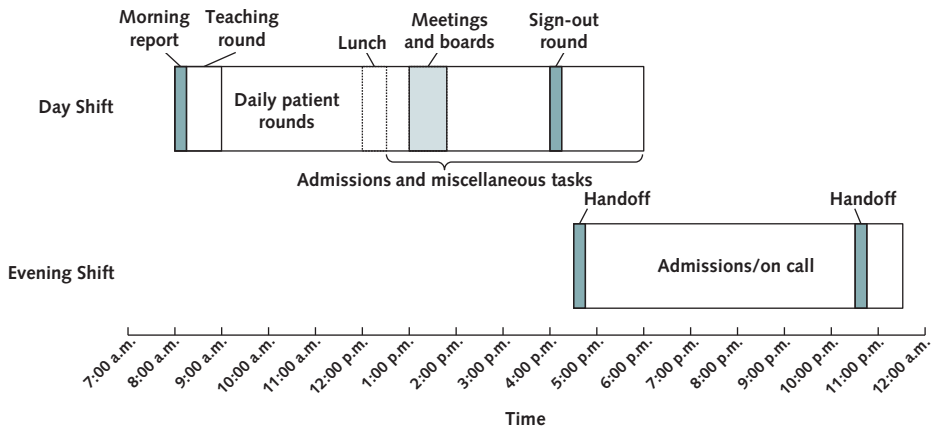
Figure 1. Official schedule of day and evening shifts in the Department of Internal Medicine at Lausanne University Hospital.



During evening shifts, staff is reduced to 2 residents in charge of all wards.

scanned medical archives and is available on desktop and laptop computers.

The Department of Internal Medicine receives approximately 6200 patients per year and has 203 beds organized in 8 wards. Each ward is staffed with 1 senior physician and 1 chief resident supervising 3 residents. The minimum postgraduate training for internal medicine is planned over 5 years (3 years of basic training, mostly in an internal medicine department, and 2 additional years more freely organized in specialties). At least 6 months have to be certified in an ambulatory practice. Chief residents usually have at least 4 years of postgraduate training. Within each ward, a resident is responsible for 6 to 10 patients. There are day (8:00 a.m. to 6:00 p.m.), evening (4:30 p.m. to 11:30 p.m.), and night (10:30 p.m. to 8:30 a.m.) shifts. Scheduling of the residents' daily activities is similar to that in U.S. hospitals (**Figure 1**), with daily patient rounds, supervision, training, and new patient admissions. The staff is reduced to 2 residents and 1 chief resident (for 203 beds) during evening and night shifts. Evening shifts mostly involve late patient admissions, unstable patient care, and emergency situations. In this study, only day and evening shifts were considered; night shifts were not considered because activities are mostly limited to emergency situations.

All residents working in internal medicine inpatient wards—which do not cover any critical care or specialty unit—during the study period were eligible for inclusion. There were no exclusion criteria. The Human Research Ethics Committee of Canton de Vaud certified that the study was exempt from human subjects ethics review. All residents were informed of the study and provided written consent. No patient identifier or health information was recorded.

Data Collection Procedures

Data were collected by undergraduate medical students, who were extensively trained to collect data without interfering with residents' work. The training consisted of a dedicated e-learning program on how to categorize the residents' various activities, a teaching session that focused on the definition of activities and the use of recording devices, a 2-hour practice session based on a 1-hour video of residents engaging in typical medical activities, 8 hours of observation and recording of a resident's activity in the wards (the resulting data were not included in the study), and a final session to resolve any remaining issues. The reproducibility of the observers was assessed during the practice session; overall, observers recorded activities and contexts similarly (**Appendix Table 1**, available at www.annals.org).

Recording began when the resident arrived at his workplace and lasted until he left. Residents were randomly assigned to an observer. To decrease observation bias, observers had to avoid communicating with the residents and were allowed to ask for clarification about an activity or context only. To optimize observation accuracy, day shifts were sequentially covered by 2 observers, with handoff after the first 6 hours. Evening shifts were covered by only 1 observer because these shifts were shorter.

Each activity was recorded in real time using a tablet (**Appendix Figure**, available at www.annals.org). The application was designed by the investigators and developed with the Information Technology Department of the hospital. To promote similar studies, the source code is available "as is" on the GitHub Web site (https://github.com). The observer selected an activity, a context, or both. After the observer pressed a confirmation icon, the application automatically recorded the start time of the activity or context being performed. We defined 22 activities in 6 categories (**Table 1**), based on expertise and earlier studies (13–17, 22). Our department is keen on quality development and is particularly interested in assessing residents' communication skills; hence, we created a category labeled "communication" to find out how much time was dedicated to news delivery (for example, bad news or therapeutic orientation) and meeting with family members. Other types of

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Table 1. Distribution of Activities According to Shift in the Department of Internal Medicine of Lausanne University Hospital

Activity	Description	Mean Time During Day Shifts (95% CI)*†		Mean Time During Evening Shifts (95% CI)*‡	
		Minutes	Percentage	Minutes	Percentage
Directly related to patient		198 (177–218)	28.0 (24.9–31.1)	181 (147–214)	39.4 (34.4–44.5)
Admission	Anamnesis, clinical examination, and communication with the patient. Starts when the resident is looking after a new patient.	27 (10–43)	3.4 (0.3–6.5)	156 (128–183)	34.1 (29.0–39.1)
Patient rounds	Daily medical round of inpatients the resident is in charge of: EMR review, anamnesis, clinical examination, prescription of treatments, and orders. Also includes daily sign-out round at the nursing desk.	142 (131–154)	20.6 (19.0–22.2)	16 (0–34)	3.5 (1.1–6.0)
Patient discharge activities	Preparation for patient discharge: Prescription writing, last interview with the patient, and delivery and explanation of prescription.	16 (10–22)	2.2 (1.4–3.0)	1 (0–11)	0.3 (0–1.6)
Clinical procedures	All medical procedures performed by the resident on a patient, including but not limited to arterial blood gas testing and punctures (e.g., ascites, lumbar, or pleural).	11 (5–17)	1.5 (0.7–2.4)	5 (0–15)	1.0 (0–2.5)
Out-of-unit support	Attendance of the resident alongside the patient outside the ward: Oversight during examinations, transfer to another department, and emergency situations.	2 (0–4)	0.3 (0–0.5)	1 (0–4)	0.3 (0–0.8)
Communication		15 (11–20)	2.3 (1.5–3.0)	5 (0–12)	1.2 (0–2.3)
News delivery	Bad news or therapeutic orientations that need a specific additional interview and patient educational therapy.	5 (2–7)	0.7 (0.3–1.0)	1 (0–5)	0.3 (0–0.9)
Family meeting	Communication with family, close relatives, or nonprofessional caregivers. Time for providing information and explanation and collecting information and opinions.	11 (7–15)	1.6 (NA)	4 (0–10)	0.9 (NA)
Indirectly related to patient		365 (344–385)	52.4 (49.6–55.3)	216 (181–251)	47.9 (43.1–52.8)
Looking for information	Looking for information in the paper record, EMR, computer archives, or other medical record. Excludes admission activity.	39 (31–46)	5.7 (4.3–7.2)	39 (27–51)	8.7 (6.4–11.0)
Literature review	Looking for scientific data to improve/determine patient management, including medical textbooks, scientific papers, and Web sites.	6 (4–8)	0.9 (0.6–1.2)	2 (0–5)	0.4 (0–0.9)
Writing in medical record	Writing notes, problems list, handoffs, or examination results. Excludes admission activity and discharge report.	110 (99–122)	15.8 (14.0–17.6)	29 (9–48)	6.2 (3.2–9.1)
Discharge summary redaction	Any activity related to writing hospitalization reports: brief report and discharge letter. Includes revision of reports.	14 (8–20)	2.1 (1.2–2.9)	0	0
Handoffs	Giving or receiving handoff, including preparation of documents, attending a handoff meeting, receiving/giving telephone information, or sharing information.	16 (12–20)	2.2 (1.6–2.8)	68 (61–74)	14.9 (13.9–16.0)
Supervision	Discussion with a senior physician (chief resident or chief physician) focused on a patient and resulting in a decision on patient management.	60 (52–69)	8.6 (7.3–9.9)	31 (16–46)	6.8 (4.7–9.0)
Talking with providers/ collaborators	Collecting information, booking an appointment, requesting examination or specialized consultation, and asking for consultants' advice.	69 (61–78)	9.9 (8.5–11.3)	45 (30–59)	9.9 (7.7–12.1)
Patient administrative tasks	Administrative tasks for the patient: booking appointments, writing the voucher for radiography or specialized consultation, and adding laboratory tests.	32 (28–36)	4.6 (4.0–5.2)	6 (0–13)	1.3 (0.3–2.3)
Multidisciplinary board	Multidisciplinary boards and meetings between professionals to discuss management of ≥1 patient.	18 (12–24)	2.7 (1.8–3.5)	0	0

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Table 1–Continued

Activity	Description	Mean Time During Day Shifts (95% CI)*†		Mean Time During Evening Shifts (95% CI)*‡	
		Minutes	Percentage	Minutes	Percentage
Academic		43 (32–53)	6.3 (4.6–8.0)	4 (0–21)	0.8 (0–3.4)
Receiving training	Participation in a training conference or the attending round (medical round supervised by the chief physician), self-preparation, and paper review.	35 (26–43)	5.1 (3.7–6.6)	3 (0–17)	0.6 (0–2.9)
Teaching	Resident teaches students, collaborators, and nurses. Includes supervision of an admission done by a student.	9 (6–12)	1.3 (0.8–1.8)	0	0
Academic research	Research work, thesis, and publications. Excludes literature review.	0	0	0	0
Nonmedical tasks		40 (32–48)	6.1 (4.5–7.6)	23 (11–35)	5.2 (2.9–7.4)
Nonpatient administrative tasks	Activity unrelated to the patient, directly or indirectly (e.g., answering professional e-mails).	7 (5–10)	1.1 (0.7–1.5)	5 (1–9)	1.3 (0.6–1.9)
Personal activities	Time dedicated to the resident's personal needs unrelated to the clinical activity: food, restroom, and private use of telephone or computer.	33 (26–40)	5.0 (3.7–6.3)	17 (7–27)	3.8 (2.1–5.6)
Transition		35 (31–39)	5.1 (4.5–5.8)	23 (17–29)	5.1 (4.1–6.1)
Transition time to the next activity	Time required for transition to another activity: moving, handwashing, dressing, and fetching or bringing something.	35 (31–39)	5.1 (4.5–5.8)	23 (17–29)	5.1 (4.1–6.1)
Total time, *min*		695 (674–717)	–	454 (418–490)	–
Total time, *h*		11.6 (11.2–12.0)	–	7.6 (7.0–8.2)	–

EMR = electronic medical record; NA = not assessable.
* Obtained using a linear mixed model to account for repeated measurements by resident. Negative confidence bounds have been replaced with zeros. Percentages may not sum to 100 due to rounding.
† 49 observations from 28 residents.
‡ 17 observations from 13 residents.

communication were collected in the category "directly related to the patient," within such activities as admission, patient rounds, and patient discharge. Similarly, we created 4 contexts in which the activity was being performed: in the presence of 1 or more colleagues (any professional), in the presence of the patient, with a computer, and with a telephone. Context could change regardless of the activity being performed.

For each resident, sex, age, country of medical school graduation, postgraduate training (in months), and distance between home and the hospital were collected. The number of patients the resident was in charge of during the observed shifts was also collected.

Statistical Analysis

Based on similar studies (13–17), a pragmatic sample size of 64, corresponding to 2 shifts per resident, was chosen. Statistical analyses were performed using Stata 14.0 (StataCorp). Descriptive results for residents' characteristics are presented as means and SDs for continuous data or number and percentage of participants for categorical data. Because residents could be assessed several times on the same or different shifts, we used a linear mixed model with clustering by resident to compute the means and corresponding 95% CIs of the times dedicated to each activity. We calculated the percentage of a resident's shift time devoted to a specific activity by dividing the time for that activity by the total shift duration.

Role of the Funding Source

The study was sponsored by the Information Technology Department and the Department of Internal Medicine of Lausanne University Hospital. The funding sources had no involvement in the study design; collection, analysis, or interpretation of the data; writing of the manuscript; or the decision to submit the manuscript for publication.

RESULTS

Thirty-six residents were included; 23 were women, and the mean age was 29.4 years (SD, 2.5; range, 25.7 to 39.4 years). Thirteen (36%) residents held a foreign medical diploma. The average amount of postgraduate training in internal medicine was 29 months (SD, 11; range, 0 to 50 months), and the median distance between home and the hospital was 3.0 km (range, 1.4 to 75.7 km). During day shifts, each resident was in charge of an average of 8 patients.

Data from 66 shifts (49 day shifts and 17 evening shifts) were collected, amounting to 696.7 hours of observation. Because of external factors, such as residents' vacation time, 9 residents were observed only

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once. Table 1 shows the distribution of the 22 activities during day and evening shifts. Day shifts lasted an average of 11.6 hours (95% CI, 11.2 to 12.0 hours); 52.4% of this time was dedicated to tasks indirectly related to patients, and only 28.0% was dedicated to tasks directly related to patients. Academic, nonmedical, transition, and communication tasks represented 6.3%, 6.1%, 5.1%, and 2.3% of total time, respectively. Two of the longest activities (>1 hour) were daily patient rounds and writing in the EMR. Evening shifts lasted an average of 7.6 hours (CI, 7.0 to 8.2 hours). When expressed as the percentage of total time, the distributions of the main activities (directly or indirectly related to patients, communication, or nonmedical) were similar between day and evening shifts; however, almost no time was devoted to academic activities during evening shifts (Table 1).

For each category of activities, time spent by residents with patients, using a computer, doing both, and doing neither is indicated in Table 2. During day shifts, residents spent, on average, 1.7 hours (101 minutes) with patients, 5.2 hours (313 minutes) using a computer, and 13 minutes doing both. For activities directly related to patients, residents on day shifts spent the same amount of time with patients and using a computer, whereas residents on evening shifts spent more time using a computer than with patients. For activities indirectly related to patients, computer use represented 59.2% of the time during day shifts and 42.3% during evening shifts. The distribution of time spent

Table 2. Distribution of Activities With Patients and a Computer in the Department of Internal Medicine of Lausanne University Hospital

Activity	Mean Time During Day Shifts (95% CI)*†		Mean Time During Evening Shifts (95% CI)*‡	
	Minutes	Percentage	Minutes	Percentage
Directly related to patient	198 (177–218)	100.0	181 (147–214)	100.0
With patients	80 (70–91)	41.0 (36.5–45.5)	57 (39–75)	36.3 (28.7–43.9)
Using computer	81 (67–95)	39.4 (34.4–44.4)	98 (74–122)	49.5 (41.2–57.8)
Both	10 (6–14)	5.1 (2.8–7.4)	0	0
Neither	27 (22–32)	14.5 (11.9–17.0)	26 (18–33)	14.4 (10.3–18.5)
Communication	15 (11–20)	100.0	5 (0–12)	100.0
With patients	8 (5–11)	56.5 (43.5–69.5)	5 (1–10)	100.0
Using computer	0 (0–1)	2.1 (0–5.8)	0	0
Both	0	0	0	0
Neither	7 (4–9)	41.8 (28.6–54.9)	0	0
Indirectly related to patient	365 (344–385)	100.0	216 (181–251)	100.0
With patients	8 (4–11)	2.0 (1.1–2.9)	1 (0–6)	0.4 (0–1.8)
Using computer	216 (199–233)	59.2 (55.9–62.5)	93 (65–122)	42.3 (36.8–47.9)
Both	1 (0–2)	0.3 (0–0.6)	0	0
Neither	139 (126–152)	38.5 (35.3–41.7)	123 (101–144)	57.3 (51.9–62.7)
Academic	–	100.0	–	100.0
With patients	5 (2–8)	8.2 (2.7–13.7)	0	0
Using computer	10 (6–14)	26.9 (15.1–38.7)	2 (0–9)	100.0
Both	2 (0–5)	1.7 (0–5.1)	0	0
Neither	27 (19–34)	63.0 (50.8–75.3)	0	0
Nonmedical tasks	40 (32–48)	100.0	23 (11–35)	100.0
With patients	0	0	0	0
Using computer	5 (3–7)	14.5 (10.4–18.6)	4 (1–7)	11.5 (4.6–18.5)
Both	0	0	0	0
Neither	35 (28–41)	85.5 (81.4–89.6)	20 (9–30)	88.5 (81.6–95.4)
Transition	35 (31–39)	100.0	23 (17–29)	100.0
With patients	0	0	0	0
Using computer	0	0	0	0
Both	0	0	0	0
Neither	35 (31–39)	100.0	23 (17–29)	100.0
All	695 (674–717)	100.0	454 (418–490)	100.0
With patients	101 (89–113)	14.4 (12.8–16.1)	62 (43–81)	13.7 (11.0–16.2)
Using computer	313 (293–332)	44.9 (42.3–47.5)	198 (164–231)	43.7 (39.2–48.0)
Both	13 (6–19)	2.0 (1.0–3.0)	0	0
Neither	267 (251–284)	38.7 (36.3–41.0)	194 (167–222)	42.6 (38.5–46.5)

* Obtained using a linear mixed model to account for repeated measurements by resident. Negative confidence bounds have been replaced with zeros. Percentages may not sum to 100 due to rounding. Table 1 provides definitions of activities.
† 49 observations from 28 residents.
‡ 17 observations from 13 residents.

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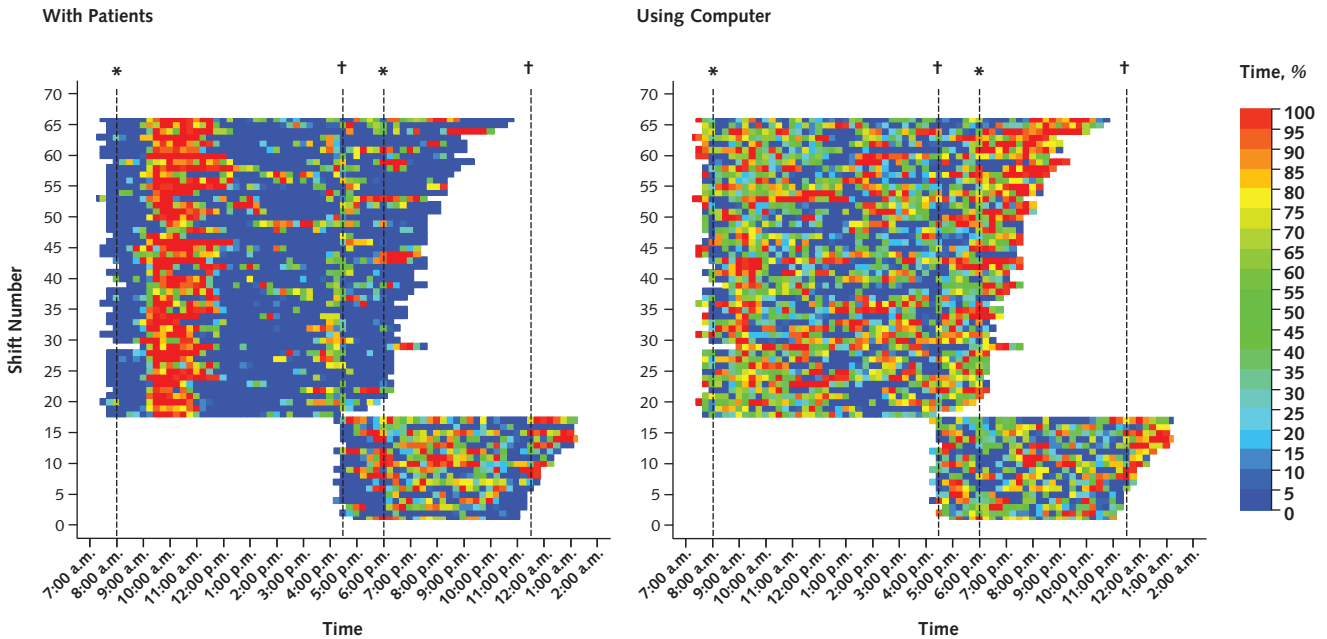
Figure 2. Heat maps of 2 contexts of activity: time spent with patients (*left*) and time spent using a computer (*right*) during day and evening shifts.



Each pixel represents 15 min.
* Start and end of day shift.
† Start and end of evening shift.

with patients or using a computer is shown in Figure 2; time spent with patients was concentrated from 9:00 to 11:00 a.m. (Figure 2, *left*), whereas time spent using a computer was more scattered, with higher percentages after 6:00 p.m. (day shifts) and 11:30 p.m. (evening shifts) (Figure 2, *right*).

Overall, residents spent 48.1% of their time in the presence of colleagues during day shifts and 30.9% during evening shifts. Telephone use was similar during day and evening shifts, representing 9.4% of the time.

Discussion

This is the largest observational European study to objectively and comprehensively assess the organization of a resident's workday in a hospital setting. Most of our findings agree with the literature (13–17): Most residents did not fulfill their duties in the scheduled time; activities indirectly related to patients dominated, with activities directly related to patients coming in second; and residents spent almost 3 times as much time using a computer as they did with patients. Finally, no consistent association was found between residents' personal characteristics and time dedicated to the different activities and contexts.

Most residents did not fulfill their duties in the scheduled time. Thus, day shifts lasted, on average, 1.6 hours longer than the official 10 hours scheduled (Figures 1 and 2). After-hours activities consisted mostly of writing in the EMR, a finding also reported in ambulatory practice (12). Almost two thirds of residents were women, and duty hours might be affected in cases where women work part-time; however, all of the residents we assessed in this study were working full-time, so we doubt that gender affected duty hours. In a recent survey conducted in Switzerland, residents self-reported spending 27% of their time writing in the EMR and 29% with patients (23). Compared with our results, residents seemed to overestimate the time they dedicate to patients and underestimate the burden of computer work. This finding is important because it could mean that time and motion studies are a better methodological approach to studying how physicians allocate their working time.

Overall, for every hour the residents spent with patients, they spent an average of 5 hours on other tasks. For day shifts, writing in the EMR and writing the discharge summary were the most time-consuming activities, amounting to approximately 2 hours per shift.

During day shifts, most of the time residents spent with patients corresponded to daily patient rounds in the morning and admissions in the afternoon (Figure 2, *left*). For evening shifts, time spent with patients was more evenly distributed among late patient admissions, unstable patient care, and emergency situations. Residents spent roughly 14.6 minutes per patient per day, twice as long as reported by Block and colleagues (7.7 minutes per patient per day) (13). One explanation is that the U.S. residents who were studied have more patients to care for (25 [24] vs. 8 in our study). However,

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the percentage of time spent with patients was similar between our study (16%) and Block and colleagues' study (12%). Of note, compared with studies conducted in the United States in 1994 (22), 1971 (25), and 1961 (26)—before EMRs were implemented—residents in our study spent approximately the same proportion of time with patients. Assuming that the amount of time spent with patients has not changed substantially in recent decades, the main change is how residents allocate their time to other tasks.

With regard to time spent on communication activities, time per shift was too short for us to draw any conclusions; however, residents did not use a computer while delivering news to patients or meeting with their families.

Residents spend almost 3 times as much time using a computer as they do with patients, a finding also reported elsewhere (13–15, 17). However, until now, few time and motion studies specifically focused on how, when, and why residents used a computer. A previous study concluded that residents spend considerably more of their shift time using computers (>50%) than in direct contact with patients (<10%) (15). However, generalizability of these results is limited by the small number of residents observed (n = 7) and the short overall observation time (84 hours [1 shift per resident]).

In the current study, time spent using a computer was evenly distributed throughout the day (**Figure 2**, *right*), whereas time with patients was more clustered. After hours, time allocated to computer tasks predominated, showing that residents postponed writing notes. Possible reasons include a better summing up of the clinical issues encountered, not being interrupted, and not needing to interact with other members of the medical team. Although residents could be with patients and use a computer simultaneously, they seldom did so. This attitude differs from the ambulatory setting, where physicians interacted with the EMR during one third of the time they spent with patients (12). This is likely due to the hospital setting, which does not facilitate use of a computer during interaction with the patient. Still, the large amount of time dedicated to computer use or other activities not centered on the patient could lead to dissatisfaction of residents due to the limited medical value of such activities and could also increase the risk for burnout (27). Thus, our results suggest the need to rethink residents' work organization to fit the digital age (21).

On the basis of our results, several interventions targeting residents' time allocation could be tested. First, increasing the ratio of residents to patients could limit the number of extra hours but would be cost-prohibitive in many institutions and would also affect educational opportunities for the residents. Second, delegation of administrative tasks (approximately 40 minutes per day in the current study) could allow residents to focus on more valuable medical activities. Third, optimizing documentation supports, using speech or writing recognition systems, or putting medical assistants in charge of entering data into the EMR could decrease the time residents spend writing in the EMR. Fourth, continuous improvement of the ergonomics of EMRs and redefinition of documentation procedures could reduce time spent using a computer. Indeed, despite much promise, EMRs still fail to capture and synthesize the growing amount and complexity of clinical data (21). Finally, the residents' timetable and training should be adapted to the challenges of digital medicine (28).

Time and motion studies are preferred over interview studies to assess physicians' time allocation because they allow an objective estimation of the time dedicated to each activity and avoid recall bias. Further, our study is considerably larger in the number of residents and observation time than other studies using similar methods (12–16). To highlight this strength, we summarized the methods and findings of recently published studies assessing the allocation of time in hospital practice (**Appendix Table 2**, available at www.annals.org). As was done in another study (12), we recorded activities separately from context, which allowed for an accurate measure of time spent with the patient and using a computer.

This study also has several limitations. First, it was performed in a single hospital, so results might not be generalizable to other settings. Most other published studies were also conducted in a single hospital, and replicating our study in other settings would be interesting. Second, observational bias (the Hawthorne effect) cannot be excluded because residents knew they were being observed. However, this bias was present in all observational studies on the topic (12–17), and it is not possible to assess its direction (for example, whether residents remained longer or left earlier).

In a hospital setting, residents in internal medicine did not complete their duties during their scheduled shift. Activities indirectly related to patients predominated, and about half the workday was spent using a computer, especially during the later hours. Organizational changes and EMR improvement are required to increase efficiency when facing highly complex inpatients.

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Presented in part at the first Swiss Society of General Internal Medicine Congress, Basel, Switzerland, 26 May 2016.

Note: Dr. Wenger affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Acknowledgment: The authors thank Olivier Pignolet, Information Technology Department, for supporting the study; Raphael Santos for developing the application; Dr. Marie-Angela Gagliano, Dr. Aude Giger, and Prof. Claudio Sartori for making substantial contributions to the conception of the study; and Milva Cappai and Marco Martinuz for helping in organization.

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Financial Support: By the Information Technology Department and the Department of Internal Medicine of Lausanne University Hospital.

Disclosures: Authors have disclosed no conflicts of interest. Forms can be viewed at www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M16-2238.

Reproducible Research Statement: *Study protocol:* Available from Dr. Wenger (e-mail, nathalie.wenger@chuv.ch). *Statistical code:* Available from Prof. Marques-Vidal (e-mail, pedro-manuel.marques-vidal@chuv.ch). *Data set:* Requests should be sent to Dr. Wenger (e-mail, nathalie.wenger@chuv.ch) and are conditional on a signed data transfer agreement. The source code for the application is available "as is" at https://github.com/agarnier00/MEDAY.

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References

1. **Nardi R, Scanelli G, Corrao S, Iori I, Mathieu G, Cataldi Amatrian R.** Co-morbidity does not reflect complexity in internal medicine patients. Eur J Intern Med. 2007;18:359-68. [PMID: 17693224]
2. **Dammacco F.** [Internal medicine and the holistic approach to the patient between globalization and advanced technologies]. Recenti Prog Med. 2012;103:248-55. [PMID: 22688379] doi:10.1701/1104.12130
3. **Kellett J, Vanderschueren S.** What is internal medicine? [Editorial]. Eur J Intern Med. 2007;18:509. [PMID: 17967330]
4. **Vanderschueren S; Board of the Belgian Society of Internal Medicine.** General internal medicine in Belgium: to be or not to be? Acta Clin Belg. 2009;64:344-5. [PMID: 19810423]
5. **Zulman DM, Shah NH, Verghese A.** Evolutionary pressures on the electronic health record: caring for complexity. JAMA. 2016;316:923-4. [PMID: 27532804] doi:10.1001/jama.2016.9538
6. **Hom J, Richman I, Chen JH, Singh B, Crump C, Chi J.** Fulfilling outpatient medicine responsibilities during internal medicine residency: a quantitative study of housestaff participation with between visit tasks. BMC Med Educ. 2016;16:139. [PMID: 27160008] doi:10.1186/s12909-016-0665-6
7. **Spychalla MT, Heathman JH, Pearson KA, Herber AJ, Newman JS.** Nurse practitioners and physician assistants: preparing new providers for hospital medicine at the Mayo Clinic. Ochsner J. 2014;14:545-50. [PMID: 25598719]
8. **Poissant L, Pereira J, Tamblyn R, Kawasumi Y.** The impact of electronic health records on time efficiency of physicians and nurses: a systematic review. J Am Med Inform Assoc. 2005;12:505-16. [PMID: 15905487]
9. **Alkureishi MA, Lee WW, Lyons M, Press VG, Imam S, Nkansah-Amankra A, et al.** Impact of electronic medical record use on the patient-doctor relationship and communication: a systematic review. J Gen Intern Med. 2016;31:548-60. [PMID: 26786877] doi:10.1007/s11606-015-3582-1
10. **Ratanawongsa N, Barton JL, Lyles CR, Wu M, Yelin EH, Martinez D, et al.** Association between clinician computer use and communication with patients in safety-net clinics. JAMA Intern Med. 2016;176:125-8. [PMID: 26619393] doi:10.1001/jamainternmed.2015.6186
11. **Asaro PV, Boxerman SB.** Effects of computerized provider order entry and nursing documentation on workflow. Acad Emerg Med. 2008;15:908-15. [PMID: 18785946] doi:10.1111/j.1553-2712.2008.00235.x
12. **Sinsky C, Colligan L, Li L, Prgomet M, Reynolds S, Goeders L, et al.** Allocation of physician time in ambulatory practice: a time and motion study in 4 specialties. Ann Intern Med. 2016;165:753-60. [PMID: 27595430] doi:10.7326/M16-0961
13. **Block L, Habicht R, Wu AW, Desai SV, Wang K, Silva KN, et al.** In the wake of the 2003 and 2011 duty hours regulations, how do internal medicine interns spend their time? J Gen Intern Med. 2013;28:1042-7. [PMID: 23595927] doi:10.1007/s11606-013-2376-6
14. **Fletcher KE, Visotcky AM, Slagle JM, Tarima S, Weinger MB, Schapira MM.** The composition of intern work while on call. J Gen Intern Med. 2012;27:1432-7. [PMID: 22865015] doi:10.1007/s11606-012-2120-7
15. **Mamykina L, Vawdrey DK, Hripcsak G.** How do residents spend their shift time? A time and motion study with a particular focus on the use of computers. Acad Med. 2016;91:827-32. [PMID: 27028026] doi:10.1097/ACM.0000000000001148
16. **Westbrook JI, Ampt A, Kearney L, Rob MI.** All in a day's work: an observational study to quantify how and with whom doctors on hospital wards spend their time. Med J Aust. 2008;188:506-9. [PMID: 18459920]
17. **Ammenwerth E, Spötl HP.** The time needed for clinical documentation versus direct patient care. A work-sampling analysis of physicians' activities. Methods Inf Med. 2009;48:84-91. [PMID: 19151888]
18. **Shanafelt TD, Dyrbye LN, Sinsky C, Hasan O, Satele D, Sloan J, et al.** Relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction. Mayo Clin Proc. 2016;91:836-48. [PMID: 27313121] doi:10.1016/j.mayocp.2016.05.007
19. **Wilson A, McDonald P, Hayes L, Cooney J.** Health promotion in the general practice consultation: a minute makes a difference. BMJ. 1992;304:227-30. [PMID: 1739798]
20. **Dugdale DC, Epstein R, Pantilat SZ.** Time and the patient-physician relationship. J Gen Intern Med. 1999;14 Suppl 1:S34-40. [PMID: 9933493]
21. **Wachter RM.** Annals for Hospitalists inpatient notes—hospitalists and digital medicine—overcoming the productivity paradox. Ann Intern Med. 2016;165:HO2-3. [PMID: 27429311] doi:10.7326/M16-1367
22. **Guarisco S, Oddone E, Simel D.** Time analysis of a general medicine service: results from a random work sampling study. J Gen Intern Med. 1994;9:272-7. [PMID: 8046530]
23. **Meyer B, Rohner B, Golder L, Longchamp C.** Hausse continue des tâches administratives. Bulletin des Médecins Suisses. 2016;97:6-8.
24. **Ouyang D, Chen JH, Hom J, Chi J.** Internal medicine resident computer usage: an electronic audit of an inpatient service. JAMA Intern Med. 2016;176:252-4. [PMID: 26642261] doi:10.1001/jamainternmed.2015.6831
25. **Gillanders W, Heiman M.** Time study comparisons of 3 intern programs. J Med Educ. 1971;46:142-9. [PMID: 5540257]
26. **Payson HE, Gaenslen EC Jr, Stargardter FL.** Time study of an internship on a university medical service. N Engl J Med. 1961;264:439-43. [PMID: 13733711]
27. **Gopal R, Glasheen JJ, Miyoshi TJ, Prochazka AV.** Burnout and internal medicine resident work-hour restrictions. Arch Intern Med. 2005;165:2595-600. [PMID: 16344416]
28. **Day TE, Napoli JT, Kuo PC.** Scheduling the resident 80-hour work week: an operations research algorithm. Curr Surg. 2006;63:136-41. [PMID: 16520117]

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Appendix Table 1. Results of the Reproducibility Study Between Observers (n = 6)

Variable	Minimum, *min*	Maximum, *min*	Average, *min*	Coefficient of Variation, %
All	68.7	69.3	68.9	0.3
Categories				
Directly related	12.0	12.2	12.1	0.7
Indirectly related	36.8	37.9	37.5	1.3
Academic	1.2	1.5	1.4	9.1
Nonmedical	17.4	18.9	17.9	3.3
Contexts				
Patient	0.5	0.9	0.6	29.9*
Computer	46.1	50.8	48.4	3.6
Telephone	3.9	6.1	5.1	17.1
Colleague	14.3	19.1	15.8	12.4

* This value is high because of the short period recorded (<1 min).

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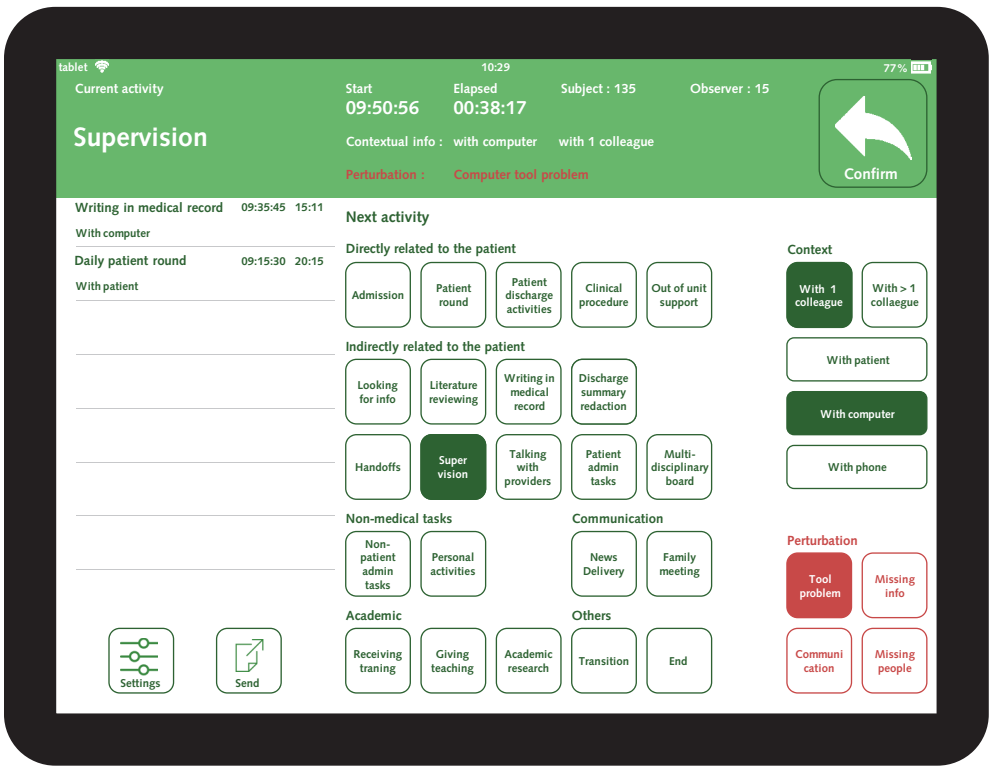
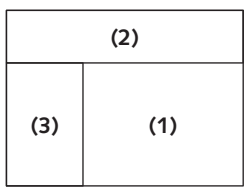
Appendix Figure. Dedicated tablet application to record observations.





The screen is split into 3 areas. 1) Observer sets the next activity and/or context. 2) After the observer presses the "Confirm" icon, preset activity becomes the current activity, exposed in detail in the green area. 3) The log allows editing of past activities. Observers and residents are identified by a number. Once the observation is finished, results are sent by secured e-mail to a designated investigator.

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Appendix Table 2. Comparison of the Current Study With a Nonexhaustive Sample of the Literature

Study, Year (Reference)	Country	Method	Time and Motion Study	Setting	Population	Total Time Recorded, *h*	Main Results
Current study, 2016	Switzerland	Real-time recording study. Day and evening shifts. Recorded with a dedicated tablet application.	Yes	University hospital (Lausanne)	36 residents (PGY-1/3)	697	28% of time directly related to patients 53% of time indirectly related to patients 16% of time with patients 47% of time using computer 14.6 min/patient/d (average)
Mamykina et al, 2016 (15)	United States	Real-time recording study. Weekday shifts. Recorded with a tablet.	Yes	University hospital (New York)	7 residents (3 PGY-1 and 4 PGY-2/3)	98	9% of time with patients 51% of time using computer
Ouyang et al, 2016 (24)	United States	Retrospective analysis of time-stamped electronic action logs.	No	University hospital (Stanford)	45 residents (PGY-2/3)	NR	47% of time using computer (EMR) Mean of 25 patients in charge
Block et al, 2013 (13)	United States	Real-time recording study. Day, night, and admitting shifts. Recorded with a small tablet.	Yes	2 academic hospitals (Baltimore)	29 residents (PGY-1)	873	12% of time with patients 64% of time for indirect patient care 40% of time using computer 7.7 min/patient/d (average) 16.6 min/admission (average)
Fletcher et al, 2012 (14)	United States	Real-time recording study. On-call shifts. Data recorded with a laptop computer program.	Yes	Veterans Affairs academic hospital (Milwaukee)	25 interns (PGY-1)	358	12% of time with patients 70% of time for indirect patient care 40% of time using computer
Ammenwerth and Spötl, 2009 (17)	Austria	Work-sampling of 2 min. Day shifts. Watch beeping/self-report.	No	A 200-bed hospital (Tyrol)	8 (1 student, 4 residents, and 3 seniors)	40	22% of time with patients 54% of time for indirect patient care 49% of documentation tasks on computer
Westbrook et al, 2008 (16)	Australia	Real-time recording study. Weekday shifts. Data recorded with a handheld computer.	Yes	A 400-bed teaching hospital (Sydney)	19 (7 interns, 5 residents, and 7 chief residents)	151	17% of time with patients (for residents) Documentation time is twice the time for direct patient care 30% for communication (for residents)
Guarisco et al, 1994 (22)	United States	Work-sampling of 3.2 recordings/h. On-call/off-call shifts, weekday and weekend. Beeper/self-report.	No	University medical center (Durham)	36 (18 interns and 18 residents)	NR	12% of time with patients (for residents) 12% of time for administrative tasks

EMR = electronic medical record; NR = not relevant; PGY = postgraduate year.