



Quantifying the Electronic Health Record Burden in Head and Neck Cancer Care

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Abstract

Background Although the main task of health care providers is to provide patient care, studies show that increasing amounts of time are spent on documentation.

Objective To quantify the time and effort spent on the electronic health record (EHR) in head and neck cancer care.

Methods Cross-sectional time–motion study. Primary outcomes were the percentages of time spent on the EHR and the three main tasks (chart review, input, placing orders), number of mouse events, and keystrokes per consultation. Secondary outcome measures were perceptions of health care providers regarding EHR documentation and satisfaction.

Results In total, 44.0% of initial oncological consultation (IOC) duration and 30.7% of follow-up consultation (FUC) duration are spent on EHR tasks. During 80.0% of an IOC and 67.9% of a FUC, the patient and provider were actively communicating. Providers required 593 mouse events and 1,664 keystrokes per IOC and 140 mouse events and 597 keystrokes per FUC, indicating almost 13 mouse clicks and close to 40 keystrokes for every minute of consultation time. Less than a quarter of providers indicated that there is enough time for documentation.

Conclusion This study quantifies the widespread concern of high documentation burden for health care providers in oncology, which has been related to burnout and a decrease of patient–clinician interaction. Despite excessive time and effort spent on the EHR, health care providers still felt this was insufficient for proper documentation. However, the need for accurate and complete documentation is high, as reuse of information becomes increasingly important. The challenge is to decrease the documentation burden while increasing the quality of EHR data.

Keywords

- ▶ electronic health records
- ▶ documentation burden
- ▶ oncology
- ▶ physician
- ▶ interfaces
- ▶ usability

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Background and Significance

The widespread use of electronic health records (EHRs) has increased substantially and dramatically changed modern medical care. The use of EHRs could lead to many advantages such as improved access to data, improved data quality, and faster documentation.^{1,2} However, most health care providers are not yet experiencing these benefits of EHR use.³ Whereas the most important task of health care professionals is to deliver patient care, the transition from paper-based to computerized documentation has led to increased documentation time.⁴ This might be caused by the increased need to fulfill regulatory, reimbursement, and quality-measurement requirements.⁵ Consequently, increased EHR time can result in less time for direct patient care, decreased physician job satisfaction, and increased burnout rates among physicians.^{6–8} Moreover, the time spent on desktop medicine is increasing at the expense of face-to-face visits, with time currently evenly split between both categories.⁹ On the other hand, benefits of EHR use, such as improved access to and quality of information, have also been reported.¹⁰

Some papers have quantitatively described how much time and effort physicians spend on the EHR during consultations in the outpatient clinic. A time–motion study (TMS) investigating documentation time in 14 different specialties reported a mean percentage of documentation time per consultation of 33%, while another TMS describing time allocation in four specialties reported similar results with 37% spent on the EHR.^{7,11} A study that used EHR activity logs found that the EHR is used for an average of 16 minutes and 14 seconds per encounter, with chart review (33%), input (24%), and ordering (17%) accounting for most of the time.¹² One study revealed that daily EHR time can vary significantly between surgical (45.6 minutes), medical (85.7 minutes), and primary care specialties (115.0 minutes).¹³ These studies consistently show a high percentage of time spent on the EHR. However, detailed data on EHR activity measures such as mouse clicks, keystrokes, and mouse movement are limited. These data might give insights into where the usability of EHRs can be improved. Additionally, physicians make significantly less eye contact with patients when using an EHR than a paper chart.¹⁴ Patients are also less likely to actively participate in consultations when a physician is physically engaged with the computer (e.g., keyboard activity) than when a physician is merely gazing at the EHR.¹⁵ This implies that less effort required for documentation during consultations could be beneficial to doctor–patient interaction. Besides, a survey study investigating the relationship between EHR design and use factors with high stress and burnout identified interference with the patient–clinician relationship and excessive data entry as significantly associated factors with high stress and burnout.¹⁶ The findings of these studies suggest that not only the amount of time spent on the EHR is relevant for the experienced documentation burden, but also the actual effort put in by the health care professional is an important factor, which is also stated in a recent scoping review by Moy et al.¹⁷ The authors discussed

the clinical documentation burden among health care providers and identified time and effort as the two main concepts that underlie the documentation burden in EHRs. The study concluded that the documentation burden remains understudied and undermeasured in both inpatient and outpatient settings, indicating that further research is warranted. As stated, time spent on the EHR can vary depending on specialty or setting. Little is known about the documentation burden in the more specific, oncological setting.

Objectives

This study investigated the current state of the documentation burden within the EHR during consultations in a tertiary oncology center. Furthermore, we assessed perceptions of head and neck cancer (HNC) care providers on various aspects regarding EHR documentation and EHR satisfaction.

Methods

A cross-sectional TMS was conducted at the Department of Head and Neck Oncology at the Antoni van Leeuwenhoek Cancer Centre in Amsterdam, the Netherlands. In the outpatient clinic, patients were routinely seen and examined by a HNC care provider. These consultations were recorded and analyzed with video-analytic software Morae version 3.1 (TechSmith, Michigan, United States). Furthermore, providers were invited to complete an online questionnaire regarding various concepts underlying the documentation process and system satisfaction. Data were collected between April and July 2020. The procedures of this study were approved by the Antoni van Leeuwenhoek Cancer Center local ethics committee (IRBd19–312).

We included patients scheduled for an initial oncological consultation (IOC; $N = 47$) or a follow-up consultation (FUC; $N = 50$). Participating providers were head and neck surgeons, fellows, residents, and physician assistants. Providers with less than 3 months of experience with the EHR (Chipsoft HiX, custom build, version 6.1), which was implemented in 2012, were excluded. After obtaining informed consent, Morae Recorder was used to capture the routine workflow during outpatient consultations. A consultation was defined as the time that a patient was present in the consultation room. Furthermore, the wrap-up time, defined as the time providers need to complete tasks after a patient has left the room, was recorded. The software simultaneously captured the screen of a provider, generated usability metrics, e.g., mouse clicks and keystrokes, and used a webcam to record audio as well as video of the mouse and keyboard. Recordings started at the beginning of a consultation and stopped when the provider finished the consultation, including the wrap up. At the end of a consultation, recordings were password-protected and stored in a secured folder, ensuring a double layer of protection. Subsequently, recordings were imported into the video-analytic software program Morae Manager. Following this, detailed video analysis was performed while using time–motion methodology. During playback of the

Table 1 Categories and subtasks used in the measurement app

Category	Subtask	Explanation
1. EHR	Chart review	When the physician is looking for or reading information from the patient record.
1. EHR	Input	When the physician is entering information into the patient record.
1. EHR	Ordering	The physician orders tests, e.g., imaging, laboratory, or medication.
1. EHR	Other	Used when the observer cannot discern whether the task falls in one of the four other (more specialized) EHR tasks.
2. Communication	Physician–patient communication	All communication between physician and a patient.
2. Communication	Discussion with colleague	All communication between the physician and a colleague.
3. Other	Other computer tasks	All tasks on the computer that are not in the EHR program (e.g., reading mail).
3. Other	Other activities	All tasks that do not fit in one of the other categories.

Abbreviation: EHR, electronic health record.

recordings, time spent on various tasks during consultations was measured by a single, independent researcher using the app Time Motion Study version 2.3 (Graphite Inc.), which is similar to the TMS capture tool TimeCAT, but available on mobile devices.¹⁸ The categories and subtasks used (→Table 1) were based on a similar study conducted by Joukes et al.⁷ When a provider was multitasking, both subtasks were measured simultaneously.

Furthermore, the number of mouse clicks, scrolls, keystrokes and EHR mouse path length in meters, consultation duration, and supervision time were extracted from the recordings. Subsequently, data from the recording software, the time–motion capture tool, and data extracted from the EHR regarding order entry were combined in a database.

A validated questionnaire was used to assess perceptions of HNC care providers on concepts regarding EHR documentation and EHR satisfaction.¹⁹ All questions were answered on a 5-point Likert scale, ranging from strongly disagree (1) to strongly agree (5). The questionnaire can be found in →Supplementary Appendix A (available in the online version). All HNC care providers working at the department were invited by mail to complete this questionnaire in the online environment of the electronic data capture tool CasterEDC. Twenty-two (84%) providers completed the questionnaire, of which 14 (64%) were supervising staff, 5 (23%) were residents, and 3 (14%) were physician assistants.

Continuous variables are presented as median and quartiles, mean and standard deviation (SD), and categorical variables as numbers and percentages. Descriptive statistics were performed using IBM SPSS Statistics software version 25.0 (IBM Corp).

Results

After excluding three incomplete recordings, a total of 97 valid outpatient consultations were used for analysis, of which 47 were IOCs, and 50 were FUCs. Provider and patient demographics are shown in →Table 2.

The median duration of an IOC with a patient present was 52:38 (43:43–62:05) and 54:27 (47:04–63:45) including wrap-up time. The median duration of a FUC with a patient present was 09:54 (06:12–15:14) and 11:55 (07:40–17:21) including wrap-up time. During an IOC, a resident or physician assistant usually consults with a supervisor outside of the room. In most cases, this provider has to wait for the supervisor. The median duration for this supervision time during an IOC was 07:29 (05:15–13:50). The clean consultation duration, in which the supervision time outside of the room is subtracted from the total consultation duration, was also calculated. This was 42:51 (36:55–48:51) with the patient present and 43:59 (38:20–52:15) including wrap-up time. →Table 3 shows how much time was spent on each of the main categories. The median percentage of time spent on a specific task relative to the total consultation time is also shown. Because some tasks are regularly conducted simultaneously, such as communicating with the patient and EHR tasks, the total percentage exceeds 100%. Furthermore, not all subtasks were used in every consultation.

The time spent on EHR tasks had a median duration of 19:16 (14:42–24:02) for IOC and 03:45 (02:28–05:32) for FUC. Furthermore, during IOC, 44.0% of the total consultation time was spent on EHR tasks, and during FUC, 30.7%. The input of information into the EHR was the most time-consuming EHR task, with 24.7% (IOC) and 14.9% (FUC) of total consultation time. When comparing time spent on EHR tasks by residents, physician assistants, and fellows, no significant differences were found. →Table 4 summarizes the usability metrics measured within the EHR during consultations.

This table shows that providers required 1,664 (SD = 896) keystrokes and 593 (SD = 300) mouse events per IOC, and providers required 450 (SD = 290) keystrokes and 140 (SD = 89) mouse events per FUC. →Table 4 also displays the number of orders placed per consultation, the mean time per order, and the time to complete all orders after consultation.

Table 2 Physician and patient demographics and details of the observed consultations

Physician characteristics	Initial oncological consultation	Follow-up consultation	All
Total HNC care providers	8 (66.6%)	4 (33.3%)	12 (100%)
Physician assistant	2 (16.6%)	0 (0.0%)	2 (16.6%)
Resident	4 (33.0%)	0 (0.0%)	4 (33.3%)
Fellow	2 (16.6%)	0 (33.0%)	2 (16.6%)
Head and neck surgeon	0 (0.0%)	4 (33.0%)	4 (33.3%)
Patient characteristics			
Age (mean)	67.6	64.6	66.1
Sex (n)			
Male	30	26	56
Female	17	24	41
Observations			
Number of consultations	47	50	97
Total recording time	44h:19m	13h:01m	57h:20m
Total duration of consultations	41h:18m	09h:26m	50h:44m

Abbreviation: HNC, head and neck cancer.

Table 3 Time spent on tasks during consultations

Initial oncological consultation	N	Median	(Q1–Q3)	Mean	(SD)	Median % of consultation spent on task
Consultation duration (including wrap-up, excluding supervision time)	47	43:59	(38:20–52:15)	45:56	(12:25)	100%
EHR tasks—total	47	19:16	(14:42–24:02)	19:20	(07:15)	44.0%
EHR tasks—chart review	47	01:36	(00:37–02:32)	01:57	(01:46)	3.1%
EHR tasks—input information	47	11:10	(07:40–14:28)	11:06	(04:23)	24.7%
EHR tasks—placing orders	44	05:59	(04:08–09:10)	06:37	(03:51)	12.2%
EHR tasks—other	16	00:05	(00:04–00:24)	00:14	(00:15)	0.2%
Other computer tasks	20	00:46	(00:18–01:54)	01:08	(00:46)	1.8%
Physician–patient communication	47	31:47	(28:02–40:09)	34:48	(11:14)	80.0%
Peer communication	43	01:37	(00:48–02:25)	02:32	(03:37)	3.1%
Other tasks	15	00:12	(00:05–00:19)	00:13	(00:10)	0.4%
Follow-up consultation	N	Median	(Q1–Q3)	Mean	(SD)	Median % of consultation spent on task
Consultation duration (including wrap-up)	50	11:55	(07:40–17:21)	13:18	(06:34)	100%
EHR tasks—total	50	03:45	(02:28–05:32)	03:56	(01:57)	30.7%
EHR tasks—chart review	49	01:12	(00:33–01:48)	01:23	(01:00)	9.8%
EHR tasks—input information	47	01:49	(01:13–02:19)	01:57	(00:57)	14.9%
EHR tasks—placing orders	47	00:24	(00:12–01:18)	00:42	(00:39)	3.7%
EHR tasks—other	16	00:11	(00:08–00:16)	00:12	(00:06)	2.0%
Other computer tasks	12	00:36	(00:14–01:31)	01:04	(01:06)	4.9%
Physician–patient communication	50	07:29	(04:23–13:01)	08:56	(05:37)	67.9%
Peer communication	29	00:58	(00:35–02:00)	01:34	(01:43)	8.4%
Other tasks	9	00:17	(00:11–00:28)	00:22	(00:17)	1.8%

Abbreviations: EHR, electronic health record; SD, standard deviation.

Table 4 Usability metrics required per consultation

Metric	Initial oncological consultation including wrap-up		Follow-up consultation including wrap-up	
	Mean	SD	Mean	SD
Total mouse events, mean (SD)	593	(300.0)	140	(89.3)
Mouse clicks, mean (SD)	215	(91.6)	55	(28.4)
Scrolling, mean (SD)	378	(233.9)	86	(67.0)
Keystrokes, mean (SD)	1,664	(896.3)	450	(290)
Mouse travel distance in meters, mean (SD)	56	(25.9)	14	(8.2)
Other				
Orders per consultation, mean (SD)	6.9	(3.4)	1.6	(1.1)
Time per order, mean (SD)	00m:53s	(00m:20s)	00m:20s	(00m:17s)

Abbreviation: SD, standard deviation.

Perceptions of HNC care providers on different aspects regarding EHR documentation and EHR satisfaction were measured using the validated questionnaire. Relevant results are displayed in **Fig. 1**. Most respondents (78%) felt that they properly mastered working with the EHR, while 4% disagreed with this statement and 18%, all attendings, were neutral. Over half of respondents (55%) said that the EHR supports their personal work processes, 44% indicated that they can always find the information they need in the EHR, and 50% agreed that the EHR facilitates agreement with colleagues on the treatment plan of the patient. However, only a minority indicated that they thought the EHR was user-friendly (32%) and had a clear interface (27%). Furthermore, less than a quarter of respondents (23%) agreed that there is enough time to properly document patient data in the EHR, and that they can easily and timely send all required information when referring a patient (23%). Despite this, over two-thirds of respondents said that the EHR helps them provide good quality patient care (73%), a vast majority indicated that they can trust that the EHR always works (86%), and only 9% disagreed with the statement that their organization has a high-quality EHR. The full questionnaire results can be found in **Supplementary Appendix B** (available in the online version).

Discussion

This study aimed to quantify the time and effort currently spent on the EHR by providers in an outpatient clinic of a Head and Neck Oncology care center. Our analysis shows that a significant proportion of time is spent on EHR tasks during consultations. We found that 44.0% of the time during an IOC and 30.7% of the time during a FUC is spent on the EHR. In contrast, during 80.0 and 67.9% of the IOC and FUC, respectively, there was active communication between the patient and the provider. On average, providers require 593 mouse events, 1,664 keystrokes, and 56 m of mouse travel distance during an IOC and 140 mouse events, 597 keystrokes, and 14 m of mouse travel distance during a FUC. Additionally, despite that over one-third to just under half of the available time during consultations is spent on the EHR, a majority of

providers still feel there is not enough time for proper documentation.

Comparison with Previous Literature and Interpretation

Our results on time spent on the EHR in Head and Neck Oncology during consultations are consistent with findings of earlier studies. A study conducted at an ophthalmology department found similar results regarding documentation time during consultations, reporting 27% of time during consultations spent on EHR use.²⁰ A study conducted at four different departments reported 37% of consultation time spent on the EHR.¹¹ Another study investigating physician time allocation in various specialties during a whole day found percentages for documentation tasks ranging from 11 to 39%, stating that the distribution of time spent by providers using EHRs varies between specialties.¹² Furthermore, de Hoop and Neumuth reported that 37.1% of time during consultations was spent on the EHR.²¹ In this study, physicians reported that the spread of patient information, poor integration of information into workflow, and limited information exchange were problematic. Only a few studies investigated usability measures such as keystrokes and mouse clicks. One study describing how physician EHR activity influences patient participation reported similar results, with a mean of 216 (SD = 174) mouse events and 729 (SD = 768) keystrokes required in consultations lasting 20.3 (SD = 10.5) minutes on average.¹⁴

Our results suggest that while already spending a large proportion of their time on the EHR, providers are also actively engaged with the EHR. Based on our results, a provider requires almost 40 keystrokes and 13 mouse clicks or scrolls for every minute of consultation time. In contrast, we found that during a large proportion of the consultations, there is active communication between providers and patients, which is beneficial to the provider-patient relationship. However, based on our results, we cannot determine whether the provider was actually talking or listening. It could also mean that the patient is talking and the provider is multitasking and conducting an EHR task while listening.

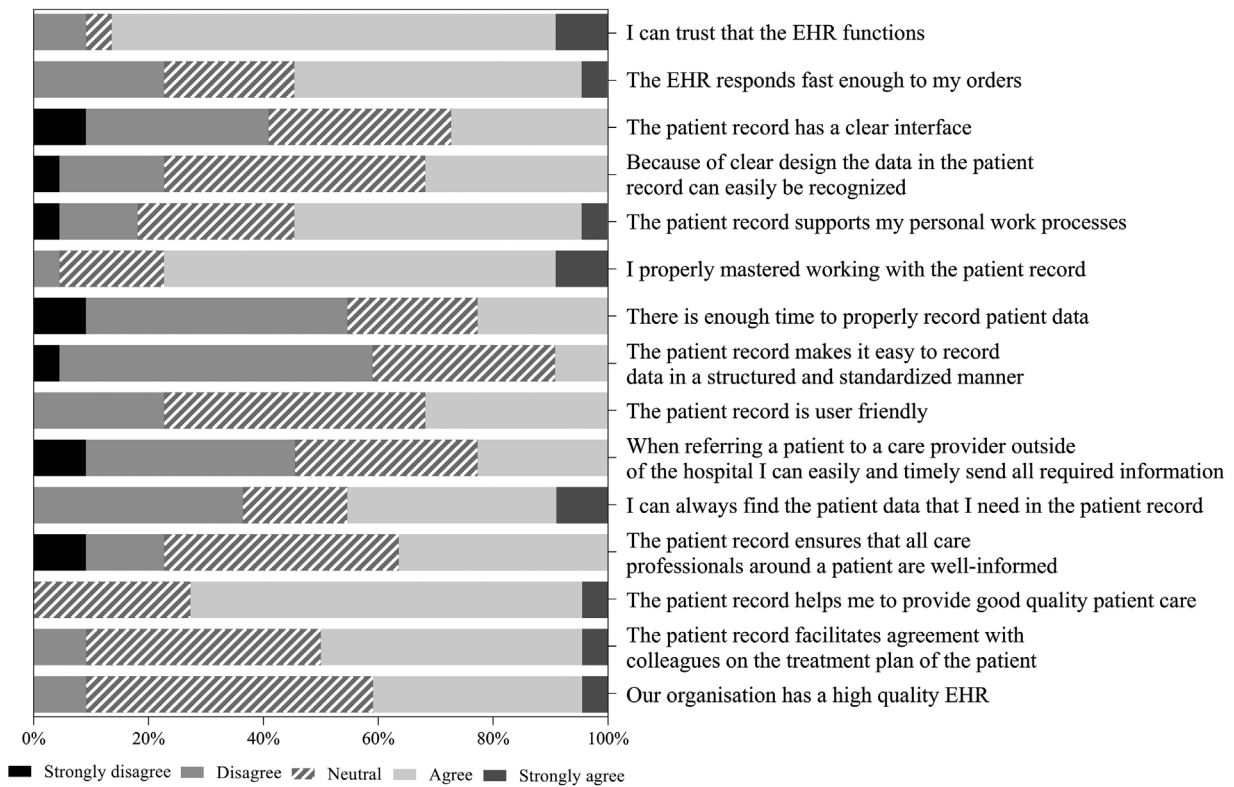


Fig. 1 Perceptions of HNC care providers on EHR documentation and EHR satisfaction. EHR, electronic health record; HNC, head and neck cancer.

While this is common practice, a high level of multitasking adds to the experienced documentation burden.^{17,22}

Health care providers mainly had concerns regarding the available time for recording data, timely sending referral information, and finding relevant information within the EHR. All of these factors can contribute to spending additional time on the EHR and therefore cannot be spent on direct patient care. Additional concerns were expressed regarding the extent to which the EHR supports structured data capture. Lack of structured data capture can impede data reuse.²³ Surprisingly, only one respondent disagreed with the statement that they properly mastered working with the EHR. This indicates that the vast majority considered themselves skilled with the EHR. This could be either the result of proper training, but overestimating their own efficiency with the EHR could also contribute to this result. Furthermore, our survey results suggest that whereas most providers are optimistic regarding the usefulness of the EHR, most also think that the usability (e.g., ease of use) of the EHR should be further improved. This suggests the EHR as a solution, rather than consider it the primary reason for the documentation burden.

Comparing our results to other studies must be done with caution because of various factors, such as differences in consultation types and complexity, different EHR vendors, EHR maturity, and study methods. Nevertheless, this study further corroborates that the high documentation burden is widespread.

Strengths and Limitations

The main strength of this study is that this study evaluated the time spent on the EHR combined with EHR usability

measures. It also quantifies the time and effort required to document and review information in the EHR while also describing provider perceptions regarding EHR satisfaction and the documentation process. This allows for comparison between quantitative data and the opinion of health care providers on this topic. Another strength is the chosen methodology for our study. While time-consuming, TMSs are still generally considered the gold standard methodology for accurately measuring a process.

A limitation of this study is that, as expected, we found variation in consultation duration and usability metrics between consultations in both IOC and FUC. This can probably be attributed to differences in various factors, such as patient complexity and provider variation. Another limitation is that, due to the chosen methodology, we did not investigate time spent on the EHR outside of consultation hours, which is also a construct underlying the documentation burden. However, only a minority of providers indicated that they felt that the amount of time they spent on the EHR outside of consultation hours is high (14.3%), whereas most providers rated this as acceptable (61.9%). Nevertheless, this does not rule out that health care professionals still spent a considerable amount of time on the EHR outside of consultation hours. Lastly, as stated in the Introduction, a high level of interaction with the computer can negatively influence the doctor-patient relationship. In this study, the measure patient satisfaction was not measured. However, it can be expected that patient satisfaction can increase when EHR time decreases, as more time can be

spent on the patient, which was also established by Marmor et al.²⁴

Implication for Practice

While our results indicate that the burden of documentation during consultations is already high, accurate and complete documentation is becoming increasingly important as information recorded by providers is increasingly reused for other purposes, such as research, quality registries, and other improvements that rely on structured data, such as clinical decision support. However, policy makers should be critical as to which information should be recorded by health care providers while providing care. If information is not relevant for providing care and solely documented for secondary purposes, it is better to minimize the burden for providers and collect it in different ways. For example, employing coding staff or using patient-entered before-visit questionnaires that are automatically integrated into provider documentation could be a solution that increases data collection and also reduces documentation burden by relieving physicians.²⁵ The challenge is to reduce the documentation burden while simultaneously increasing the accuracy and completeness of recorded data in the EHR. For this reason, a national program, “Facilitating Clinical Documentation at the Point of Care,” has started in the Netherlands. This program urges hospitals and EHR vendors to optimize EHRs to support unambiguous, single registration of data during the care process. It also stimulates that data are stored as discrete, coded data to enable reuse for various purposes. This should lead to a decrease of the documentation burden for health care providers and simultaneously increase the accuracy and completeness of data in EHRs. Furthermore, streamlining workflow and aligning the documentation process with clinical workflow might also be effective in reducing the documentation burden.^{22,26} Lindsay and Lytle found that this can result in an 18.5% reduction in documentation time.²⁶ Minimizing interruptions of workflow, for example, by being critical of which decision support alerts should and which should not be used, can also contribute to reducing the burden.²⁷ Other solutions that have been suggested are, for example, telehealth expansion, changing compliance rules and performance metrics, and EHR optimization sprints.²⁸

The optimal strategy to reduce the burden could differ based on the primary underlying reason. This might vary based on region or setting. A recent study evaluated the difference in EHR use between United States and non-United States clinicians and found that U.S. clinicians daily spent over 50% more time using the EHR.²⁹ This might be attributed to additional documentation requirements for billing or administrative functions. Policy makers could also consider such nontechnical aspects when developing a strategy. Future studies should focus on implementing and evaluating innovations and developments within EHRs that aim to decrease documentation burden while increasing the quality of EHR data. Providing evidence is important in identifying the best practices that should be implemented.³⁰ To make this type of research more scalable, it might be better suitable to use EHR log studies instead of TMSs.³¹ However,

the process of turning raw audit logs into insights is still complex and can result in largely under- or overestimating of time spent on the EHR.³² This might be helpful to conduct more studies in which audit log data are compared with time-motion data to further validate the reliability of audit log studies and define validated standards.

Conclusion

This study found that HNC care providers spent up to 44.0% of consultation time on EHR tasks. During these consultations, providers require up to 40 keystrokes and 13 mouse clicks for every minute of consultation time. These results quantify the widespread concern of high documentation burden for health care providers, which is known to lead to potential burnout and decrease of patient-clinician interaction. Despite the significant amount of time spent on documentation, most providers still feel this is insufficient for proper documentation. The challenge is to decrease documentation burden while increasing the quality of EHR data.

Clinical Relevance Statement

While the results of this study further corroborate a high documentation burden, accurate and complete documentation is becoming increasingly important as information recorded by providers is increasingly reused for secondary purposes, such as measuring the quality of care. The challenge is to reduce the documentation burden while simultaneously increasing the accuracy and completeness of recorded data in the EHR.

Multiple Choice Questions

1. How much time is spent on EHR tasks during outpatient consultations in head and neck cancer?
 - a. Up to 24%
 - b. Up to 34%
 - c. Up to 44%
 - d. Up to 54%

Correct Answer: The correct answer is option c. In initial oncological consultations, up to 44% of the time a provider is interacting with the electronic health record. Multitasking is common, other tasks might also be conducted simultaneously.

2. Which task is the most time-consuming during consultations, according to this study?
 - a. Chart review
 - b. Information input
 - c. Placement of orders
 - d. Other

Correct Answer: The correct answer is option b. According to our results, providers spent the most time on entering information into the EHR. However, other studies have shown that provider spent the most time on chart

review. This might vary based on specialty or appointment type.

Data Availability Statement

Data are available upon reasonable request.

Protection of Human and Animal Subjects

The study was performed in compliance with the World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects, and was reviewed by the Antoni van Leeuwenhoek Cancer Center local ethics committee (IRBd19–312).

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None.

Conflict of Interest

None declared.

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