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# Measuring Documentation Burden in Healthcare



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**None of the investigators have any affiliations or financial involvement that conflicts with the material presented in this report.**

The information in this report is intended to help healthcare decision makers—patients and clinicians, health system leaders, and policymakers, among others—make well-informed decisions and thereby improve the quality of healthcare services. This report is not intended to be a substitute for the application of clinical judgment. Anyone who makes decisions concerning the provision of clinical care should consider this report in the same way as any medical reference and in conjunction with all other pertinent information, i.e., in the context of available resources and circumstances presented by individual patients.



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# Preface

The Agency for Healthcare Research and Quality (AHRQ), through its Evidence-based Practice Centers (EPCs), sponsors the development of evidence reports and technology assessments to assist public- and private-sector organizations in their efforts to improve the quality of healthcare in the United States. The reports and assessments provide organizations with comprehensive, science-based information on common, costly medical conditions and new healthcare technologies and strategies. The EPCs systematically review the relevant scientific literature on topics assigned to them by AHRQ and conduct additional analyses when appropriate prior to developing their reports and assessments.

This EPC evidence report is a Technical Brief. A Technical Brief is a rapid report, typically on an emerging medical technology, strategy or intervention. It provides an overview of key issues related to the intervention—for example, current indications, relevant patient populations and subgroups of interest, outcomes measured, and contextual factors that may affect decisions regarding the intervention. Although Technical Briefs generally focus on interventions for which there are limited published data and too few completed protocol-driven studies to support definitive conclusions, the decision to request a Technical Brief is not solely based on the availability of clinical studies. The goals of the Technical Brief are to provide an early objective description of the state of the science, a potential framework for assessing the applications and implications of the intervention, a summary of ongoing research, and information on future research needs. In particular, through the Technical Brief, AHRQ hopes to gain insight on the appropriate conceptual framework and critical issues that will inform future research.

AHRQ expects that the EPC evidence reports and technology assessments will inform individual health plans, providers, and purchasers as well as the healthcare system as a whole by providing important information to help improve healthcare quality.

If you have comments on this Technical Brief, they may be sent by mail to the Task Order Officer named below at: Agency for Healthcare Research and Quality, 5600 Fishers Lane, Rockville, MD 20857, or by email to epc@ahrq.hhs.gov.

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## Key Informants

In designing the study questions, the EPC consulted a panel of Key Informants who represent subject experts and end-users of research. Key Informant input can inform key issues related to the topic of the technical brief. Key Informants are not involved in the analysis of the evidence or the writing of the report. Therefore, in the end, study questions, design, methodological approaches and/or conclusions do not necessarily represent the views of individual Key Informants.

Key Informants must disclose any financial conflicts of interest greater than $5,000 and any other relevant business or professional conflicts of interest. Because of their role as end-users, individuals with potential conflicts may be retained. The TOO and the EPC work to balance, manage, or mitigate any conflicts of interest.

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Prior to publication of the final evidence report, EPCs sought input from independent Peer Reviewers without financial conflicts of interest. However, the conclusions and synthesis of the scientific literature presented in this report do not necessarily represent the views of individual reviewers. AHRQ may also seek comments from other Federal agencies when appropriate.

Peer Reviewers must disclose any financial conflicts of interest greater than $5,000 and any other relevant business or professional conflicts of interest. Because of their unique clinical or content expertise, individuals with potential non-financial conflicts may be retained. The TOO and the EPC work to balance, manage, or mitigate any potential non-financial conflicts of interest identified.

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# Measuring Documentation Burden in Healthcare

## Structured Abstract

**Background.** The 2009 enactment of the Health Information Technology for Economic and Clinical Health (HITECH) Act and the wide adoption of electronic health record systems (EHR) have ushered an increasing documentation burden, frequently cited as a key factor affecting the work experience of healthcare professionals and a contributor to burnout.

**Purpose.** This Technical Brief aims to identify: (1) measures of documentation burden, including evaluation of validity evidence, strengths, and weaknesses; (2) different perspectives on the appropriateness of different measures of documentation burden; and (3) perceptions of documentation burden from people in different clinical roles including patients/caregivers. The targeted audiences of this Technical Brief are clinicians, researchers, healthcare system leaders, policymakers, and electronic health record (EHR) vendors.

**Methods.** We integrated discussions with Key Informants and synthesis of evidence from a comprehensive search of the literature, including Embase®, Epub Ahead of Print, In-Process & Other Non-Indexed Citations, MEDLINE® Daily, MEDLINE®, Cochrane Central Registrar of Controlled Trials, Ovid® Cochrane Database of Systematic Reviews, Scopus®, and select gray literature from January 2010 to December 2023.

**Findings.** We identified 135 articles about measuring documentation burden. We identified 11 categories of measures for documentation burden: overall time spent in EHR, activities related to clinical documentation, inbox management, time spent in clinical review, time spent in orders, work outside work/after hours, administrative tasks (billing and insurance related), fragmentation of workflow, measures of efficiency, EHR activity rate, and usability. The most common source of data for most measures was EHR usage logs. Direct tracking such as through time–motion analysis was fairly uncommon. We found that measures have been developed and applied across a diverse range of settings, populations, and uses, with physicians and nurses in the United States being the most frequently represented groups. Evidence of validity of these measures was limited and incomplete. Published information on the appropriateness of measures in terms of scalability, feasibility, or equity across various contexts was limited. Physician perspective on documentation burden was the most robustly captured in the literature than other stakeholders and focused on increased stress and burnout due to documentation burden, satisfaction with EHR and its usability, EHR-associated workload, and impact on teaching.

**Conclusion.** The current literature on documentation burden measures offers a wide range of measures, yet with serious limitations that must be remedied to further inform practical solutions. Greater diversity of settings and perspectives is needed for future development of valid measures. Identifying measurement gaps of documentation burden should serve as the basis for developing interventions and solutions, and benchmarking progression of mitigating documentation burden.

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# Executive Summary

## Main Points

- This technical brief identifies 11 measure categories for documentation burden: overall time spent in the electronic health record (EHR), activities related to clinical documentation, inbox management, time spent in clinical review, time spent in orders, work outside work/after hours, administrative tasks (billing and insurance related), fragmentation of workflow or multitasking, measures of efficiency, EHR activity rate, and usability.
- The most common source for measures was EHR usage logs. Direct tracking, such as through time-motion analysis, was fairly uncommon.
- Documentation burden measures have been developed and applied across a diverse range of settings, populations, and uses, with physicians and nurses in the United States (U.S.) being the most frequently represented groups.
- Published information on the validity of documentation burden measures is limited and incomplete, hindering interpretation and implementation.
- Published information on the appropriateness of measures in terms of scalability, feasibility, or equity across various contexts is limited.
- The physician perspective on documentation burden was the most robustly captured in the literature compared with perspectives from other stakeholders including other healthcare professionals, patients, and caregivers, and it focused on increased stress and burnout, satisfaction with EHR, EHR usability, EHR-associated workload, and impact on learners' education.
- Future research on measuring documentation burden should address the perspectives of various healthcare professional and other stakeholders, explicitly report validity evidence of developed measures, and produce measures that are multidimensional incorporating facets other than measurement of time.

## Background and Purpose

The 2009 enactment of the Health Information Technology for Economic and Clinical Health (HITECH) Act and the wide adoption of electronic health record systems (EHR) have ushered an increasing documentation burden, frequently cited as a key factor affecting the work experience of healthcare professionals and a contributor to burnout. Aside from burnout, documentation burden may affect patients' outcomes and satisfaction with healthcare delivery. Numerous factors contribute to documentation burden, including regulatory demands, payor needs, organizational structure and needs, and possibly fear of litigation.

Definitions and measures for documentation are not well established, and the published literature applying these measures is limited and has not been systematically collated. Evidence for validity and scalability of measures and key strengths and weaknesses are not well delineated. In addition, measures related to documentation burden have been intended for application primarily to physician work experiences with less evaluation for other healthcare professionals. Whether measures of documentation burden apply fairly and equitably across clinical disciplines, job roles, and demographic factors such as gender is unclear. In addition, the patient and caregiver perspective on documentation burden are rarely included in the literature of measuring documentation burden.

The purpose of this Technical Brief was to identify: (1) measures of documentation burden that have been developed or used across various settings and populations, including evaluation of validity, strengths, and weaknesses of these measures; (2) different perspectives on the appropriateness of different measures of documentation burden that have been applied/proposed (e.g., scalability, resource intensiveness to collect, equitable across populations); and (3) perceptions of documentation burden measurement from the perspective of healthcare professionals in different clinical roles and of patients/caregivers.

# Methods

We supplemented the literature search with discussions with nine Key Informants (KIs) with different expertise, backgrounds, and professional affiliations, including healthcare professionals, researchers, policymakers, and an EHR trade association representative. We searched Embase®, Epub Ahead of Print, In-Process & Other Non-Indexed Citations, MEDLINE® Daily, MEDLINE®, Cochrane Central Registrar of Controlled Trials, Ovid® Cochrane Database of Systematic Reviews, Scopus®, and select gray literature from 2010 to 2023. Details of our methodology can be found in the full report.

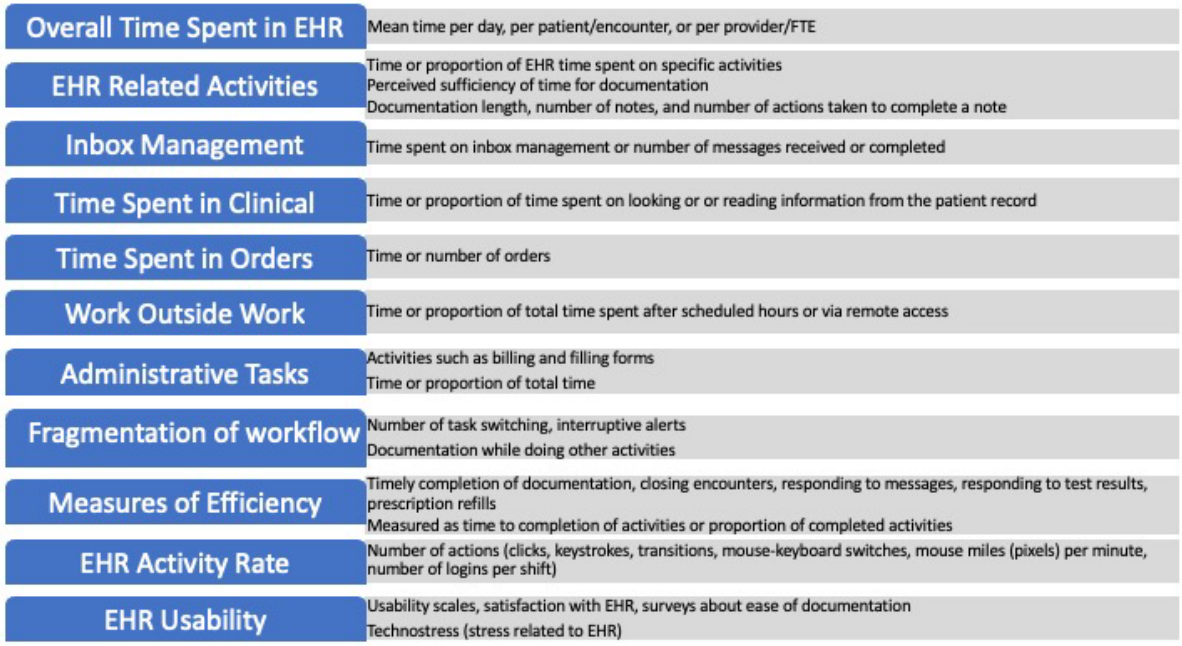
# Results

We identified a total of 135 articles. We summarize the key findings below by Guiding Question (GQ).

## Guiding Question 1: What Measures of Documentation Burden Have Been Developed or Used (Including Measures Broadly – Quantitative and Qualitative)?

**Findings:** We identified 11 categories of measures for documentation burden, from overall time spent in the EHR to usability (ES Figure 1). The most common source for most measures was EHR usage logs, whereas direct tracking used in time–motion analysis (i.e., researchers follow clinicians and document each task and related time) was fairly uncommon. Specific work functions contributing to documentation burden included clinical note entry, flowsheet entry, inbox management, clinical review, order entry, and administrative clinical support tasks, such as billing and insurance-related documentation. Measures included both time during scheduled work and time required outside of work and after hours, although definitions of these parameters varied. Efficiency was also an important measurement category, with measures reported for workflow fragmentation, multitasking, time to complete documentation requirements, and EHR activity down to the level of individual keystrokes and mouse clicks.

**ES Figure 1. Measures of documentation burden**




Abbreviations: EHR = electronic health record; FTE = full-time equivalent

We found that measures have been developed and applied across a diverse range of settings, populations, and uses. Settings include both ambulatory and inpatient clinical practices, primary care and nonprimary specialties, surgical and nonsurgical settings, rural and urban sites, academic and community-based medical centers, and private practices. The most commonly studied group was physicians in the United States, and additional geographic locations included Canada, the United Kingdom (U.K.), Germany, the Netherlands, Switzerland, Saudi Arabia, China, Taiwan, and Australia. South American clinical settings were not well represented. Relevant clinician types include faculty and resident physicians, nurse practitioners, physician assistants, clinical psychologists, registered and licensed practical nurses, social workers, occupational and physical therapists, dietitians, and speech pathologists. Validity of documentation burden measures was evaluated using a framework of five sources of evidence that can support construct validity, which are content, response process, internal structure, relations to other variables, and consequences. We found published information on validity evidence to be limited and incomplete. Validity evidence was judged as adequate for the five domains between 8%-30% of the measures. This challenges interpretation of studies of documentation burden and makes credible comparisons of results across studies extremely difficult. Limited validity evidence also hinders support for widespread implementation of a specific measure.

## Guiding Question 2: What are the Different Perspectives on the Appropriateness of Different Measures of Documentation Burden That Have Been Applied/Proposed?

**Findings:** We identified sparse data regarding the appropriateness of documentation burden measures based on consideration of scalability, feasibility, or equity across clinical settings, clinician and patient/caregiver populations, and geographic locations. Comparability of EHR-derived measures when interoperability is limited is an ongoing concern, as is generalizability of both objective and subjective evaluations of documentation burden conducted within specific environments.

### Guiding Question 3: What are the Perceptions of Documentation Burden Based on Clinical Roles and Patients/Caregivers?

**Findings:** Physician perspectives on documentation burden were more robustly represented in the literature, followed by nurses' perspectives. These perspectives associated documentation burden with burnout, overall satisfaction, satisfaction with the EHR, EHR usability, and EHR-associated workload. Only two studies evaluated documentation burden from patients' perspective and found increased EHR usage was associated with decreased patient satisfaction and less interaction with physicians.[1, 2]

### Guiding Question 4: What Is the Role of Patients in Documentation Burden?

**Findings:** The role of patients in documentation burden was assessed across only a small number of studies with limited outcomes primarily focused on volume of communications and associated time demands for paperwork, chart review, and clinician responses to patient communications.

### Guiding Question 5: What Is the Role of Setting in Documentation Burden?

**Findings:** There were minimal data about the effect of setting on documentation burden. Overall patterns for documentation burden appear to be broadly similar across settings, although there is evidence that note length and other burdens are greater in the United States than in other health systems.[3] Interventions to mitigate documentation burden may be more accessible and more often implemented in settings or specialties with greater resources, but the underlying documentation burdens themselves are endemic.

## Strengths and Limitations

A key strength of this Technical Brief is the systematic search of literature applying methodologically rigorous techniques including a medical librarian-developed search strategy of multiple databases, duplicate assessment of inclusion for every identified report, and duplicate assessment of data extraction from reports included in the final summary. The timeline selected for this report aligns with a major shift in documentation burdens occurring with enactment of the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009. Hence the resulting literature summary reflects modern practice experiences.

This Technical Brief also has limitations. The literature has the greatest relevance to the U.S. healthcare system. The focus of this Technical Brief was primarily on measures of documentation burden, not on effectiveness of interventions to address it. Validity evidence to support specific measures was infrequently reported and did not encompass the full range of sources of such evidence. The literature also contains very little discussion of issues relating to the appropriateness of measures according to considerations of scalability, feasibility, or equity across clinical settings, clinician and patient/caregiver populations, and geographic locations. Although clinician perspectives were generally consistent, certain groups were poorly represented (e.g., pharmacists, nurses, and medical assistants). Patient perspectives were rarely reported, but their role in contributing to documentation burden through patient portal messaging was described in the literature.

## Implications and Conclusions

The findings of this Technical Brief have important implications for healthcare systems, clinicians working within them, and patients receiving care from them. Documentation burden in healthcare is well documented, and its consequences are serious for all stakeholders. This review identifies a wide range of measures for documentation burden, yet also have serious limitations that must be remedied to further inform the scope of the problem and evaluate interventions and solutions. Attention to validity evidence in support of existing and proposed measures is needed to identify the most robust and scalable measures for the many dimensions of documentation burden. Greater diversity of settings and perspectives is also necessary, including patients as active participants in documentation processes and their associated burdens and benefits. Identifying measurement gaps is just the first step that serves as the basis for developing interventions and solutions and benchmarking progression of mitigating documentation burden.

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# 1. Introduction

## 1.1 Background

Satisfaction and burnout of healthcare professionals are urgent challenges currently facing the healthcare system in the United States (U.S.), especially given the effects of the COVID-19 pandemic.[1] There are multiple contributors driving these issues, but documentation burden is commonly cited as a key factor.[2-4] Many clinicians report that electronic health records (EHRs), electronic prescribing, electronic patient portals, and computerized physician order entry (CPOE) lead to information overload, frequent interruptions/distractions, and a change in the content of professional work to tasks less connected to meaning and purpose.[2, 5, 6] Greater time spent on administrative tasks is associated with decreased career satisfaction and increased burnout,[5] and greater use of EHRs and CPOE is associated with increased burnout.[5] EHR usability is generally poor, and physician assessment of poor EHR usability is strongly associated with burnout.[7] In addition, clinical documentation requirements often cannot be completed during the work day,[8-10] and "work outside of work" is a strong driver of burnout.[11] Aside from burnout, documentation burden may affect patients' outcomes. One study has shown that the total in-basket notifications and delivery of alerts over the weekend can impact the opening of time-sensitive EHR alerts, and another has suggested a role of health information technology in diagnostic delays.[12, 13] Documentation burden on clinicians may be associated with reduced patient satisfaction.[14] Numerous factors contribute to documentation burden, including regulatory demands, payor needs, organizational structure and needs,[15] and possibly fear of litigation.[16-18]

The 2009 enactment of the Health Information Technology for Economic and Clinical Health (HITECH) Act is often identified as the beginning of the modern era of clinical burdens associated with health information technology (IT), including documentation burden.[19] More recently, there have been calls to evaluate and address clinician burden associated with the EHR, including documentation burden. Although the adoption of EHRs in the United States has increased since the mid-2000s and burdens have been a concern for many years, clear definitions and measures for documentation burden are lacking.[6, 20, 21] Documentation burden has been described largely in the context of time and effort associated with specific clinical documentation tasks.[6] For example, a summary of organizational interventions targeting reduced job demands, improved job resources, and improved clinical workflows is provided by Sinsky and colleagues.[11] These include eliminating multiple unnecessary documentation requirements, aligning EHR functions with clinical workflows, reducing inbox message volume, streamlining documentation involving verbal orders, and reducing the work associated with prior authorization. Additional interventions include team support for documentation and shifting to annual prescription renewals from more frequent intervals.

Measures for these interventions are often simplistic, for example, the number of messages or time spent on documentation.[6] Expanded and more granular measures have been introduced through the American Medical Association's Joy in Medicine Health System Recognition Program.[22] These include the Work Outside of Work metric based on time outside of patient scheduled hours, Time on Inbox, Time on Encounter Note Documentation, and Total EHR Time.

In part because established definitions and measures for documentation are not well developed, published literature applying these measures is limited and has not been systematically collated to date. Evidence for validity of documentation burden measures is often lacking or not reported clearly, scalability is not demonstrated, and key strengths and weaknesses

are not well delineated.[6, 23] These challenges and controversies collectively highlight the need for a summary of the literature across different clinical fields and types of health professionals to increase the understanding of how best to measure and report documentation burden. This understanding would then support the evaluation of interventions designed to minimize documentation burden to reduce burnout, promote job satisfaction, increase efficiency, and improve the quality of patient care.

## 1.2 Purpose of This Technical Brief

This Technical Brief will evaluate multiple aspects relating to measuring documentation burden with the aim of assessing the current documentation burden and measuring progress of interventions targeting mitigation of the burden. This work will be used by the American Medical Informatics Association (AMIA) in alignment with the 25x5 Task Force's vision of a "U.S. healthcare workforce free of documentation burden and focused on patient care and improved patient outcomes."[4] The AMIA 25X5 Task Force Reducing Documentation Burden aims to reduce the existing burden to 25% by 2025. The Task Force is in a position to develop, collaborate, and disseminate potential incremental documentation burden strategies.

## 1.3 Guiding Questions

The purpose of this Technical Brief is to address the following Guiding Questions (GQs):

Description/Overview of measurements of documentation burden:

1. What measures of documentation burden have been developed or used(including measures broadly – quantitative and qualitative)?
    a. For which settings, populations, and intended uses were the measures developed?
    b. How have these measures been applied?
    c. Is there published information available on validity of the measures?
    d. What are the key strengths and weaknesses of different measures that have been used?
2. What are the different perspectives on the appropriateness of different measures of documentation burden that have been applied/proposed (e.g., scalability, resource intensiveness to collect, equitable across populations)?
3. What are the perceptions of documentation burden based on clinical roles (e.g., physician, nurse, physician assistant) and patients/caregivers?

Factors influencing documentation burden:

4. What is the role of patients in documentation burden?

5. What is the role of setting (i.e., rural vs. urban, hospital, outpatient, academic institution, etc.) in documentation burden?

# 2. Methods

To address the Guiding Questions (GQs), we followed the established methodologies of Technical Briefs as outlined in the Agency for Healthcare Research and Quality (AHRQ) Content and Procedures Guide for the Evidence-based Practice Center (EPC). The study protocol was published on the AHRQ Effective Healthcare website. This report specifically addresses clinical documentation in EHR, not entry of other types of data.

## 2.1 Discussions With Key Informants

To supplement findings from literature search and gain additional contextual information around the GQs, we recruited nine Key Informants (KIs) with different expertise, backgrounds, and professional affiliations, including healthcare professionals (internist, cardiologist, surgeon, and nurse), researchers, policymakers, and an electronic health record (EHR) trade association representative. Between October and November 2023, we conducted two group conferences to collect input on the Guiding Questions (GQs) and where KIs also shared their experiences, opinions, and challenges related to documentation burden. KIs were invited to review and provide feedback on the draft report; however, all findings and opinions expressed within the report are solely the authors'.

## 2.2 Gray Literature Search

We searched the following sources for gray literature: U.S. Food and Drug Administration, ClinicalTrials.gov, Health Canada, U.K. Medicines and Healthcare Products Regulatory Agency (MHRA), conference proceedings, web search engines (Google), and websites of Federal and State Government, patient advocate groups, EHR vendors, and professional societies. A Supplemental Evidence and Data for Systematic Reviews (SEADS) portal was posted to collect additional study-specific information from industry stakeholders, professional societies, and researchers. In addition, we sought and reviewed gray literature sources proposed by the KIs. A Federal Register Notice was posted for this review.

## 2.3 Published Literature Search

We conducted a comprehensive database search, including Embase®, Epub Ahead of Print, In-Process & Other Non-Indexed Citations, MEDLINE® Daily, MEDLINE®, Cochrane Central Registrar of Controlled Trials, Ovid® Cochrane Database of Systematic Reviews, and Scopus® from January 1, 2010 to December 7, 2023. Reference mining of relevant systematic reviews/meta-analyses, eligible primary studies (i.e., randomized clinical trials [RCTs], observational studies, surveys, qualitative studies, and mixed-method studies) were conducted to identify additional literature. The literature search strategy was developed by an experienced medical librarian and peer-reviewed by an independent information specialist. The same medical librarian conducted the literature search. The detailed search strategy is listed in Appendix A.

For abstract screening, we used a validated natural language processing (NLP) algorithm developed by DistillerSR® (Evidence Partners Incorporated, Ottawa, Canada). Each abstract was screened by two human reviewers and the NLP technique with constant surveillance of possible misclassified citations for quality control. Consensus for inclusion and any abstracts with conflicting recommendations were advanced for full-text screening. Independent reviewers, working in pairs, screened the full-text version of eligible references. Discrepancies between the

reviewers were resolved through discussions and consensus. When consensus could not be reached, a third reviewer resolved the difference.

We applied the following inclusion and exclusion criteria for the studies identified in the literature search (Table 1).

**Table 1: PICOTS (Populations, Interventions, Comparators, Outcomes, Timing, and Settings)**

| PICOTS Elements | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| **Population** | Healthcare professionals, including but not limited to:<br>• Physicians<br>• Nurses<br>• Other professionals | • Any healthcare professional without direct patient contact |
| **Interventions (Exposure)** | • EHR<br>• Electronic prescribing<br>• Electronic patient portals<br>• CPOE | • None |
| **Comparators** | • None | • None |
| **Outcomes** | Measures of documentation burden, including but not limited to:<br>• Work Outside of Work<br>• Time on Inbox<br>• Time on Encounter Note Documentation<br>• Excessive workload<br>• Time on EHR<br>• Administrative tasks<br>• Fragmentation of workflow<br>• Clinician-patient interaction | • None |
| **Timing** | • All | • None |
| **Settings** | • Any clinical settings | • None |
| **Study design** | • RCTs<br>• Comparative observational studies<br>• Surveys<br>• Qualitative studies<br>• Mixed-method studies<br>• Systematic review or meta-analysis | • In vitro studies<br>• Erratum<br>• Editorials<br>• Letters<br>• Case studies/case reports<br>• Narrative reviews |
| **Publications** | • Studies published in English as peer reviewed full-text articles<br>• Published after the year 2010 | • Non-English language studies<br>• Conference abstracts |

Abbreviations: CPOE = computerized provider order entry; EHR = electronic health record; PICOTS = populations, interventions, comparators, outcomes, timing, and settings; RCT = randomized clinical trial

# 2.4 Data Organization and Presentation

## 2.4.1 Information Management

We developed a standardized data extraction form to extract study characteristics (author, year, study design, inclusion and exclusion criteria, study settings, population, measures of documentation burden and its validity, strength and weakness, users' perspectives, and related items for addressing the GQs). Using randomly selected studies, all study team members evaluated the feasibility and accuracy of the standardized form to capture relevant data for this Technical Brief. Evidence generated from published literature were supplemented with data

derived from KIs and gray literature. We used DistillerSR® to create data extraction forms and facilitate data extraction.

## 2.4.2 Data Presentation

We summarized measures of documentation burden in evidence tables and visual depictions. We highlighted intended uses of these measures, strengths and weakness, different perspectives from clinical roles and patients/caregivers, and factors affecting the use. Additional information provided from KIs was synthesized and presented narratively. Documentation burden measures were narratively synthesized into distinctive categorizes based on similarity of the identified measures through consensus among the team. We started with an existing framework from Moy et al. and added additional measures identified in the current search.[6] Evidence supporting validity of measures was evaluated following the model developed by Messick and adapted by Cook and Beckman.[24, 25] The model identifies five sources of evidence that can support construct validity, which are content, response process, internal structure, relations to other variables, and consequences. Thematic narrative synthesis of data was based on consensus of the authors of this report.

## 2.5 Peer Review and Public Commentary

Experts and stakeholders provided external peer review on of this draft report; AHRQ also provided a review of the draft report. The draft report was posted on the AHRQ Effective Health Care website for public comment from 2/16/2024 to 3/15/2024. A disposition of comments document of the peer review and public comments will be posted approximately 3 months after the final report is published.

# 3. Findings

## 3.1 Results From Discussion With Key Informants

We completed two 1-hour group conferences with nine Key Informants (KIs) between October and November 2023. The KIs emphasized the importance of the Guiding Questions (GQs) and agreed with the proposed methods for this Technical Brief. They helped identify a list of measures of documentation burden, evidence relating to their reliability and validity, and factors that may affect the measures and their value in assessing documentation burden. The KIs also suggested to limit the literature search from approximately 2010 as electronic health record/electronic medical record (EHR/EMR) systems started to be widely adopted in the United States (U.S). health systems partially due to enactment of the Patient Protection and Affordable Care Act on March 23, 2010 after enactment of the 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act. Findings from the KI discussion were synthesized with those from gray and published literature and presented in Section 3.3.

## 3.2 Results of the Gray Literature Search

Three main sources were identified from the gray literature. The 2019 National Academy of Medicine (NAM) report on clinician burnout offers a comprehensive overview of contributors to clinician burnout,[2] including documentation burden and the consequences of these issues. This report called for validated measurement tools for documentation burden but did not identify specific measures for this purpose beyond identifying numerous examples of these burdens. It did classify administrative burdens (including documentation concerns) into patient care-related and nonpatient care-related categories. This report also cautioned against simply shifting administrative burdens from one job role to another. Relevant to the current Technical Brief, the NAM report identified determination of how to best measure administrative burden as a key research priority.

The 2020 Office of the National Coordinator for Health Information Technology report on reducing regulatory and administrative burden relating to health information technology (IT) and EHRs emphasized that documentation burden impedes efforts to improve patient safety and quality of care.[3] This report noted certain documentation burdens, including requirements for clinical visit data entry that could be streamlined, beyond simply representing a measurable target. Confirming the accuracy of automated data collection is highlighted as a necessary step to leveraging EHR tools to reduce documentation burden.

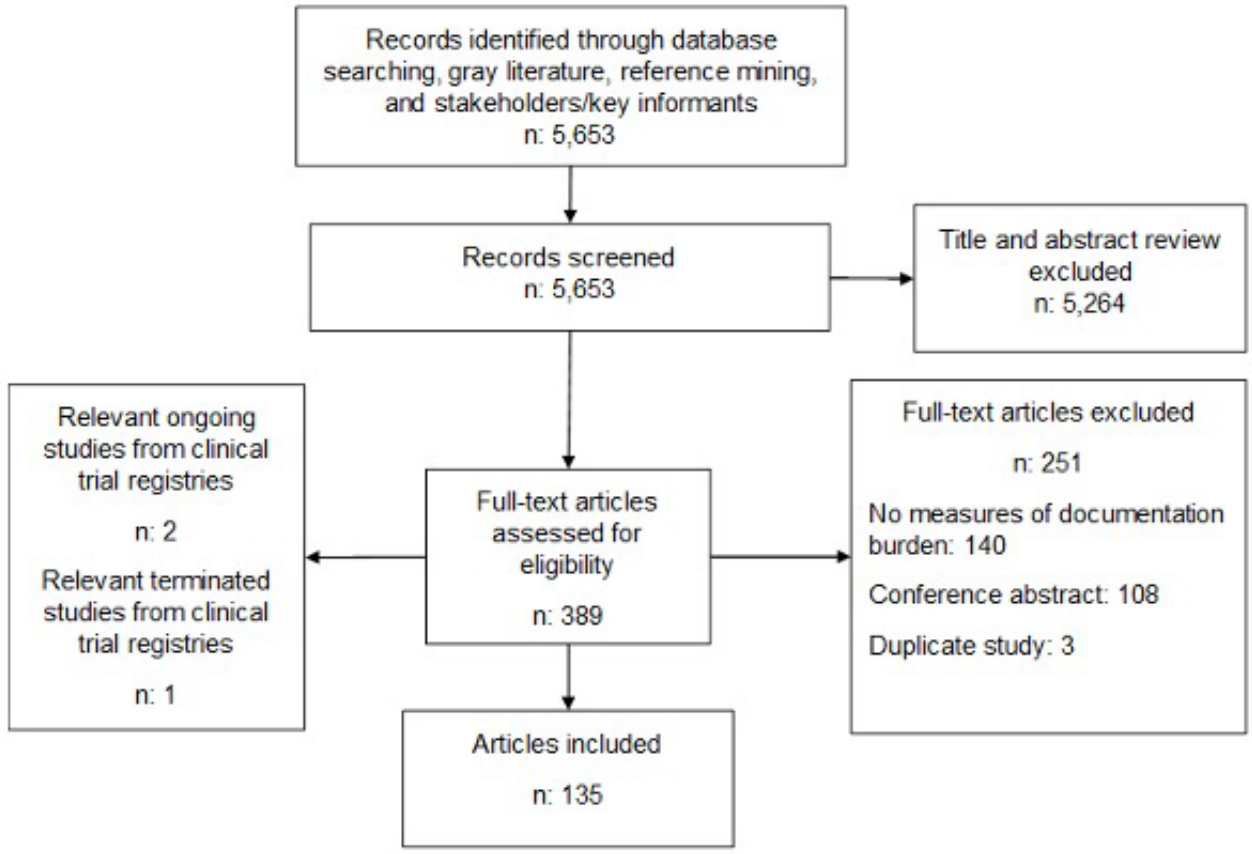
Finally, the 2021 American Medical Informatics Association (AMIA) 25x5 Task Force effort to reduce health professionals' documentation burden established an expectation that documentation burden on clinicians in the United States be reduced to 25% by 2025, in order to focus more effectively on patient care needs. The Task Force did not specifically identify measures of documentation burden but noted the need for more detailed analysis of such measures. This resulted in a nomination of measures for documentation burden as a topic for a new evidence review from the Agency for Healthcare Research and Quality (AHRQ), culminating in the present Technical Brief.

## 3.3 Results of the Published Literature Search

The literature search strategy identified 5,653 citations. We excluded 5,264 articles after abstract screening. Two hundred fifty-one articles were excluded after full text screening. The

main reasons for exclusion were the study reported no measures of documentation burden (n=140), was a conference abstract (n=108), or was a duplicated publication (n=3). The excluded studies with exclusion reasons are listed in Appendix B. We also identified two ongoing studies and one terminated study from clinical trial registries. One hundred thirty-five articles met the inclusion criteria. The results of the literature search are displayed in the flow chart found in Figure 1. Appendix C lists characteristics of the included studies.

**Figure 1: Flow chart**

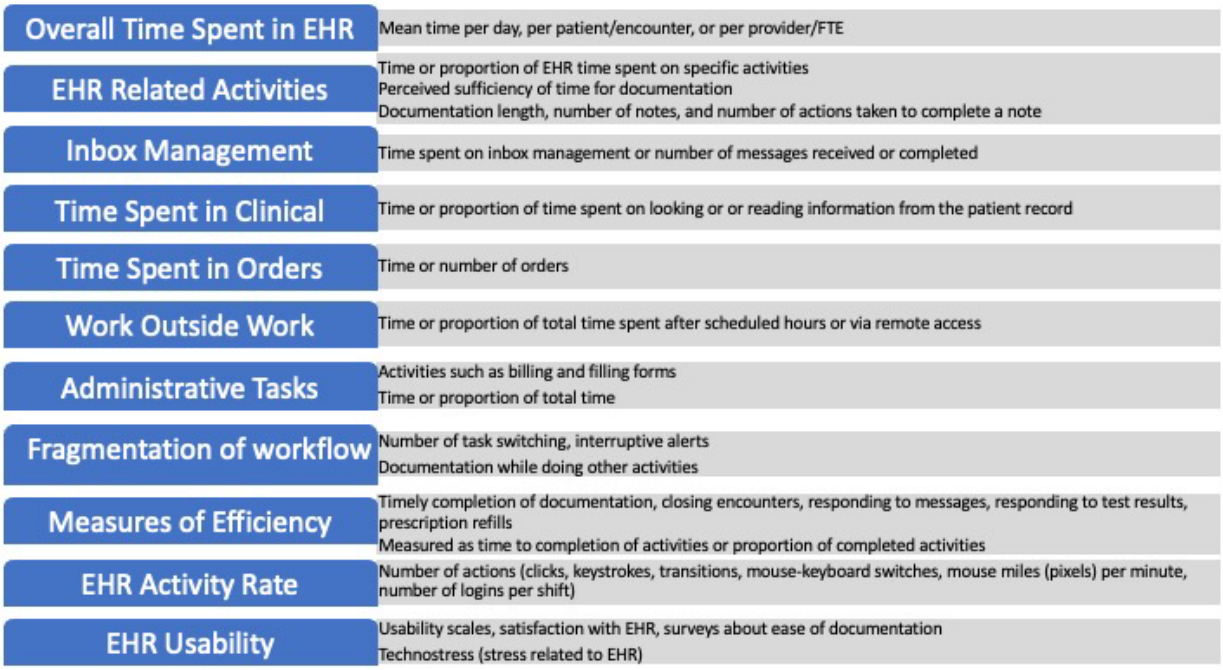



Abbreviations: n = number

## 3.3.1 Findings, Guiding Question 1: What Measures of Documentation Burden Have Been Developed or Used?

This narrative synthesis identified 11 measures of documentation burden that are summarized in Figure 2.

**Figure 2. Measures of documentation burden**




Abbreviations: EHR = electronic health record; FTE = full-time equivalent

## 3.3.1.1. Overall Time Spent in EHR

Total time spent in the EHR was tracked most commonly through EHR usage logs.[8, 14, 26-56] It was tracked through time−motion analysis in five studies.[8, 57-60]

In addition, two studies tracked time spent in EHR remotely through a smart phone or tablet applications.[61, 62] Five studies reported subjective EHR use.[63-67]

## 3.3.1.2. Activities Related To Clinical Documentation

Time specifically spent in clinical documentation activities was most commonly tracked through EHR usage logs, both as total time spent on clinical documentation specifically and the proportion of total EHR time spent in clinical documentation.[8, 30, 32-36, 40, 41, 43-45, 47, 48, 51-55, 62, 66, 68-86] Additional time measurement of clinical documentation activities occurred via smart phone or tablet applications[39, 62, 77, 87-98] or video time-motion recording.[58, 60]

Measures related to clinical documentation other than time spent in clinical documentation activities included number of flowsheet-related entries such as vital sign entry,[59, 60, 99, 100] documentation length,[30, 42, 44, 62, 70, 73, 85-87, 94, 101-105] number of notes,[75] and number of actions taken to complete each note.[74, 84, 85, 106]

Some studies also provided subjective assessments of clinical documentation burden, including perceived sufficiency of time for documentation and estimated time spent on clinical documentation.[10, 65, 107-118] For example, Carlson et al.[108] administered a survey to resident physicians with items evaluating self-report of usual time to documentation completion, minutes for individual note completion after leaving a patient's room, and whether documentation was completed in a timely manner, incorporated an adequate physical exam, and contained an accurate list of diagnoses. A parallel survey administered to attending physicians evaluated self-report of usual time to documentation completion, minutes per week spent attesting notes, and whether documentation was completed in a timely manner, contained an accurate physical exam,

and included an accurate diagnosis list. De Groot et al.[119] surveyed nurses estimating time spent per week on clinical documentation and self-perceived workload of clinical documentation (reported on a 5-point scale). Gilman et al.[120] surveyed general internists to report time spent completing clinical documentation, including the after-visit summary and dismissal letter, using a 5-point scale with response options of *no time, very little, just right, more than expected, and too much*.

### 3.3.1.3. Inbox Management

Measures of inbox management-related documentation burden included tracking of time spent specifically in this activity,[8, 30, 32, 33, 35, 37, 39, 40, 46, 47, 51-55, 71, 78, 79, 81, 83, 87, 101, 103, 121, 122] and volume/number of messages.[44, 46, 49, 52, 55, 121-124] Self-reported assessment of inbox burden was described in several studies, including time elapsed before responding to inbox messages,[125] time spent on inbox management,[120] and estimated number of messages received.[64]

### 3.3.1.4. Time Spent in Clinical Review

Time spent in clinical review activities was tracked most commonly through EHR usage logs,[8, 32, 35-37, 40, 42, 46, 47, 52-54, 61, 62, 71, 78, 79, 81, 83, 87, 101, 122] followed by time-motion analysis.[39, 58, 61, 91, 93, 97, 98] One study tracked time spent in clinical review remotely through a smart phone or tablet application.[61] Subjective reporting of time spent in clinical review was described in three studies.[34, 117, 120]

### 3.3.1.5. Time Spent in Orders

Documentation burden associated with time spent in clinical orders was assessed through EHR usage logs,[30, 32, 33, 37, 39, 45, 53, 61, 71, 81, 83, 87, 126] in time-motion studies monitored via iPad,[96] or in person.[58, 94] One study examined orders placed remotely through smart phone or tablet application.[61]

Subjective reporting of time spent in orders was described in one study using a 5-point scale.[120] Other measures measuring the burden of orders included an assessment of the number of orders entered.[39, 101]

### 3.3.1.6. Work Outside Work/After Hours

Numerous studies reported objective measures of work activities occurring outside of usual clinical time. These were most often tracked through the EHR, and definitions varied widely as outlined across studies (Appendix Box D.1). For example, Adler-Milstein et al.[123] measured total time active after hours (7:00 P.M.-7:00 A.M.) on scheduled clinic days and time active anytime on unscheduled days. Beiser et al.[127]measured time spent in the EHR outside 7:00 P.M.–7:00 A.M., time spent in the EHR on unscheduled days, and "pajama time" (5:00 P.M.–7:00 A.M.).

Several studies also reported subjective measures of documentation burden from work outside of regular work hours (Appendix Box D.2). DiAngi et al.[125] measured self-reported time spent per week in the EHR outside routine work hours (i.e., 8:00 A.M.–6:00 P.M. Monday through Friday), using a survey with responses on a 5-point scale (from none to excessive). This study also examined self-reported time spent per week precharting outside routine work hours (i.e., 8:00 A.M.–6:00 P.M. Monday through Friday). Gilman et al.[120] measured self-reported time spent after hours, assessed on a 5-point scale (response options no time, very little, just right, more than expected, too much).

### 3.3.1.7. Administrative Tasks (Billing and Insurance Related)

Three studies objectively evaluated documentation burden associated with billing- and insurance-related administrative tasks using EHR automated tracking features.[8, 32, 53] One study used video time-motion analysis to evaluate the burden of administrative tasks.[58] Five studies subjectively examined the burden of administrative tasks.[116, 119, 120, 128, 129]

### 3.3.1.8. Fragmentation of Workflow or Multitasking

Task switching has been evaluated in studies by Bartek et al.,[71] who measured switching between different EHR tasks, and Ehrler et al.,[59] who assessed time spent on uninterrupted EHR documentation. Moy et al.[81, 130] measured time spent on single tasks and the number of task switches per minute to measure workflow fragmentation in different clinical settings (e.g., intensive care unit [ICU], emergency department [ED], acute care, and ambulatory clinic). Additional measures of fragmentation include number of weekly interruptive alerts[131] and number of interruptions per hour.[89] Fouquet et al.[132] observed attending physician behaviors and found that a majority of the attendings multitasked and completed documentation while residents were actively staffing cases. Mamykina et al.[95, 96] completed a time-motion study identifying a high frequency of multitasking and task transitions in clinical documentation, with resulting fragmentation in clinical work.

### 3.3.1.9. Measures of Efficiency

Several studies reported objectively assessed efficiency measures (Appendix Box D.3). These measures can be further subcategorized as: timely completion of documentation,[34, 66, 72, 133] time to chart/encounter closure,[55, 72, 105, 132, 134, 135] visits closed same day,[35, 43, 49, 52, 69, 87, 127, 136] clinical encounters that were closed on the same day as the visit,[30, 42, 55, 56, 62, 104] charts closed within 72 hours,[79] time spent in the EHR relative to expected time based on clinical workload,[123] timely inbox completion,[43, 46, 49, 52] documentation compliance,[97] number of steps in healthcare staff workflow,[28] mean nursing admission database dataset completion rate,[74] and time to completion of results, prescription requests, and patient messages.[137]

Two studies subjectively assessed measures of efficiency via survey. DiAngi et al.[125] assessed the frequency of closing encounters on the same workday and Taylor et al.[117] assessed the number of notes closed within a 72-hour period.

### 3.3.1.10. EHR Activity Rate

Several studies reported measures of EHR activity. Alissa et al.[106] assessed the number of actions required to complete clinical notes (defined as clicks, keystrokes, transitions, and mouse-keyboard switches). Anderson et al.,[26] Aziz et al.,[27] Krawiec et al.,[78] and Overhage et al.,[83] applied a Cerner Advance definition of three or more mouse clicks per minute, 15 or more keystrokes per minute, or 1,700 or more mouse miles (pixels) per minute of mouse movement. Horn et al.,[74] and Karp et al.,[77] measured the number of mouse clicks required to complete a nursing admission patient history. Khan et al.[37] measured the number of chart clicks in a 1-month period and chart clicks per minute. Li et al.[138] assessed clinical documentation words per minute and keystrokes per character. Lastly, Patel et al.[62] assessed the number of logins per shift, number of charts reviewed per shift, and number of patient charts documented per shift.

### 3.3.1.11. Usability

Various aspects of EHR usability were subjectively assessed from the perspective of the clinician in several studies. Four of these studies used the system usability scale (SUS), which is a validated survey instrument.[7, 91, 110, 139] The rest of the studies used nonvalidated surveys to assess usability as described in the following (Appendix Box D.4).

Examples of these studies include Kadish et al.[35] who assessed confidence in the EHR overall and in five key activities: placement of orders (excluding chemotherapy), documentation, chemotherapy ordering, clinical review, and inbox message management, using a 5-point scale. Tell et al.[140] evaluated "technostress" (stress experienced by end users in organizations attributed to EHR) on a 5-point scale (1 = do not agree at all/no technostress to 5 = fully agree/high technostress levels).

## 3.3.2. Findings, Guiding Question 1a: For Which Settings, Populations, and Intended Uses Were the Measures Developed?

Measures have been developed across a diverse range of settings, populations, and uses. Settings include both ambulatory and inpatient clinical practices, primary care and nonprimary specialties, surgical and nonsurgical settings, rural and urban sites, academic and community-based medical centers, and private practices. The most commonly studied group of healthcare professionals was physicians in the United States, but geography and clinician types have been diverse. Geographic locations include the United States, Canada, the United Kingdom (U.K.), Germany, the Netherlands, Switzerland, Saudi Arabia, China, Taiwan, and Australia. South American clinical settings are not well represented in the literature. Relevant clinician populations included faculty and resident physicians, nurse practitioners, physician assistants, clinical psychologists, registered and licensed practical nurses, social workers, occupational and physical therapists, dietitians, and speech pathologists. Intended applications spanned a broad range of documentation burden measures as previously described. Study details relevant to GQ 1a are outlined in Appendix Table C.1.

## 3.3.3. Findings, Guiding Question 1b: How Have These Measures Been Applied?

Applications spanned a broad range of documentation burden measures as previously described. These include overall time in the EHR, activities related to clinical documentation, inbox management-related documentation burden, time spent in clinical review activities, time spent in clinical orders, work outside of scheduled hours or usual clinical time, documentation burden associated with administrative tasks such as billing and insurance requirements, workflow fragmentation and multitasking, measures of efficiency, EHR activity measures, and EHR usability.

Objective measures across these applications most commonly involved EHR usage logs, activity tracking apps, and time-motion analyses. Subjective measures were also common, including clinician self-report of experiences, attitudes, and effort, along with methodologically more rigorous qualitative evaluations. Study details relevant to GQ 1b are outlined in Appendix Table C.1.

Multiple studies adopted measures of documentation burden to evaluate effectiveness of interventions to reduce documentation burden. For example, Chaparro et al. developed a quality improvement project to reduce the total volume of EHR interruptive alerts received by

clinicians.[131] However, very limited evidence existed that linked documentation burden to health outcomes. Detailed information on application of the measures is summarized in Appendix Table C.1.

## 3.3.4. Findings, Guiding Question 1c: Is There Published Information Available on Validity of the Measures?

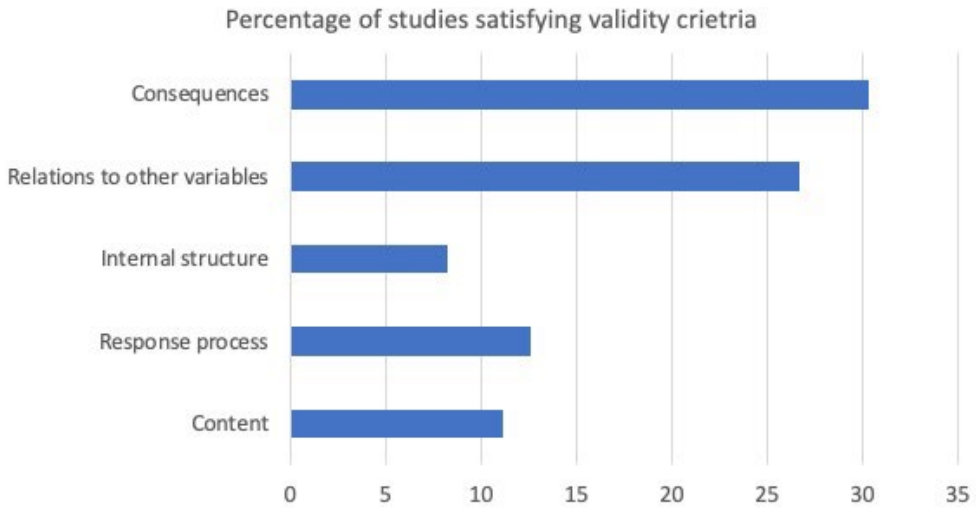
The majority of the included studies did not provide sufficient evidence to establish validity of documentation burden measures. Figure 3 depicts the proportion of studies that adequately provided each of the five validity evidence types and Appendix Table E.1 provides details about the individual studies:

1. Content evidence was judged to be inadequate in studies that simply measured time, number of clicks or completion of tasks without clear linkage to documentation burden, whereas studies that associated time with specific documentation tasks and linked it to burden were considered to provide adequate evidence (approximately 11% of the studies). For example, Gardner et al. associated the perception of insufficient time for documentation and excessive use of EHR at home with 2.8 and 1.9 higher odds of burnout, respectively.[109]
2. Response process evidence was considered adequate when the actions and thoughts of researchers and respondents in the studies intended to measure the burden associated with documentation (approximately 12% of the studies). For example, Kroth et al. conducted focus groups in which researchers and participants purposefully targeted documentation burden and its correlation with technology stress, ergonomic problems, poor interoperability between systems, her use at home, and excessive data entry requirements.[112]
3. Internal structure evidence was considered adequate when the measure was judged to be reliable and reproducible (approximately 8% of the studies). While many studies used EHR usage logs to capture documentation time, which is a reliable and reproducible method, we judged these studies to 'partially' fulfill this criterion because time itself was a surrogate for burden and because EHR usage logs may miss inactive users and those who are multitasking on their screens. Time-motion studies and studies with observers may capture true documentation time better. For example, Arndt et al.[8] and Karp et al.[77] used parallel time-motion studies to validate EHR measures.
4. Relations to other variables evidence was considered adequate when studies correlated the time measure with other measures of burden or provider stress or satisfaction (approximately 27% of the studies).
5. Consequences evidence was considered adequate when documentation time was associated in a study with burnout, patients' outcomes or satisfaction, or teaching time (approximately 31% of the studies). For example, Baugh et al. demonstrated that every minute spent on documentation in emergency department was associated with 0.48 fewer minutes spent on teaching ($p<0.05$).[141]

Several studies applied instruments to assess factors related to documentation burden such as work stress and well-being but did not report on the validity of documentation burden measures themselves (e.g., Al Qahtani et al.,[142] Linzer et al.,[113] Mosquera et al.,[42] Olson et al.,[114] and Peccoralo et al.[129]). Additional validity information was provided in some specific studies in the form of survey or tool validation. Melnick et al.,[7] Feely et al.,[91] Gesner et al.,[110] and Windle et

al.[139] measured usability of the EHR using the SUS, a validated survey instrument to assess usability of various technologies. However, SUS captures only limited aspects of documentation burden. Benson et al.[124] applied a validated survey instrument to evaluate the impact of health IT, including the EHR, on clinician job satisfaction. Gesner et al.[110] applied the BurDoNsaM (Burden of Documentation for Nurses and Mid-wives) tool to evaluate clinician views of documentation burden. BurDoNsaM had a separate publication in which it underwent content validity analysis by content experts and only items with adequate content validity indices were retained in the instrument.[143]

**Figure 3. Evidence supporting validity**




## 3.3.5. Findings, Guiding Question 1d: What Are the Key Strengths and Weaknesses of Different Measures That Have Been Used?

Key strengths across measures of documentation burden include the combination of both objective and subjective measures to capture time and effort directly and with the additional context of perceptions around these burdens. The diversity of measures is also a strength as this offers a broad overview of documentation burden across multiple dimensions. In addition, the literature is quite broad in its coverage of clinical settings, clinician groups, and geographic locations. The most common measures of documentation burden involved electronic data capture via time stamps or usage logs, which would be expected to minimize the likelihood of measurement error assuming these measures are accurately calibrated within the electronic systems from which they are derived.

Key weaknesses include limited evidence in support of validity across all measures, as previously described. Although the diversity of measures is a strength, there is clear heterogeneity in the definitions of documentation burden even within specific intended measurement targets (e.g., work outside of scheduled work time, as noted previously). The

heterogeneous definitions of documentation burden led to inconsistency and difficulty in comparing results across studies. There are also specific gaps in groups included in the literature, including South American clinical settings and important clinician roles such as pharmacists, nurses, and medical assistants.

## 3.3.6. Findings, Guiding Question 2: What Are the Different Perspectives on the Appropriateness of Different Measures of Documentation Burden That Have Been Applied/Proposed?

The literature contains very little discussion of issues relating to appropriateness of measures based on consideration of scalability, feasibility, or equity across clinical settings, clinician and patient/caregiver populations, and geographic locations. Comparability of EHR-derived measures when interoperability is limited is an ongoing concern, as is generalizability of both objective and subjective evaluations of documentation burden conducted within specific environments. There is greater discussion of the appropriateness and feasibility of solutions to documentation burden (e.g., scribes and health informatics technology development).

## 3.3.7. Findings, Guiding Question 3: What Are the Perceptions of Documentation Burden Based on Clinical Roles and Patients/Caregivers?

### 3.3.7.1. Clinician/Healthcare Professional Perspective

Prior evidence makes clear that documentation burden is perceived as substantial across multiple studies involving physicians, residents, nurse practitioners, physician assistants, and nurses specifically, with every clinician role identifying documentation burden as a major concern. As such, these issues are universal across healthcare professionals who interface with documentation functions in their work. Documentation burden is associated with stress, dissatisfaction, and frustrations with poor usability. These issues are thought to at least indirectly compromise patient care experiences and outcomes.[2-4]

Three studies used qualitative methodology and conducted interviews with participants to understand the burden of documentation. Windle et al.[139] interviewed ED physicians to assess the burden of documenting patient encounters. De Groot et al.[119] conducted qualitative interviews with nurses to address how they perceived clinical and organizational documentation in relation to their workload and user-friendliness of the EHR. Goldberg et al.[144] interviewed primary care physicians to identify causes of burnout and strategies to improve clinician well-being.

Consequences of documentation burden as reported by healthcare professionals are described across the following specific domains:

#### 3.3.7.1.1. Burnout/Stress Related To the EHR

Numerous studies provided evidence of a strong association between documentation burden and burnout (Appendix Box D.5). For example, Frintner et al.[128] found that among pediatricians, higher reported EHR burden was associated with lower scores on career and life satisfaction measures and on multiple measures of work-life balance. Three-quarters of participants reported that EHR documentation was a major or moderate burden on a 4-point scale from no to major

burden. Mosquera et al.[42] assessed the association of time spent writing notes with depersonalization, emotional exhaustion, and overall engagement among psychiatrists in outpatient practice, finding a statistically significant association with depersonalization. The authors also assessed the association of the frequency of same-day visit closure with levels of engagement, compassionate satisfaction, and sense of personal accomplishment, finding statistically significant associations with levels of engagement and sense of personal accomplishment.

### 3.3.7.1.2. Satisfaction and Usability With the EHR

The majority of the available studies reported decreased satisfaction with EHR across clinical roles, specialties, and geographic locations (Appendix Box D.6). Hsieh et al.[76] evaluated staff nurse satisfaction with EHR charting content, functionality, effectiveness, and usability on a 5-point Likert scale (1 = very dissatisfied to 5 = very satisfied). Baseline mean satisfaction scores were 3.4, 3.5, 4.4, and 3.7 across these dimensions, respectively. Kroth et al.[112] generated themes relating to satisfaction with the EHR from focus groups primarily involving primary care physicians. Stressors and dissatisfiers included click boxes and too many clicks in general, note bloat (from cut and paste entry), the intrusive presence of the EMR at home, limited interoperability between hospitals and EMR systems, difficulty locating or documenting key information within charts, and inefficiency relating to redundancy. The studies reporting EHR usability from the clinician/healthcare professional perspective can be seen in Appendix Box D.7.

### 3.3.7.1.3. Workload and Satisfaction With Practice

The studies reporting on workload can be seen in Appendix Box D.8. De Groot et al.[119] reported on Dutch community nurses' views on the relationship of self-reported time spent on clinical documentation and administrative tasks with perceived high workload. More than half (52.3%) endorsed perceived high workload from clinical documentation at least regularly, and 57.9% endorsed perceived high workload from organizational documentation at least regularly.

The studies reporting satisfaction with practice can be seen in Appendix Box D.9. For example, Benson et al.[124] reported on whether EHR improved job satisfaction for gastroenterology and hepatology clinicians, finding that 17% agreed, 52% disagreed, and 31% strongly disagreed.

## 3.3.7.2. Patient Perspective

Marmor et al.[14] found that for attending physicians at an academic teaching institution in the United States, increased total time spent in EHR during daytime hours was associated with decreased patient satisfaction, lower communication ratings, and lower likelihood of recommending the physician. However, no association was seen between after-hours EHR use and these outcomes. Among primary care physicians working outside of academic medical centers in California, Mishra et al.[66] found that within a scribe intervention allowing reduced physician documentation burden, patients reported more time spent by their physicians on direct interaction, less time engaging with the computer during their visit, and greater satisfaction with the quality of the visit under these conditions. We did not identify any studies specifically reporting on patient perspectives of documentation burden borne by their care team members.

### 3.3.7.3. Perspectives of Clinical Trainee

The negative effect of documentation burden on teaching was reported in several studies. Raney et al.[97] found that, among inpatient pediatric oncologists, increased time spent on documentation was associated with statistically significantly decreased time spent on teaching but not associated with time spent on direct patient care. Yuan et al.[118] evaluated how EHR completion time demands affected fellow education in nephrology. Overall, 70%-80% of program directors, clinical faculty, and nephrology fellows said that more time was spent during encounters on documentation than on the patient, and a majority of respondents felt EHR time demands placed fellows at risk of training program duty hour violations. A majority (65%-75%) of program directors, faculty, and nephrology fellows reported excessive and/or irrelevant EMR documentation, and 80% endorsed "copy forward" issues leading to incorrect information in the medical record. Roughly one-third of respondents indicated that fellows were reluctant to engage in education because of EMR time demands. This figure was higher for fellow-reported reluctance to participate in specific educational activities (52% for procedures, 57% for conferences, 74% for prolonging patient encounters, and 55% for independent case-directed literature reviews). Baugh et al.[141] demonstrated that time spent documenting was significantly associated with less time spent on teaching, controlling for patient arrivals per hour.

## 3.3.8 Findings, Guiding Question 4: What Is the Role of Patients in Documentation Burden?

Patients may contribute to required documentation in their clinical care, such as in previsit questions or followup questions after visits. At the time of this report, however, literature evaluating the role of patients in documentation burden beyond the volume of communications and associated time demands for associated paperwork, chart review, and responses is extremely limited. It is also important to note that patients are often intermediaries in these processes between insurance providers, billing entities, and regulatory groups and patients' clinical teams. Hence, the true source of documentation burden may not be primarily the patients themselves.

As previously noted, inbox demands are a common metric of documentation burden. However, these are seldom divided by their source in published studies. Thus, patient-specific contributions are difficult to delineate. In addition, patient perceptions of the documentation demands they may place on clinicians have been largely unexplored. With these caveats, several relevant studies are described below.

Congelosi et al.[64] reported on surgical staff perceptions of patient portal usage, noting mixed evaluations of the portal as a preferred method of communication with patients and negative views of the portal's contribution to workload and professional satisfaction. However, complementary patient perceptions of these issues were not included in this study. DiAngi et al.[125] evaluated clinician satisfaction with Epic's InBasket function, which sends direct messages to and receives messages from patients, finding only fair self-reported ease of use for the EHR for responding to patient call InBasket messages (mean of 2.9 on 1-5 scale from unsatisfactory to satisfactory).

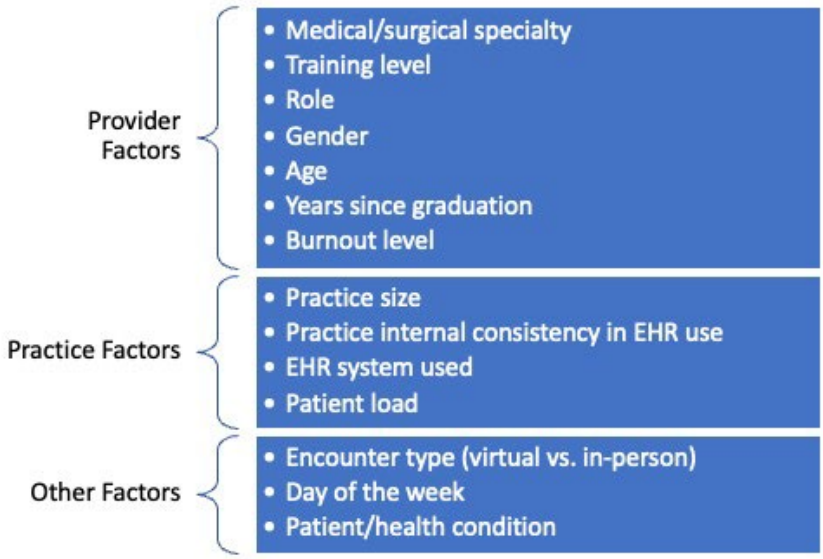
Holmgren et al.[73] found that immediate patient access to clinical notes did not increase documentation workload for clinicians, although documentation quality was not assessed. Kumah-Crystal et al.[102] assessed the usefulness and impact of a previsit questionnaire on clinician documentation content and length (as a marker of documentation burden), with favorable evaluations from both patients and clinicians.

## 3.3.9 Findings, Guiding Question 5: What Is the Role of Setting in Documentation Burden?

Measures have been developed to evaluate documentation burden across a diverse range of settings. These include both ambulatory and inpatient clinical practices, primary care and nonprimary specialties, surgical and nonsurgical wards, rural, suburban, and urban sites, academic and community-based medical centers, and private practices. Overall patterns for documentation burden appear to be broadly similar across settings, although there is evidence that note length and other burdens are greater in the United States than in other health systems.[145] Increased EHR time spent on clinical review has been associated with decreased throughput efficiency in Emergency Medicine,[78] and clinical workflow fragmentation in multiple studies across diverse settings.[81, 89, 95, 96, 130, 131] Interventions to mitigate documentation burden may be more accessible and more often implemented in settings (and especially disciplines within settings) with greater resources, but the underlying documentation burdens themselves are endemic. Unfortunately, efforts to limit documentation burden in one setting or for one group can result in increased demands on other teams, particularly outpatient primary care clinicians and offices.[2]

The various mediators identified in the included studies of documentation burden are summarized in Figure 4 and can be categorized to provider, practice, and other factors.

**Figure 4. Reported mediators of documentation burden**




Abbreviations: EHR = electronic health record

# 4. Summary and Implications

We identified 135 articles reporting on various aspects of documentation burden and measures for its assessment. Documentation burden in healthcare is well documented, and its consequences are serious for healthcare professionals, the systems they work in, and patients. No single established definition for documentation burden exists, which contributes to the difficulty in creating valid and scalable measures. Before turning to the measures of documentation burden, it is important to note that the sources of document burden may be direct clinical work or organizational requirements around clinical work. Clinicians are able to distinguish these sources, and they likely require different approach to mitigation.

For Guiding Question (GQ) 1, we identified 11 categories of measures for documentation burden, from overall time spent in the electronic health record (EHR) to usability. The most common source for most measures was EHR usage logs, and direct tracking used in time-motion analysis (i.e., researchers follow clinicians and document each task and related time) was fairly uncommon. Specific work functions contributing to documentation burden were represented in the set of measures. These included flowsheet entry, inbox management, clinical review, order entry and review, and administrative clinical support tasks, such as billing and insurance-related documentation. The capture of the latter administrative tasks is likely underestimated. For example, medication-related pre-authorizations can involve lengthy phone calls with pharmacy staff and insurers, as well as providing information through websites outside of the EHR. Measures included both time during scheduled work and time required outside of work and after hours, although definitions of these parameters varied. It is noteworthy that with expanded virtual healthcare delivery and remote access, working off hours or off location may not correlate with documentation burden as well as they did when most work was in person. Efficiency was also an important measurement category, with measures reported for workflow fragmentation, multitasking, time to complete documentation requirements, and EHR activity down to the level of individual keystrokes and mouse clicks. If certain efficiency measures, such as timely closure of charts, are used to measure performance or penalize clinicians, these measures can become invalid measures of documentation burden.

We found that measures have been developed and applied across a diverse range of settings, populations, and uses. Settings include both ambulatory and inpatient clinical practices, primary care and nonprimary specialties, surgical and nonsurgical wards, rural and urban sites, academic and community-based medical centers, and private practices. The most commonly studied group was physicians in the United States (U.S.), and additional geographic locations included Canada, the United Kingdom (U.K.), Germany, the Netherlands, Switzerland, Saudi Arabia, China, Taiwan, and Australia. South American clinical settings are not well represented in the literature. Relevant clinician populations include faculty and resident physicians, nurse practitioners, physician assistants, clinical psychologists, registered and licensed practical nurses, social workers, occupational and physical therapists, dietitians, and speech pathologists. In addition, published information on the validity of documentation burden measures is limited and incomplete. This challenges interpretation of studies of documentation burden and makes credible comparisons of results across studies extremely difficult. Limited validity evidence also hinders support for widespread implementation of any specific metric. The scalability of measures is unclear considering that the current literature is mostly derived from academic medical centers.

For GQ 2, we identified important limitations to literature addressing the appropriateness of measures based on consideration of scalability, feasibility, or equity across clinical settings,

clinician and patient/caregiver populations, and geographic locations. Comparability of EHR-derived measures when interoperability is limited is an ongoing concern, as is generalizability of both objective and subjective evaluations of documentation burden conducted within specific environments.

For GQ 3, clinician perspectives on documentation burden were more robustly represented in the literature than perspectives from other stakeholder groups such as patients. Clinician perspectives on the impact of documentation burdens on stress and burnout were commonly reported, as were satisfaction with the EHR overall, EHR usability, and EHR-associated workload.

Extending the limitations for GQ 3, the role of patients in documentation burden as explored in GQ 4 was assessed across only a small number of studies with limited outcomes primarily focused on volume of communications and associated time demands for paperwork, chart review, and clinician responses to patient communications.

Finally, for GQ 5, the literature offers little ability to distinguish the role of settings in documentation burden. Overall patterns for documentation burden appear to be broadly similar across settings, although there is evidence that note length and other burdens are greater in the United States than in other health systems.[145] Interventions to mitigate documentation burden may be more accessible and more often implemented in settings (and especially disciplines within settings) with greater resources, but the underlying documentation burdens themselves are endemic. Unfortunately, efforts to limit documentation burden in one setting or for one group can result in increased demands on other teams, particularly outpatient primary care clinicians and offices. Each of these conclusions is limited by the aforementioned challenges involving validity, consistent application, and narrow stakeholder representation for measures for documentation burden as of this report.

## 4.1 Strengths and Limitations

A key strength of this Technical Brief is the systematic search of literature applying methodologically rigorous techniques including a medical librarian-developed search strategy of multiple databases, duplicate assessment of inclusion for every identified report, and duplicate assessment of data extraction from reports included in the final summary. Artificial intelligence (AI) was used to facilitate the initial stage of abstract review but was supplemented with duplicate assessments in all cases. The timeline selected for this report aligns with a major shift in documentation burdens occurring with enactment of the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009, so the resulting literature summary reflects modern practice experiences.

This Technical Brief also has limitations. The literature offers the greatest relevance to the U.S. healthcare system and may result in a less complete summary of documentation burdens in other systems. The focus of this Technical Brief was primarily on measures of documentation burden. Hence, the effectiveness of initiatives to lessen these burdens were not addressed in this report. Thematic synthesis can be conducted in multiple ways that can all be reasonable. For example, clinician satisfaction and system usability are interrelated concepts and so are scalability and feasibility. Thus, a different categorization of the findings of this report is possible. Heterogeneity in how different organizations implemented and configured their EHR limits comparative inferences across studies.

In addition, available literature was limited for certain GQs. Very few of specific measures have been tested and validated in rigorous studies, and validity evidence to support these

measures was infrequently reported. There was limited knowledge of validation of vendor-derived measures and their reproducibility. The literature also contains very little discussion of issues relating to the appropriateness of measures according to considerations of scalability, feasibility, or equity across clinical settings, clinician and patient/caregiver populations, and geographic locations. Limited data from healthcare systems outside of the United States and Europe limit our ability to compare experiences across these systems. Although clinician perspectives were generally consistent about the impact of the burden, certain groups were poorly represented (e.g., pharmacists, nurses, and medical assistants), and certain potential mediators were not evaluated (e.g., being a graduate from a non-U.S. medical school, keyboarding skills).

Patient perspectives were also not commonly reported. Related to this limitation, literature evaluating the role of patients in documentation burden beyond the volume of communications and associated time demands for associated paperwork, chart review, and responses is extremely limited.

## 4.2 Next Steps

Documentation burden continues to increase. A recent study comparing the period from 2019-2020 to 2022-2023 showed a significant increase in the time primary care physicians spent in the EHR across most tasks.[146] While some EHR vendors are trying to develop measures, the measures are in preliminary stages and do not appear to be consistent with proposals of multidisciplinary informatics workgroups and are not multi-dimensional.[147, 148] As suggested above, there are several necessary advances in measures of documentation burden to allow a more complete understanding of the magnitude of current burdens across a wider range of documentation activities and to inform more effective solutions. For both existing and newly developed measures, renewed attention to fundamental instrument development procedures such as establishing validity and reliability is needed. Measures should explicitly map to specific burden domains and address multiple domains of this construct. Another important characteristic of documentation burden measures is that they need to assess documentation that is necessary to serve patients. Thus, parts of the documentation that do not serve patient needs should be eliminated and subsequently not measured. The primary source of the information may determine its necessity. For example, when a clinician documents the deterioration of a patient's status, they are the source of information, and this documentation is important. Conversely, documentation that merely reflects awareness of information or is simply copied from another place is not necessary. Other parts of the documentation may support billing, administrative tasks, or research, and these require a different way of documenting that does not lead to burden and burnout of healthcare professionals.

Another measurement need is to expand measures beyond the most common "time or effort" domains to include concepts such as "rework" associated with order revisions, duplication, and inefficiency in documentation processes both within and across job roles, and interoperability across data sources. One aspect of measurement could be the perceived value associated with documentation as a driver of associated experiences such as job satisfaction, burnout, and meaning from work. Measures that address burnout, emotional exhaustion, depersonalization, and moral distress in healthcare professionals should also be incorporated to assess the human dimensions of documentation burden. There is also a need to intentionally expand documentation burden evaluations to include more diverse healthcare systems both within and across nations, to inform comparative analyses of measures and outcomes. Similarly, representation from all

clinical roles remains incomplete. As healthcare delivery increasingly requires highly integrated team structures, changes affecting one group within a structure will have effects on every other group as well. Given this, studies should strive to include every clinical role involved in each care process, as well as the individuals at the center of these care processes, the patients themselves.

Future research should explore how patients use patient portals to communicate with clinicians (thereby generating additional documentation requirements), how often paperwork is brought by patients to clinicians to complete and how much time and cognitive effort this requires, and assess patient expectations of documentation (e.g., timeliness, level of detail, who the response should come from). Documentation quality is another important issue for future research that is closely related to documentation burden. Creating guidance and measures for high-quality documentation can identify areas where burden can be reduced and highlight what documentation requirements are truly necessary for effective patient care. Poor documentation includes repeatedly capturing the same information, and this redundancy clearly exacerbates documentation burden. The role of AI in decreasing (or potentially exacerbating) documentation burden is another important domain for future studies. Future studies should report key elements such as reporting timeframes, EHR type and configuration, healthcare personnel type, and clearer definitions of measures. A reporting guideline or checklist for studies that measure or intervene on documentation burden is needed.

This report serves as a call to action and emphasizes the urgency of the problem. Identifying measurement gaps is just the first step that serves as the basis for developing interventions and solutions and benchmarking progression of mitigating documentation burden.

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# Abbreviations and Acronyms

| | |
|---|---|
| AHRQ | Agency for Healthcare Research and Quality |
| AMIA | American Medical Informatics Association |
| BurDoNsaM | Burden of Documentation for Nurses and Mid-Wives |
| CPOE | Computerized Physician Order Entry |
| ED | Emergency Department |
| EHR | Electronic Health Record |
| EMR | Electronic Medical Record |
| EPC | Evidence-based Practice Center |
| FTE | Full-Time Equivalent |
| GQ | Guiding Question |
| HITECH | Health Information Technology for Economic and Clinical Health |
| ICU | Intensive Care Unit |
| IT | Information Technology |
| KI | Key Informant |
| MHRA | Medicines and Healthcare Products Regulatory Agency |
| NAM | National Academy of Medicine |
| NLP | Natural Language Processing |
| RCT | Randomized Clinical Trial |
| SEADS | Supplemental Evidence and Data for Systematic Reviews |
| SUS | System Usability Survey/Scale |
| TOO | Task Order Officer |
| U.K. | United Kingdom |
| U.S. | United States |

# Appendix Contents



**Tables and Boxes**

# Appendix A. Search Strategy

## Ovid

Database(s): EBM Reviews - Cochrane Central Register of Controlled Trials December 7, 2023, EBM Reviews - Cochrane Database of Systematic Reviews 2005 to December 7, 2023, Embase 1974 to December 7, 2023, Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions 1946 to December 7, 2023

Search Strategy:

| # | Searches |
|---|---|
| 1 | Medical Records/ |
| 2 | exp Medical Records Systems, Computerized/ |
| 3 | medical record/ |
| 4 | exp electronic health record/ or exp electronic medical record/ |
| 5 | inform*.jw. |
| 6 | ((("Computer-based" or computerized or "Computer-stored" or Electronic) adj2 ("Medical Record" or "Medical Records" or "Patient Record" or "Patient Records" or "Health Record" or "Health Records" or "Order Entry" or "Order Entries")) or EHR or EMR or "health information exchange*" or "medical information exchange*" or "Physician Order Entries" or "Physician Order Entry").ti,ab,kf. |
| 7 | or/1-6 |
| 8 | exp medical documentation/ |
| 9 | Documentation/ |
| 10 | (clerical or document* or note*).ti,ab,kf. |
| 11 | 8 or 9 or 10 |
| 12 | 7 and 11 |
| 13 | Burnout, Professional/ or Burnout, Psychological/ |
| 14 | burnout/ |
| 15 | exp Patient Satisfaction/ |
| 16 | (burden* or burnout or "cognitive load" or satisfaction or "off-hours" or stress or wellbeing or "well-being" or wellness or "work-life").ti,ab,kf. |
| 17 | 13 or 14 or 15 or 16 |
| 18 | 12 and 17 |
| 19 | exp Allied Health Personnel/ or exp Dentists/ or Health Personnel/ or exp Nurses/ or exp Patients/ or Physical Therapists/ or exp Physicians/ or Physician Assistants/ or Psychotherapists/ |
| 20 | (assistants or clinician* or dentist* or doctor* or "healthcare professional*" or "healthcare worker*" or nurse* or nursing or patient* or physician* or provider* or psychiatrist* or psychologist* or psychotherapist* or therapist*).ti,ab,kf. |
| 21 | 19 or 20 |
| 22 | 18 and 21 |

23 remove duplicates from 23

## Scopus

1 TITLE-ABS-KEY((("Computer-based" or computerized or "Computer-stored" or Electronic) W/2 ("Medical Record" or "Medical Records" or "Patient Record" or "Patient Records" or "Health Record" or "Health Records" or "Order Entry" or "Order Entries")) or EHR or EMR or "health information exchange*" or "medical information exchange*" or "Physician Order Entries" or "Physician Order Entry")

2 TITLE-ABS-KEY(clerical or document* or note*)

3 TITLE-ABS-KEY(burden* or burnout or "cognitive load" or satisfaction or "off-hours" or stress or wellbeing or "well-being" or wellness or "work-life")

4 TITLE-ABS-KEY(assistants or clinician* or dentist* or doctor* or "healthcare professional*" or "healthcare worker*" or nurse* or nursing or patient* or physician* or provider* or psychiatrist* or psychologist* or psychotherapist* or therapist*)

5 PUBYEAR AFT 1999

6 1 and 2 and 3 and 4 and 5

7 INDEX(embase) OR INDEX(medline) OR PMID(0* OR 1* OR 2* OR 3* OR 4* OR 5* OR 6* OR 7* OR 8* OR 9*)

8 6 and not 7

## Clinicaltrials.gov

Other terms
burden and documentation and record
First posted from 01/01/2010

burnout and documentation and record
First posted from 01/01/2010

satisfaction and documentation and record
First posted from 01/01/2010

## Google Search

("Medical Record" or "Patient Record" or "Health Record")
AND
documentation
AND
(burden or burnout or satisfaction)
AND
(clinician or doctor or "healthcare professional" or "healthcare worker" or nurse or patient or physician)

## Specific Medical Websites

For example, ecri.org

site: www.ecri.org documentation
AND
(burden or burnout or satisfaction)

# Appendix B. Excluded Studies

## No Metrics of Documentation Burden


1. Web-Based Shared Care for GPs and Mental Health Services in Sydney. 2022. PMID: CN-02408114.
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## Duplications

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# Appendix C. Characteristic of Included Studies

**Table C.1. Characteristics of included studies.**

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Adler-Milstein et al., 2020**[1] | *Type of Institution:* Large academic health system *Type of Practice:* Primary care practice; outpatient *Number of Participating Centers/Practices:* 10 *Location:* Urban*;* USA | 78 physicians and 9 nurse practitioners; internal medicine, family medicine, pediatrics, geriatrics, and mixed primary care specialties | The aim of study was to determine whether objective measures of EHR use—related to time, volume of work, and proficiency—are associated with either or both components of clinician burnout: exhaustion and cynicism. Time was after hours (between 7:00 P.M. and 7:00 A.M,) on scheduled clinic days and time active anytime on unscheduled days. Also measured was EHR proficiency and perceived burden of EHR time at home (self-perceived), and time clinicians spend in EHR relative to expected time based on clinical workload (efficiency). The study measured frequency of use of available EHR tools and degree to which each healthcare professional personalized the system to increase efficiency. |
| **Ahlgrim et al., 2016**[2] | *Type of Institution:* University hospital *Type of Practice:* Outpatient department *Number of Participating Centers/Practices:* 1 *Location:* NA*;* Germany | 8 residents and physicians; internal medicine | The aim of this study was to provide a case study on the steps to successfully implement speech recognition software in a highly specialized university outpatient department focusing on the prearrangements that appear to be beneficial concerning productivity of the software and user motivation as the importance of this "predesign stage" has been emphasized before. |
| **Ahn et al., 2017**[3] | *Type of Institution:* Tertiary hospital *Type of Practice:* inpatient *Number of Participating Centers/Practices:* 3 medical and 3 surgical wards *Location:* NA*;* South Korea | 99 nurses; NA | This study investigated the factors associated with the timeliness of electronic nursing documentation using the entry time on the EMR system and whether it occurred during or after work shift hours. |
| **Alissa et al., 2022**[4] | *Type of Institution:* Major academic university hospital *Type of Practice:* Inpatient *Number of Participating Centers/Practices:* 1 *Location: NA;* USA | 12 residents; pediatrics | This study assessed physician note optimization on saving time for patient care and improving physician satisfaction. Note completion time and number of clicks per patient were measured. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Al Qahtani et al., 2021**[5] | *Type of Institution:* Eye specialist hospital<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* 1<br>*Location:* Urban*;* Saudi Arabia | 212 nurses; ophthalmology | In this study the perceived prevalence of EHR-related stress among nurses at an eye hospital measured by previously validated questionnaire. |
| **Anderson et al., 2020**[6] | *Type of Institution:* Ambulatory and academic setting<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* 1<br>*Location:* NA*;* USA | 34 family practice physicians (24 residents, 10 faculty physicians); family medicine | This study quantified and described variation in resident and faculty EHR use in one family medicine residency program including after-hours use (between 6:00 P.M. and 6:00 A.M. and on weekends) per month. |
| **Apathy et al., 2023**[7] | *Type of Institution:*<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:*<br>*Location:* Urban, suburban, and rural*;* USA<br>*Participants:* All outpatient physicians who use Epic (309 organizations) | 130,079 ambulatory physicians; NA | This study evaluated the impact of the 2021 initiative that reduced documentation requirements for emergency medicine visits. The focus was on documentation of H/P and physical exam. Physicians who reduced note length or time spent in notes were identified. Subsequent analysis on these physicians to examine if/how various note support tools and strategies affected these variables. Note length decreased by approximately 20% and average time spent in notes by approximately 38%. Specific variables included a decrease in manual text, minimal change to copy/paste and SmartTools text. |
| **Apathy et al., 2023**[8] | *Type of Institution:* Ambulatory-based practice that used Epic<br>*Type of Practice:* Outpatient and inpatient<br>*Number of Participating Centers/Practices: NA*<br>*Location:* Urban, suburban, and rural*;* USA<br>*Participants:* National sample of physicians | 203,728 physicians; multiple specialties | This study analyzed how physician clinical note length and composition relate to EHR-based measures of burden and efficiency that have been tied to burnout. Primary outcomes were three time-based measures of EHR burden (i.e. time writing EHR notes, time in the EHR after-hours, and EHR time on unscheduled days), and one measure of efficiency (i.e. percent of visits closed in the same day). Physicians with longer notes, and those who used copy/paste and templated text spent more time in the EHR after hours and closed fewer visits per day. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Arndt et al., 2017**[9] | *Type of Institution:* Large academic healthcare center<br>*Type of Practice:* Residency clinics and community-based nonresidency clinics; *outpatient*<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 142 physicians (76 community physicians, 22 academic physicians, 44 residents): 14 physicians for time−motion validation portion of study; family medicine | This study assessed time allocated by primary care physicians within the EHR as indicated by EHR user-event log data (e.g., time in chart review and clinical documentation, order entry, inbox management, billing), both during clinic hours and outside clinic hours (Monday-Thursday between 7:00 P.M. and 7:00 A.M. and weekends defined as 7:00 P.M. Friday to 8:00 A.M. Monday). A time−motion study through direct observation was completed to validate EHR measurements. |
| **Arora et al., 2018**[10] | *Type of Institution:* NA<br>*Type of Practice:* Inpatient and outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban, suburban, and rural*;* USA | 601 residents and fellows; pediatrics | This study sought to assess time spent charting in pediatric practice and clinician understanding and comfort level regarding billing/coding. |
| **Attipoe et al., 2022**[11] | *Type of Institution:* Children's hospital<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 56 physicians; pediatrics | This study characterized EHR work during and outside scheduled clinic hours. It included total time spent in EHR broken down by task (i.e. clinical review, documentation, inbox, and order entry) and time spent on them outside clinical hours. |
| **Aziz et al., 2017**[12] | *Type of Institution:* Tertiary care academic teaching center<br>*Type of Practice:* Hospital; inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 5 residents; vascular surgery | This study determined the feasibility of using innovative EHR technology to examine vascular surgery resident workflow (particularly relating to tasks performed outside of work hours) measured by active total time spent in EHR, broken down further into chart review time, documentation time, electronic order entry, patient discovery, and electronic messages. |
| **Bartek et al., 2023**[13] | *Type of Institution:* Academic medical center<br>*Type of Practice:* Inpatient and outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban*;* USA | 75 resident physicians; internal medicine, pediatrics, and anesthesia | This study determined switch costs, or the cognitive burden associated with task switching and assessed its magnitude during routine EHR-based clinical tasks. The study assessed time spent before and after task switching in seconds (e.g. chart review, note entry, order entry, and inbox). It found that higher patient load was associated with less time per task. Task switching costs were found on postswitch tasks related to chart review, note entry, and order entry. Inbox viewing resulted in a postswitch speed up. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Baugh et al., 2020**[14] | *Type of Institution:* Quaternary care academic medical center *Type of Practice:* Inpatient *Number of Participating Centers/Practices:* NA *Location:* Urban; USA | 10 attending physicians; emergency medicine | This study assessed how time spent on documentation activities affected time spent on teaching by attending physicians or time spent on direct patient care or other attending activities. |
| **Beiser et al., 2021**[15] | *Type of Institution:* NA *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* NA *Location:* NA; USA | 609 clinicians including nonphysician clinicians such as nurse practitioners and physician assistants; 72 specialties and subspecialties | This study measured documentation burden through the following metrics: visits closed same day, time spent outside 7:00 A.M. to 7:00 P.M., time spent on unscheduled days, and pajama time. |
| **Benson et al., 2023**[16] | *Type of Institution:* Multispecialty group *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* NA; USA | 35 clinicians (mix of MDs/DOs and NP/PAs); gastroenterology and hepatology | The main aim of the study was to assess after-hour EHR work. Additional data were obtained via a validated survey designed to assess impact of health information technology on clinician job satisfaction. |
| **Berg et al., 2020**[17] | *Type of Institution:* NA *Type of Practice:* Resident council at a medical school *Number of Participating Centers/Practices:* NA *Location:* NA; USA | 15 resident physicians; NA | This study determined physician perspectives and usability issues of local EHR systems. |
| **Bliven et al., 2016**[18] | *Type of Institution:* Academic hospital *Type of Practice:* NA Inpatient *Number of Participating Centers/Practices:* NA *Location:* NA; USA | Clinicians NA; NA | This study used information technology to enable data from the device to flow into the EHR without the need for a clinician to manually record data from the device. |
| **Byrne et al., 2016**[19] | *Type of Institution:* NA *Type of Practice:* American Society of Peri Anesthesia Nurses survey *Number of Participating Centers/Practices:* NA *Location:* NA; USA | 1,352 nurses; NA | The purpose of the survey administered as a part of this study was to evaluate progress toward meeting the goals of broader EHR adoption for perianesthesia nurses and the impact it is having on clinical practice documentation. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Carlson et al., 2015**[20] | *Type of Institution:* Academic<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban*;* USA | 74 residents and 14 attending physicians; pediatrics | This study aimed to improve resident documentation timeliness. It measured the proportion of clinical documentation completed within 3 days (resident physicians) and proportion of attending physicians that completed their attestations within 14 days (as measured by time stamp data in EMR). A survey was administered to resident physicians measuring usual time to documentation completion, minutes for individual note completion after leaving patient's room, if documentation was completed in a timely manner, if documentation incorporated adequate physical exam, and if documentation contained an accurate list of diagnoses. A survey was administered to attending physicians measuring usual time to documentation completion, if documentation was completed in a timely manner, if documentation contained an accurate physical exam, if documentation had accurate list of diagnosis, and minutes per week spent attesting notes. |
| **Chaparro et al., 2020**[21] | *Type of Institution:* Academic children's hospital<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | Attending physicians, fellows, residents, nurse practitioners, and physician assistants NA; NA | The study used the Institute for Healthcare Improvement model for improvement methodology to reduce interruptive alert burden for clinicians. |
| **Chen et al., 2020**[22] | *Type of Institution:* Academic oculoplastic practice<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 3 attending physicians; ophthalmology | In this study, the authors evaluated how EHR adoption affected an oculoplastics practice via detailed analyses of the following outcomes: clinical volume, reimbursement, and patient experience and satisfaction. |
| **Chen et al., 2023**[23] | *Type of Institution:* Cancer centers<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* 7<br>*Location:* Urban and rural*;* USA | Physicians; NA; NA | This study assessed the burden of EHR alerts. The alert was defined as interruptive if triggered when the patient chart was opened. If this alert was postponed, the alert presented again after 10 minutes or when the patient chart was reopened. The burden of interruptive alerts was measured by two metrics: *alert firing rate* (the number of times the alert fired during a specific period divided by the number of times the alert was completed during that period) and *alert handling time*. Assessed average time healthcare professionals spent completing an alert per encounter and average time spent postponing alerts per encounter. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Collins et al., 2018**[24] | *Type of Institution:* Academic medical center *Type of Practice:* Inpatient *Number of Participating Centers/Practices:* 4 acute care general medicine units and 2 medical intensive care units *Location:* NA*;* USA | Nurses (RNs and LPNs – n not reported); acute and critical care settings | This study quantified documentation burden by analyzing number of flowsheets, which are primarily used by nurses to document assessments and interventions. Percentage of time spent outside of regularly scheduled work hours was reported in this study (measured by week). |
| **Congelosi et al., 2023**[25] | *Type of Institution:* Academic medical center *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 66 clinical staff (physician 38, physician assistants 5, nurse practitioners 12, and clinic nurses 11); surgery | This study examined changes in surgical healthcare professionals' perceptions of patient portal usage before and after its implementation. |
| **Cross et al., 2023**[26] | *Type of Institution:* Organizations that use an Epic ambulatory EHR *Type of Practice:* NA *Number of Participating Centers/Practices:* 299 *Location:* NA*;* USA | 75,124 physicians; primary care (family medicine, general internal medicine, pediatrics, and obstetrics and gynecology) | This study measured the total time in EHR per visit (i.e. clinic documentation, inbox, orders, chart review, and documentation length) and compared it to same variables at the organizational level. It also measured use of SmartTools (% of note text) and use of copy/paste (% of note text). |
| **Cox et al., 2018**[27] | *Type of Institution:* Large academic medical center *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 36 residents; general surgery | The study measured total EHR usage that occurred within scheduled work hours vs. outside work hours. |
| **De Groot et al., 2022**[28] | *Type of Institution:* NA *Type of Practice:* Nursing Staff Panel *Number of Participating Centers/Practices:* NA *Location:* NA*;* The Netherlands | 223 community nurses; NA | The goal of this study was to gain insight into community nurses' views on a potential relationship between their clinical and organizational documentation activities and their perceived nursing workload. The study measured perceived high workload of clinical documentation, estimated time per week spent on clinical documentation (survey- self reported), with interviews addressing how community nurses perceived clinical and organizational documentation in relation to their workload and how they perceived user-friendliness of electronic health records. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **De Hoop et al., 2021**[29] | *Type of Institution:* Large university medical center<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* Germany | 19 physicians; NA | The aim of this study was to obtain a general profile of physician time expenditure and EHR limitations in a large university medical center in Germany. They also aimed to illustrate the merit of a tool allowing for easier capture and prioritization of specific clinical needs at the point of care. Data were measured through direct clinical observations, and semistructured interviews conducted to determine perceived limitations, frustrations, and desired improvements regarding the EHR. |
| **Dela Cruz et al., 2015**[30] | *Type of Institution:* Academic hospital EDs<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* 2<br>*Location:* NA*;* USA | 12 attending physicians; emergency medicine | This study was designed to compare physician time use and interruptions between an EHR system using typed data entry versus an EHR with voice recognition. |
| **DiAngi et al., 2019**[31] | *Type of Institution:* Academic and community<br>*Type of Practice:* Inpatient and outpatient<br>*Number of Participating Centers/Practices:* 127 academic and 20 community<br>*Location:* NA*;* USA | 147 clinicians; primary care, pediatric subspecialty, obstetric, behavioral health, and surgical subspecialty | The goal of this study was to measure time spent in the EHR after work hours (1 hour after last scheduled appointment to 30 minutes prior to first appointment the following day Monday-Friday) and user knowledge of EHR functionality/tools, frequency of use of tools, and self-perceived competence in EHR (5-point Likert scale). It also measured time to respond to inbox messages and frequency of closing encounters on the same workday (5-point Likert scale), level of ease in using various EHR functions (e.g., documenting a visit, placing orders, sending in basket messages, responding to in basket messages [further stratified by message type], closing an encounter, and cosigning notes) on 5-point Likert scale (very easy to very difficult). |
| **Dibbs et al., 2022**[32] | *Type of Institution:* Tertiary pediatric hospital<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 83 Surgeons and 28 APPs; surgery | The goal of this study was to investigate the number of login encounters and time expended on EMRs by surgeons and advanced practice providers (APPs) across several surgical specialties. The study differentiated between surgical clinicians (surgeons) and surgical APPs in terms of their EMR usage. |
| **Earls et al., 2017**[33] | *Type of Institution:* Healthcare site affiliated with an academic medical center<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Rural*;* USA | 7 physicians; family medicine | This study measured time spent in clinical documentation per week (at work vs. at home) collected using a smartphone time-tracking application for two 3-week periods. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
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| **Ebbers et al., 2022**[34] | *Type of Institution:* Academic cancer care center<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Outpatient; The Netherlands | 12 clinicians (4 head and neck surgeons, 4 residents, 2 fellows, and 2 physician assistants); oncology | This study investigated the current state of documentation burden within the EHR during consultations in a tertiary oncology center and assessed perceptions of head and neck cancer care clinicians on various aspects regarding EHR documentation and EHR satisfaction (using a validated survey questionnaire). EHR metrics were collected with time spent in all EHR tasks, broken down further into chart review, orders, documentation, and other administrative tasks. |
| **Edwards et al., 2023**[35] | *Type of Institution:* Academic medical center<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; USA | 4 physicians (2 Pediatric endocrinologists and 2 developmental-behavioral pediatrics/pediatrician; pediatrics | This study presented the results of a pilot quality improvement project on use of medical scribes in two outpatient pediatric subspecialties, including both clinician and patient factors. |
| **Ehrler et al., 2021**[36] | *Type of Institution:* Academic orthopedic unit<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; Switzerland | 40 nurses; NA | This study quantified the impact of an app that links to the EHR on time spent on clinical documentation as well as on direct interaction with the patients. Outcomes evaluated included overall EHR documentation, EHR documentation without vital signs, time spent documenting vital signs, time spent on uninterrupted EHR documentation, time spent on uninterrupted EHR documentation without vital signs, and uninterrupted time spent on vital signs |
| **Ehrlich et al., 2016**[37] | *Type of Institution:* NA<br>*Type of Practice:* Inpatient and outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; USA | 58 attending physicians; ophthalmology | The goal of this study was to understand the attitudes and perceptions of ophthalmologists toward an EHR system, before and after its clinical implementation. |
| **Feely et al., 2023**[38] | *Type of Institution:* Academic medical center<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; Australia | 224 allied health clinicians: physiotherapy (83), occupational therapy (31), speech pathology (21), social work (27), dietetics (21), clinical psychology (12), spiritual care (8), allied health assistant (5), music therapist (3), exercise physiologist (2), other (10); NA | The goal of this study was to assess system usability, level of proficiency, satisfaction, and evaluate the impact of an EMR implementation on workflows. System usability was measured along with time spent in accessing patient information (chart review) and documentation. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
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| **Ferguson et al., 2023**[39] | *Type of Institution:* Interprofessional clinic *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* Semirural*;* Canada | 12 family physicians, NPs, and PAs; primary care | The goal of this study was to investigate how an electronic patient portal affected the use of traditional, synchronous primary care services over a much longer time period than any existing studies and to assess the impact of portal messaging on clinicians' workload. |
| **Flanagan et al., 2019**[40] | *Type of Institution:* Veteran affairs primary care clinic *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* NA *Location:* NA *Country:* USA | 5 physicians (four primary care physicians and one specialist); primary care | The study evaluated burden related to EHR-related tasks in exam room and reported additional after-clinic hours to complete documentation (range=30 minutes to 3 hours per day). |
| **Florig et al., 2021**[41] | *Type of Institution:* Academic medical center *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 129 physicians; medicine, surgery, pediatrics, and obstetrics and gynecology | The goal of this study was to use EHR data to determine the impact of scribes on chart closure time across the institution and determine factors associated with differences in completion time. |
| **Fouquet et al., 2021**[42] | *Type of Institution:* Level I Trauma Center and emergency department *Type of Practice:* Outpatient and inpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 11 physicians; emergency medicine | The study examined the tasks associated with attending physician documentation workflow, including measuring interruptions, time and motion, documentation locations, and qualitative field notes. This was followed by analysis of documentation data from the electronic medical record system. |
| **Frintner et al., 2021**[43] | *Type of Institution:* NA *Type of Practice:* Ambulatory and inpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 1,069 physicians; pediatrics | The goals of the study were to examine (1) the early and midcareer pediatricians' perspectives on administrative tasks, including EHR documentation burden; (2) existing approaches to reduce burden; (3) variation of perspectives by specialization (e.g., generalist, subspecialist, or hospitalist); and (4) the effect of EHR burden on work–life balance and satisfaction with work. The survey was an annual survey administered by the American Academy of Pediatrics and was called the Pediatrician Life and Career Experience Study (PLACES). |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
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| **Gaffney et al., 2022**[44] | *Type of Institution:* National sample of physicians<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 1524 physicians; multiple specialties | This study assessed the burden of medical documentation on U.S. office-based physicians. |
| **Gali et al., 2019**[45] | *Type of Institution:* Academic ophthalmology department<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 11 physicians (7 residents; 4 fellows); ophthalmology | This study evaluated ophthalmology trainee time spent on clinical activities in an outpatient clinic undergoing EHR implementation. |
| **Gardner et al., 2019**[46] | *Type of Institution:* Rhode Island database of physicians<br>*Type of Practice:* Inpatient and outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban and rural*;* USA | 1792 physicians; NA | The goal of this study was to understand how stress related to health information technology use predicts burnout among physicians. Health-information-technology-related stress measures include: 1) whether the EHR adds to the frustration of one's day, 2) sufficiency of time for documentation, and 3) the amount of time spent on the EHR at home. Questions were developed and approved by an ongoing multi-stakeholder consensus process, described previously. |
| **Gesner et al., 2022**[47] | *Type of Institution:* Academic hospital<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban*;* USA | 69 nurses; various specialties | The aim of this study was to explore documentation burden among nurses and whether it is a contributing factor to clinician burnout syndrome. To measure documentation burden, two surveys were administered: the SUS survey (validated) to evaluate EHR usability and the BurDoNsaM survey (validated), which consists of six subscales: view of clinical documentation, burden of documentation, hospital leadership and documentation, and time taken to complete documentation. |
| **Gidwani et al., 2017**[48] | *Type of Institution:* Family medicine clinic associated with a large academic medical center<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 4 physicians; family medicine | This study assessed time to chart close (calculated as the time from appointment start to the physician signing the chart note, marked by timestamps in the EHR). |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
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| **Gilman et al., 2023**[49] | *Type of Institution:* Academic medical center – ambulatory practice<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 57 physicians; internal medicine | The goal of this study was to decrease the EHR clerical burden and improve patient/clinician satisfaction via visit facilitators (trained allied health staff) to assist the physician in clinical and administrative tasks. Areas assessed included time spent locating and reviewing outside material, time spent teeing up/modifying orders, time spent completing documentation, time spent resolving in baskets, time spent completing the after-visit summary and dismissal letter, time spent completing forms, time spent completing visit-related work tasks outside work, and time spent face to face with the patient. |
| **Goldberg et al., 2023**[50] | *Type of Institution:* Multiple settings<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban, suburban, and rural*;* USA | 27 physicians and nurse practitioners; primary care | This study describes clinicians' experiences with burnout and mental health challenges during the COVID-19 pandemic, noting that high levels of documentation were among the contributors to burnout. |
| **Goldstein et al., 2019**[51] | *Type of Institution:* Academic medical center<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 70 physicians; ophthalmology | This study assessed time spent in the EHR per office visit, progress note length, and time to chart closure. |
| **Golob et al., 2015**[52] | *Type of Institution:* Level 1 trauma center<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | Trauma surgeons NA; surgery | This study assessed the impact of scribe utilization on improving documentation efficiency while also yielding a financial benefit to the institution. |
| **Harris et al., 2018**[53] | *Type of Institution:* Rhode Island Department of Health<br>*Type of Practice:* Inpatient and outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 371 APRN's; NA | This study characterized health information technology use and measured associations between EHR-related stress and burnout among APRNs. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Heaton et al., 2018**[54] | *Type of Institution:* Academic<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | Physicians NA; emergency medicine | The goal of study was to compare how ED practitioners spent their time on a shift, with and without a scribe on their team. |
| **Ho et al., 2023**[55] | *Type of Institution:* Academic medical center<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:*<br>*Location:* Urban*;* USA | 53 trainees (43 residents and 10 fellows); vascular medicine | This study characterized trainee EMR activity in the vascular surgery service to identify modifiable factors associated with high EMR use. |
| **Hilliard et al., 2020**[56] | *Type of Institution:* Two academic ambulatory sites<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 422 clinicians (358 physicians, 47 APRNs, 17 PAs); NA | The study sought to examine the association between clinician burnout and measures of electronic health record (EHR) workload and efficiency, using vendor derived EHR action log data. Questions were developed and approved by an ongoing multi-stakeholder consensus process, described previously. |
| **Holmgren et al., 2021**[57] | *Type of Institution:* Ambulatory care settings at an academic medical center<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 622 resident physicians; NA | This study measured how much time resident physicians spend in the EHR during clinic hours and after- hours, and how EHR usage changes as they gain experience over a 12-month period. Variables included mean EHR time per patient, mean EHR time for documentation, mean EHR time for chart review, mean EHR time for orders, and mean percentage of EHR time spent after hours. |
| **Holmgren et al., 2022**[58] | *Type of Institution:* All physicians and advance practice providers using Epic as their ambulatory EHR<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:*<br>*Location:* Urban, suburban, and rural*;* USA | 341,234 clinicians; NA | This study evaluated the immediate impact of patient access to clinician notes on clinician note length and time spent documenting in the EHR. Dependent variables were mean progress note length (i.e. number of characters per note), mean time documenting in the notes section of the EHR per visit and per progress notes written. There was no evidence of a change in note length or time spent writing notes following the implementation of the policy, suggesting patient access to clinical notes did not increase documentation workload for clinicians. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Holmgren et al., 2022[59]** | *Type of Institution:* Ambulatory care health systems<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* 351<br>*Location:* NA*;* USA | Physicians NA; NA | This study evaluated the association between state-level malpractice climate and clinician time spent in the EHR. |
| **Horn et al., 2021[60]** | *Type of Institution:* Acute care pediatric organization<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 97 nurses; medical and surgical | This study determined if there are differences in nursing documentation and satisfaction using a pediatric admission history database before and after an intervention. The project aimed to compare nursing EHR documentation time, dataset completion rate, and satisfaction preimplementation and postimplementation of an essential clinical dataset intervention. The study intervention was a validated tool (although the data collection instrument that measured documentation burden was researcher designed– but not otherwise validated) utilizing active time to document, and the number of clicks, mouse or keyboard, to complete nursing documentation of the pediatric admission history form. |
| **Hripcsak et al., 2011[61]** | *Type of Institution:* Academic medical center<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 4,121 participants (1,725 nurses, 777 resident physicians, 704 attending physicians, 161 APPs (NP/PAs), 199 social workers, 166 OT/PT, 62 respiratory therapists, 25 dieticians, 28 dietician interns, 45 chemotherapy administrators, 3 child life specialists, 2 speech pathologists, 1 psychologist, 67 other); pathology and clinical laboratory services | Constructs measured in this study were the number of notes authored per week per user/healthcare professional (as measured by usage log in EMR) AND total number of notes per type of healthcare professional, and mean time spent in clinical documentation (writing notes) per day (in minutes) per type of healthcare professional. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Hsieh et al., 2017**[62] | *Type of Institution:* Tertiary medical center *Type of Practice:* Inpatient *Number of Participating Centers/Practices:* NA *Location:* NA; Taiwan | 22 staff nurses; NA | This study assessed time spent in clinical documentation and nurse satisfaction in EHR usability, content, functionality, and effectiveness. |
| **Jhaveri et al., 2021**[63] | *Type of Institution:* Academic primary care pediatrics practice *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* NA *Location:* NA; USA | 6 clinicians (5 physicians, 1 NP); pediatrics | This study examined the impact of medical scribes on actual and perceived documentation time in an academic pediatric outpatient practice. Documentation burden was analyzed by the following metrics: Documentation time per patient, EHR time per patient, time spent in the EHR after hours, timeliness in signing note. Clinicians also provided estimations of remaining documentation time per visit, at home EHR time per clinic visit, and at home EHR time per week. |
| **Joukes et al., 2018**[64] | *Type of Institution:* University hospitals *Type of Practice:* NA *Number of Participating Centers/Practices:* 2 *Location:* NA; The Netherlands | 24 attending physicians; all specialties | This study assessed time spent in documentation. |
| **Kadish et al., 2018**[65] | *Type of Institution:* Academic medical center *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* NA *Location:* NA; USA | 185 clinicians (133 MDs, 42 NPs, and 10 PAs); medical oncology | This study assessed time spent in EHR broken down by documentation, clinical review, orders, and inbox management (reported by time of day that activity occurred, and percentage of total time spent in each particular activity), and percent of office visits closed the same day (documentation completed and charge entered). Also, it measured self-reported confidence in the EMR overall and in five key activities: placement of orders (excluding chemotherapy), documentation, chemotherapy ordering, clinical review, and inbox message management. |
| **Kannampallil et al., 2018**[66] | *Type of Institution:* Emergency department at academic hospital *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* Urban; USA | 8 attending physicians; emergency medicine | This study assessed time spent in documentation, review, orders, and onscreen navigation and whether this correlated with performance (time for door-to-institution, door-to-doctor, door-to-disposition, and length of stay) and workflow effectiveness. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Karp et al., 2019**[67] | *Type of Institution:* Academic medical center *Type of Practice:* Inpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | Nurses NA; study reported number of admission patient histories completed pre (n=536) and post (n=640) intervention; medical-surgical, ICU, emergency department, step-down, and telemetry units | The goal of this study was to determine whether a standardized nursing admission patient history form improved nursing efficiency and quality of documentation (as measured by the number of data elements documented in the admission patient history, the number of mouse clicks required to complete the admission patient history for each encounter, and time spent documenting patient admission history per episode of care ([measured by EHR system timer data and validated by an electronic video recording of a sample of nurses completing the forms and comparing the system timers to the video recording timers]). |
| **Kesler et al., 2022**[68] | *Type of Institution:* Academic medical center *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 1060 physicians (28 orthopedic surgeons, 134 other surgeon, 898 nonsurgical medicine physicians); all specialties | The goals of this study were to (1) characterize the utilization of the EHR by orthopaedic surgeons at an academic medical center; (2) identify specific activities done in the EHR with notable time usage; and (3) compare EHR usage between orthopaedic surgeons, other surgical subspecialties, and medicine physicians. The study looked at the number of messages received per day, time spent answering inbox messages, time per completed message, and time reviewing medical record/imaging. |
| **Khan et al., 2022**[69] | *Type of Institution:* Academic tertiary care center *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 317 nurses working in ICU setting; medical, neurosurgical, surgical trauma ICU | This study quantified the amount of time spent by intensive care nurses in the electronic health record, with results categorized based on whether the nurse was full-time, part-time, or PRN. The assessment included total time in the EHR, time spent on documentation, chart review, order entry, and medication administration. Additionally, the total number of chart clicks was also evaluated. |
| **Krawiec et al., 2020**[70] | *Type of Institution:* PICU at university-affiliated tertiary care facility *Type of Practice:* Inpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 7 attending physicians; pediatrics | This study assessed total active time (any EHR activity), chart review time (time spent reviewing clinical documents, patient flowsheet, medication administration record), documentation time (time spent performing clinical documentation), time spent in messages, and order entry time during all hours and after hours (i.e., between 7:00 P.M. and 8:00 A.M..). |
| **Kroth et al., 2018**[71] | *Type of Institution:* Academic and community practices *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 41 clinicians. (40 physicians, 1 APRN); family and internal medicine | This goal of this study was to determine the specific aspects of health information and communications technologies, including EHRs, most associated with physician burnout, and identify effective coping strategies. Mini Z was administered (validated) and focus groups conducted. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
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| **Kroth et al., 2019**[72] | *Type of Institution:* Academic medical centers *Type of Practice:* NA *Number of Participating Centers/Practices:* 3 *Location:* NA*;* USA | 282 clinicians (mix of physicians and advanced practice clinicians, including nurse practitioners and physician assistants); general internal medicine, medical subspecialties, general pediatrics, pediatric subspecialties, and family medicine | This study investigated the association between EHR design and use factors and clinician stress and burnout, also identifying other contributing sources to this problem. The methodology encompassed using questions from previously validated instruments to measure stress and burnout |
| **Kumah-Crystal et al., 2021**[73] | *Type of Institution:* Academic medical center *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 16 clinicians (mix of physicians and nurse practitioners); pediatric endocrinology | This study assessed usefulness of a previsit questionnaire in clinician documentation content and length. The number of words typed was used as a surrogate outcome measure for documentation burden. |
| **Lam et al., 2021**[74] | *Type of Institution:* Outpatient academic clinic *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 6 physicians; dermatology | The aim of this study was to assess the impact of a scribe on physician and patient satisfaction at an academic dermatology clinic. Documentation burden was measured by time spent charting, time spent charting after hours, active documentation time per patient, and %percentage of charts closed within 72 hours. |
| **Li et al., 2023**[75] | *Type of Institution:* Hospital setting *Type of Practice:* Inpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* China | 952 physicians; NA | This study explored a user-friendly approach to make text entry easier and faster for Chinese physicians. |
| **Lilly et al., 2019**[76] | *Type of Institution:* Academic medical center *Type of Practice:* Inpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | Physicians; NA; ICU | This study evaluated the relationship between EHR-related workload and ICU team member burnout. Measures included documentation length and documentation-related task time. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
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| **Lindsay et al., 2022**[77] | *Type of Institution:* A health system (academic and nonacademic)<br>*Type of Practice:* Outpatient and inpatient<br>*Number of Participating Centers/Practices:* Three hospitals and over 150 ambulatory platforms<br>*Location:* NA*;* USA | 161 nurses; NA | The purpose of this study was to implement and evaluate the effectiveness of modifications made to nursing reassessment documentation across a large health system to decrease time spent in documentation using timestamped audit logs and video motion-time recording. Workflow redesign and documentation practice changes led to a notable improvement in time in the EHR, time in flowsheets, time spent in documentation, and number of steps to complete reassessment documentation. |
| **Linzer et al., 2016**[78] | *Type of Institution:* Academic medical centers<br>*Type of Practice:* Multiple settings<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 579 clinicians (554 MDs/DOs, 12 NPs, 9 PAs, 4 other); family and internal medicine | This study aimed to assess academic general internal medicine work life balance and determine remediable predictors of stress and burnout (using validated survey to measure stress). |
| **Lo et al., 2022**[79] | *Type of Institution:* Academic mental health hospital<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* Canada | 314 physicians; NA | This study evaluated the impact of pandemic-related changes in the EHR on clinician burden. Metrics evaluated were total time spent in EHR per patient, documentation time/patient, order time/patient, and proportion of time spent after hours in EHR. |
| **Loszko et al., 2023**[80] | *Type of Institution:* Academic medical center<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban*;* USA | 51 attending physicians; surgery | The study objectively quantified EHR usage for acute care surgery and compared it to other general surgery specialties. |
| **Lou et al., 2022**[81] | *Type of Institution:* Academic medical center<br>*Type of Practice:* Outpatient and inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 75 resident physicians (35 internal medicine, 23 pediatrics, 17 anesthesia); internal medicine, pediatrics, anesthesiology | This study characterized the evolution of burnout at a monthly timescale, measured the association between time-varying clinical workload and burnout, and determined whether burnout is associated with an increased risk for wrong-patient errors. EHR variables that were measured included total time spent using the he EHR; time spent using the EHR after-hours (between 6:00 P.M. and 6:00 A.M.); patient load (number of patients seen per day); time spent on the clinical inbox; number of ordering sessions per patient per day; time spent writing notes per patient per day; and time spent on chart review per patient per day. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Ludley et al., 2023**[82] | *Type of Institution:* Trauma center<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; UK | Physicians NA; Orthopedic surgery | This study assessed the documentation burden for trauma patients by contrasting entries against predetermined key information elements, dubbed 'data entry points' and by evaluating completeness of entries. |
| **Mamykina et al., 2012**[83] | *Type of Institution:* Large teaching hospital<br>*Type of Practice:* General medicine ward; inpatient<br>*Number of Participating Centers/Practices:* 1<br>*Location:* NA; USA | 11 resident physicians; general medicine | The study revealed that electronic documentation practices among resident physicians are highly fragmented, leading to inefficiencies. It highlighted a significant mismatch between clinical workflows and electronic documentation systems, emphasizing the need for better system design to support clinical activities more effectively. |
| **Mamykina et al., 2016**[84] | *Type of Institution:* Large teaching hospital<br>*Type of Practice:* General medicine ward; inpatient<br>*Number of Participating Centers/Practices:* 1<br>*Location:* NA; USA | 7 resident physicians; general medicine | This study analyzed how medical residents allocated their shift time, focusing on computer usage for clinical documentation, chart review, and order entry. The duration of shifts varied, often extending up to 14 hours. |
| **Mani et al., 2023**[85] | *Type of Institution:* Academic medical center<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; USA | 636 physicians (141 residents/ fellows; 495 attending physicians); all | This study aimed to (1) determine the impact of COVID-19 (coronavirus disease 2019) and the corresponding increase in use of telemedicine on volume, efficiency, and burden of electronic health record (EHR) usage by residents and fellows; and (2) to compare these metrics with those of attending physicians. Metrics to measure documentation burden were Time in In Basket per day, Time outside of 7:00 A.M. to 7:00 P.M., and Time in notes. |
| **Marckini et al., 2019**[86] | *Type of Institution:* Adult congenital heart disease specialists<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; USA and Canada | 110 clinicians (88 based at an academic medical center); NA | The goal of this study was to assess stress associated with EHRs and its relationship with burnout. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
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| **Marmor et al., 2018**[87] | *Type of Institution:* Academic teaching institution<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 39 attending physicians; internal medicine, cardiology, gastroenterology | This study evaluated time spent in EHR during and after work hours. |
| **Melnick et al., 2020**[88] | *Type of Institution:* U.S. physicians from all specialties<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 870 physicians; all specialties | This study applied the SUS to the EHR and assessed associations with burnout. |
| **Micek et al., 2022**[89] | *Type of Institution:* Ambulatory academic center<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 200 physicians; family medicine, pediatrics, and internal medicine | The study aimed to evaluate the impact of a remote scribe program in a primary care academic clinic on physician wellness, EHR satisfaction, and specific EHR use metrics. It focused on measuring the mean hours spent per 8-hour shift on EHR, documentation, inbox, and work outside of work, along with the percentage of patient visits documented on the same day. |
| **McIlreevy et al., 2021**[90] | *Type of Institution:* A 22-sState network with hospitals, urgent care, primary care clinics, home health, and imaging centers<br>*Type of Practice:* Outpatient and inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | Nurses NA; NA | The aim of this study was to evaluate the removal of duplicative or unnecessary fields and reordering fields on the admission form to increase documentation that is meaningful to the patient story. |
| **Meltzer et al., 2022**[91] | *Type of Institution:* academic primary care<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 43 practitioners (27 MDs, 10 NPs, 5 PAs, 1 missing); family and internal medicine | The goal of this study was to improve patient and practitioner experiences with the EHR, they sought to conduct an assessment of practitioner use of EHR communication skills, as well as patient and practitioner experiences and attitudes regarding EHR use during clinical encounters. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Mishra et al., 2018**[92] | *Type of Institution:* nonacademic medical center facilities<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* 2<br>*Location:* NA; USA | 18 physicians; primary care | The outcomes of this study were PCP-reported perceptions of documentation burden and visit interactions, objective measures of mean number of minutes each physician spent on EHR documentation during and after clinic hours (time stamped), time required for closing encounters, and patient-reported perceptions of visit quality. |
| **Mosquera et al., 2021**[93] | *Type of Institution:* Academic medical center<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban; USA | 51 physicians (24 attendings, 27 resident physicians); psychiatry | The study examined how objective EHR use correlates with physician well-being with a goal to develop preliminary recommendations for well-being-based EHR interventions. Constructs measured were time spent in the EHR (i.e. total, and broken down into clinical review and documentation), percent visits closed, and documentation length. Well-being was measured by the Mean Maslach Burnout Inventory, Utrecht Work Engagement Scale, and Professional Quality-of-Life Scale scores for subdomains. |
| **Moy et al., 2020**[94] | *Type of Institution:* Academic multiple settings (acute care unit, intensive care unit, ambulatory clinic, emergency department)<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; USA | 34 clinicians – physicians, resident physicians, and NP/PAs, and 13 nurses; acute care, intensive care, ambulatory, emergency medicine | The study examined the results of a time− motion study performed among clinicians in different roles (clinicians vs. RNs) and practice settings. Measures of burden included clinical information tasks (documentation, orders, chart review, medication administration/reconciliation, log on/off, smart phone messaging app) and workflow fragmentation (measured by task switching). Number of tasks switched and task duration varied across clinical setting and clinical role (higher switch rates in ED). The conclusion was that interruption rate evaluated through task switches may serve as a proxy for measuring clinical documentation burden. |
| **Moy et al., 2021**[95] | *Type of Institution:* Medical center emergency department<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban; USA | 15 clinicians (10 resident physicians and 5 physician assistants); emergency medicine | This study defined EHR documentation burden as data-entering or data-viewing tasks involving the EHR. Data-entering tasks comprised entering orders, entering data, and documenting handoff/sign-out. Data-viewing tasks comprised viewing patient list/schedule and viewing data. Overall, data-entering tasks had longer average durations than data-viewing tasks at baseline. The study also assessed multitasking and workflow fragmentation. (1) workflow fragmentation as the frequency of task-switches that occur per minute (i.e., task-switch rate) for each observation, and (2) magnitude of workflow fragmentation as the average seconds(s) spent on a single task (i.e., average duration) prior to switching to another task in the workflow for each observation. |
| **Munyisia et al., 2012**[96] | *Type of Institution:* Hospital setting<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; Australia | Nurses NA; NA | This study examined the effect of the introduction of an electronic nursing documentation system on the efficiency of documentation in a residential aged care facility. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Nguyen et al., 2022**[97] | *Type of Institution:* Academic medical health center<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 441 physicians; general internal medicine, general pediatrics, and family medicine | The goal of this study was to assess time spent in the EHR: (1) total time spent interacting with the EHR, (2) time spent outside scheduled clinical hours, (3) time spent documenting, and (4) time spent on inbox management. |
| **Nguyen et al., 2022**[98] | *Type of Institution:* Academic health system<br>*Type of Practice:* Outpatient and inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 83 physicians; neurology | The goal of this study was to quantify how long neurologists spend in the EHR. |
| **Nguyen et al., 2023**[99] | *Type of Institution:* Ambulatory care organization<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | Physicians NA; NA | The purpose of this study was to optimize the acceptance rates of medication point-of-prescribing alerts within the EMR of an ambulatory care. |
| **Nguyen et al., 2023**[100] | *Type of Institution:* Academic medical center<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | Physicians NA; family medicine | This study evaluated how the Patients Over Paperwork (POP) initiative influenced documentation burden. |
| **Olson et al., 2019**[101] | *Type of Institution:* Academic, community and private practices<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 475 practicing physicians; all specialties | This study aimed to identify remediable stressors associated with burnout. Insufficient documentation time and excessive time spent on EMR at home was associated with burnout (measured by Mini Z which is a validated survey). |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Ong et al., 2021**[102] | *Type of Institution:* Ambulatory practice<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; USA | 31 physicians; NA | This study measured the change in and magnitude of EHR usage after individual physicians worked with a virtual scribe. Measures of documentation burden included total time spent in EHR and other EHR related metrics. |
| **Overhage et al., 2020**[103] | *Type of Institution:* Integrated delivery networks (34%), regional hospitals (30%), physician groups (22%), and academic medical centers (11%)<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; USA | 155,000 physicians; all specialties | This study described how much time ambulatory medical subspecialists and primary care physicians across several U.S. care delivery systems spend on various EHR functions (documentation, inbox, and orders-related tasks) during work and after hours (between 6:00 P.M. and 6:00 A.M. local time on weekdays and anytime on weekends). |
| **Parker et al., 2021**[104] | *Type of Institution:* hospital setting<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; USA | 54 physicians (19 resident and 35 attending physicians); dermatology | This study aimed to determine if there are gender differences in EHR documentation patterns that may contribute to the increased burnout among female dermatologists. |
| **Patel et al., 2023**[105] | *Type of Institution:* Academic medical center<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban; USA | 12 residents; neurosurgery | This study described the amount of EHR time spent by PGY-2 and PGY-3 neurosurgery residents during on-call days and the distribution of EHR activities in which they engage. |
| **Peccoralo et al., 2021**[106] | *Type of Institution:* Large academic medical center<br>*Type of Practice:* Outpatient and inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA; USA | 1346 clinical faculty across all specialties (MDs/DOs/PhDs); all specialties | The goal of this study was to identify specific thresholds of daily EHR time after work and daily clerical time burden associated with burnout in clinical faculty. To assess burden of the EHR, investigators used the Mini Z which is a validated tool. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Perotte et al., 2022**[107] | *Type of Institution:* Academic medical center emergency department *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* NA; USA | 239 healthcare workers (scribes, residents, advanced practice providers, and attendings) NA; emergency medicine | This study explored the relationship between dot phrase usage and a set of factors that can measure efficiency such as: note length, time to note completion, time to note cosignature, and CPT coding level. |
| **Phillips et al., 2021**[108] | *Type of Institution:* Med-surg units at an academic medical center *Type of Practice:* Inpatient *Number of Participating Centers/Practices:* NA *Location:* 3; USA | Nurses NA; medical surgical nurses | The purpose of this quality improvement project was to conduct a scholarly assessment of the information collected within the nursing admission encounter and implement content revisions across three pilot medical surgical units with a goal to decrease the number of clicks and time expended to document electronically an acute admission encounter by 20% and to project the number of hours returned to patient care as a result of decreasing computer clicks. |
| **Raney et al., 2020**[109] | *Type of Institution:* Academic medical center affiliate clinics *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* NA; USA | 47 physicians; pediatric oncology | Documentation burden was measured in this study as clinician compliance with oral chemotherapy documentation. |
| **Rassolian et al., 2017**[110] | *Type of Institution:* Survey from American Board of Family Medicine certification exam *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* NA; USA | 1752 physician; family medicine | The purpose of the study was to examine burnout in a national sample of board-certified family physicians. |
| **Rittenberg et al., 2022**[111] | *Type of Institution:* Academic hospital system *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* NA; USA | 150 physicians; primary care | The study examined gender differences in EHR usage among primary care physicians, delving into potential causes for these disparities. It measured EHR usage metrics such as time spent in the EHR, including time for notes, orders, inbox management, and clinical review, both during scheduled hours (between 7:00 A.M. and 7:00 P.M.) and outside these hours. The study also evaluated time spent on EHR tasks on unscheduled days and the average response time for inbox messages. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Rotenstein et al., 2022**[112] | *Type of Institution:* Ambulatory setting<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 1368 nonfederally employed physicians who provided office-based patient care in 2019 and completed the 2019 National Electronic Health Records Survey; primary care, surgical, medical | The study assessed EHR satisfaction, perceptions of clinical documentation time, and staff support for documentation in physician and nonphysician-owned practices using the National Electronic Health Records Survey. This survey, conducted annually by the National Center for Health Statistics, explores respondents' views on documentation functions and burden, and staff support for documentation. It includes questions about EHR satisfaction, ease of documenting clinical care, appropriateness of documentation time, impact on patient time, and the perception that documentation for billing purposes increases time spent on documentation tasks. |
| **Rotenstein et al., 2022**[113] | *Type of Institution:* Academic medical centers<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* 2<br>*Location:* NA*;* USA | 291 physicians; primary care | The aim of this study was to characterize measures of EHR use and ambulatory care quality performance among PCPs. |
| **Rotenstein et al., 2023**[114] | *Type of Institution:* National database of physicians who used Epic in ambulatory setting<br>*Type of Practice:* Outpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Urban, suburban, and rural*;* USA | 215,207 physicians; medical specialties, surgical specialties, primary care | The study explored the variation in EHR note composition strategies among physicians, focusing on the impact of these strategies on time spent in the EHR and on documentation, including after-hour work. It analyzed how physicians use different tools for drafting clinical notes and correlated these methods with time allocation across various EHR activities and specialties. This approach provided insights into the efficiency of note composition practices and their implications for physician workload. |
| **Ruan et al., 2022**[115] | *Type of Institution:* Hospital/health system<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 495 physicians (176 in primary care; 263 in subspecialty care; and 56 in surgical specialties); medical specialties, surgical specialties, primary care | This study used metrics from physician action logs to analyze volume, physician efficiency and burden as impacted by telemedicine implementation during the COVID-19 pandemic. Number of appointments per day, aggregate messages, same day visit closer rate, PEP score, proficiency score, time and notes, turnaround time, time in in basket, pajama time, time outside 7:00 A.M. to 7:00 P.M., and time on unscheduled days. |
| **Saag et al., 2019**[116] | *Type of Institution:* NA<br>*Type of Practice:* Private practice<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 573 physicians; all specialties | This study evaluated the average time spent in EHR on days without appointments, and average time spent in EHR after work hours on days with appointments. Time spent working on the EHR on days without appointments increased as the number of appointment days per week increased as did time spent on the EHR after hours on days with scheduled appointments. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Shanafelt et al., 2016**[117] | *Type of Institution:* U.S. physicians independent of American Medical Association membership and included physicians of all specialty disciplines<br>*Type of Practice:* Multiple settings<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 6560 physicians; all specialties | This study evaluated the associations between the electronic environment, clerical burden, and burnout in U.S. physicians. |
| **Sharp et al., 2021**[118] | *Type of Institution:* Pulmonary, PCCM, and critical care medicine training programs<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 502 fellows; pulmonary/critical care | This study evaluated the burden of burnout and depressive symptoms among fellows training in pulmonary and critical care medicine (PCCM) and what are associated individual fellow, program, and institutional characteristics. Documentation burden metrics included perception of EHR burden and self-reported time spent in EHR at home. |
| **Shuaib et al., 2017**[119] | *Type of Institution:* Nonacademic community ED<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* Suburban*;* USA | physicians NA; emergency medicine | This study conducted a prospective study in a community emergency department (ED) setting to illustrate the impact of medical scribes on patient throughput, physician productivity, and patient satisfaction. |
| **Sim et al., 2023**[120] | *Type of Institution:* Hospital<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA<br>*Country:* ; USA | Physicians (n not reported)NA; primary care | This study assessed electronic health record (EHR) usage, focusing on the average time spent on unscheduled days (46 minutes), pajama time (45 minutes), and time outside of 7:00 A.M. to 7:00 P.M. (24 minutes). It also evaluated the average turnaround time for EHR tasks at 6.1 days. These measurements were part of a broader analysis to understand EHR-related workload and efficiency among physicians. This study assessed the average time on unscheduled days at 46 minutes, average pajama time at 45 minutes, average time outside of 7:00 A.M. to 7:00 P.M. at 24 minutes, and the average turnaround time at 6.1 days. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Sinsky et al., 2016**[121] | *Type of Institution:* medical practices (academic and nonacademic) *Type of Practice:* NA *Number of Participating Centers/Practices:* 16 *Location:* NA; USA | 57 physicians (12 family medicine, 19 internal medicine, 11 cardiology, and 15 orthopedics); family medicine, internal medicine, cardiology and orthopedics | This study measured total time spent in the EHR (time motion) and work after hours (self-reported via physician diary). |
| **Sockolow et al., 2012**[122] | *Type of Institution:* Community settings *Type of Practice:* NA *Number of Participating Centers/Practices:* 2 *Location:* NA; USA | 97 nurses; Community health | This study examined EHR use among nurses documenting direct patient care and EHR impact on nurse satisfaction. Workflow was assessed using time-to-completion of clinical documentation data in the EHR. |
| **Sutton et al., 2020**[123] | *Type of Institution:* Healthcare organizations *Type of Practice:* Inpatient *Number of Participating Centers/Practices:* 12 *Location:* NA; USA | Nurses NA; NA | Documentation burden, defined as the need to complete unnecessary documentation elements in the EHR, is significant for nurses and contributes to decreased time with patients as well as burnout. The goal of this study was to reduce the burden of nursing documentation during the inpatient admission process. |
| **Tajirian et al., 2020**[124] | *Type of Institution:* Academic mental health hospital *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* NA; Canada | 208 physicians (176 attending physicians; 32 residents and fellows); hospital medicine and psychiatry | The aim of this study was to determine the extent of burnout among physicians and learners (residents and fellows); identify significant EHR-related contributors of physician burnout; and explore the differences between physicians and learners with regard to EHR-related factors such as time spent in EHR, documentation styles, proficiency, training, and perceived usefulness. In addition, the study aimed to address gaps in the EHR-related burnout research methodologies by determining physicians' patterns of EHR use through usage logs. EHR usage data were subjectively reported by survey and usage logs. |
| **Tai-Seale et al., 2017**[125] | *Type of Institution:* community-based healthcare systems *Type of Practice:* NA *Number of Participating Centers/Practices:* 48 *Location:* NA; USA | 471 physicians; internal medicine, family medicine, and pediatrics | This study measured time spent in EHR (broken down into messages and documentation) both in clinic and via remote access. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Tang et al., 2023**[126] | *Type of Institution:* Academic institution *Type of Practice:* NA *Number of Participating Centers/Practices:* NA *Location:* NA *Country: ;* USA | 133 physicians; Surgery | This study assesses the Median Pajama Time at 10.4 minutes (4.5-24.5), which is the average number of minutes spent in charting activities on weekdays outside the hours of 7:00 AM and 5:30 PM and any time on weekends and non-scheduled holidays, excluding time during scheduled hours. It also examines the Median Time on Unscheduled Days at 19.4 minutes (11.6-33.6), reflecting the average minutes spent in the system on days with no scheduled patients. Additionally, the study measures the Median Time outside 7:00 AM to 7:00 PM at 6.3 minutes (2.2-15.8) and the Median Time outside scheduled hours at 19.1 minutes (8.4-28.8). |
| **Taylor et al., 2019**[127] | *Type of Institution:* Ambulatory care military treatment facility *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* NA *Location:* NA*;* USA | 2 physicians; family and internal medicine | This study determined benefits of scribes on patient and clinician experience consistent with the Surgeon General's direction. Time spent documenting after hours was measured. |
| **Tell et al., 2023**[128] | *Type of Institution:* Hospitals *Type of Practice:* NA *Number of Participating Centers/Practices:* 403 *Location:* NA*;* Germany | 168 physicians; neurosurgery and vascular surgery | The study focused on identifying "technostress" among hospital staff due to digitization, examining its impact on work and health outcomes, and highlighting the need for preventive measures. It specifically explored clinical documentation as a source of technostress. The average level of technostress was quantified using a 5-point Likert scale. Additionally, qualitative interviews revealed five primary technostress sources: technical issues, inadequate IT support, poor adaptation to clinical practice, management resistance, and technology dependence. This comprehensive approach provided insights into the multifaceted nature of technostress in healthcare settings. |
| **Tran et al., 2019**[129] | *Type of Institution:* primary care clinics *Type of Practice:* Outpatient *Number of Participating Centers/Practices:* 10 *Location:* NA*;* USA | 86 attending physicians (MDs/DOs), 19 advanced practice providers (NPs/PAs), and 2 other healthcare professionals; primary care | The study investigated the use of EHRs by physicians, focusing on the link between burnout and time spent on various EHR tasks. It analyzed time spent in EHR for chart review, clinical documentation, inbox management, and placing orders per appointment. Additionally, the study evaluated after-hours EHR usage (7:00 P.M. to 7:00 A.M. on scheduled days, and total minutes on unscheduled days) during the reporting period. Metrics also included the percentage of clinical encounters closed on the visit day, response time to inbox messages, and the count of incomplete messages at the end of the reporting period. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Verma et al., 2020**[130] | *Type of Institution:* NA<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 248 clinicians (mix of attendings, fellows, and resident physicians – breakdown not reported); NA | The study aimed to objectively quantify the total time spent using the EHR system. It also investigated whether EHR usage time varies with different levels of clinical experience and examined the potential correlation between the hours worked, resident satisfaction, and patient satisfaction. This approach provided a comprehensive understanding of EHR usage patterns and their implications on healthcare providers and patient experiences. |
| **Vogel et al., 2015**[131] | *Type of Institution:* University hospital<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* Germany | 28 resident physicians; pediatrics and trauma surgery | This study describes the effects of using a web-based medical speech recognition system for clinical documentation in a university hospital on (1) documentation speed, (2) document length, and (3) physician satisfaction. |
| **Wang et al., 2019**[132] | *Type of Institution:* Academic tertiary care hospital<br>*Type of Practice:* Inpatient<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 101 internal medicine residents (MDs/DOs); NA | This study characterized EHR activity among internal medicine residents (time spent in EHR- broken down into chart review and clinical documentation). |
| **Windle et al., 2021**[133] | *Type of Institution:* academic and private practice ambulatory, emergency department, and inpatient sites<br>*Type of Practice:* outpatient and inpatient<br>*Number of Participating Centers/Practices:* 4 academic and 4 private practices<br>*Location:* NA*;* USA | 53 clinicians (28 practicing cardiologists, 12 fellows, and 13 APPs); emergency medicine | The study focused on understanding clinicians' perspectives on Electronic Health Record (EHR) challenges, aimed at designing a user-centered EHR framework. It involved measuring system usability and conducting qualitative interviews to assess the burden associated with reviewing patient records, documenting patient encounters, and completing administrative tasks. This approach helped in creating a validated, clinician-centered EHR prototype. |

| Author, Year | Setting | Population (n; Specialty) | Uses/Applications |
|---|---|---|---|
| **Yuan et al., 2020**[134] | *Type of Institution:* Public list of nephrology specialty programs from the Accreditation Council for Graduate Medical Education<br>*Type of Practice:* NA<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 51 program directors, 97 clinical faculty, and 72 fellows; nephrology | This study assessed educational burdens and benefits of electronic medical record use on United States nephrology fellows by means of a survey. |
| **Zallman et al., 2021**[135] | *Type of Institution:* Community academic health system<br>*Type of Practice:* Outpatient, inpatient and ED<br>*Number of Participating Centers/Practices:* NA<br>*Location:* NA*;* USA | 79 providers (mix of physicians and NPs); primary care | The Goal was to compare changes in the time taken to address patient portal messages, prescription requests, and test results from before to after scribe implementation among scribed PCPs. |

Abbreviations: APRN = advanced practice registered nurse; BurDoNsaM = Burden of Documentation for Nurses and Mid-Wives; CPT = current procedural terminology; DO = Doctor of Osteopathic Medicine; ED = emergency department; EHR = electronic health record; ICU = intensive care unit; LPN = licensed practical nurse; MD = doctor of medicine; n = number; NA = not available; NP = nurse practitioner; NP/PA = nurse practitioners physician assistants; OT/PT = occupational therapist/physical therapist; PA = physician assistant; PCCM = pulmonary and critical care medicine; PCP = primary care provider; PEP = physician efficiency profile; PGY = postgraduate year; PhD = doctor of philosophy; PLACES = Pediatrician Life and Career Experience Study; POP = patients over paperwork; PRN = pro re nata or as needed; RN = registered nurse; SUS = System Usability Survey/Scale; U.K. = United Kingdom; USA = United Staes of America; U.S. = United States

# Appendix D. Measures of Documentation Burden

**Box D.1. Studies reporting objective measures of work activities occurring outside of usual clinical time**

Adler-Milstein et al.[1]: total time active after hours (7:00 P.M.–7:00 A.M.) on scheduled clinic days and time active anytime on unscheduled days.
Anderson et al.[6]: total time spent in the EHR after-hours (between 6:00 P.M. and 6:00 A.M. and on weekends).
Apathy et al.[8]: time spent after hours.
Attipoe et al.[11]: time spent in the EHR after scheduled clinic hours, further broken down into time spent in chart review, documentation, order entry, and inbox management.
Arndt et al.[9]: time spent in administrative tasks and the ratio of whether the administrative task occurred during work hours or after work hours. time spent in the EHR outside of work defined as 7:00 P.M.–7:00 A.M. Monday-Thursday and 7:00 P.M.–8:00 A.M. Friday-Monday. This time was further broken down into time spent on inbox management, clerical tasks (documentation, order entry, billing), and chart review activities.
Baxter et al.[136]: time outside scheduled hours, time outside 7:00 A.M.–7:00 P.M., time on unscheduled days.
Beiser et al.[15]: measured time spent in the EHR outside 7:00 P.M.–7:00 A.M., time spent in the EHR on unscheduled days, and "pajama time" (5:00 P.M.–7:00 A.M.).
Benson et al.[16]: time spent after-hours (between 7:00 P.M. and 7:00 A.M. Monday–Friday) and time spent on days off (EHR work completed Saturday, Sunday, or on a Federal holiday).
Collins et al.[24]: percentage of time spent outside of regularly scheduled work hours.
DiAngi et al.[31]: time spent outside clinic hours (defined as 1 hour after the last scheduled appointment to 30 minutes prior to the first appointment the following day Monday-Friday).
Dibbs et al.[32]: time spent in the EMR outside of working hours during the work week and time spent in the EMR during the weekend.
Holmgren et al.[57]: mean percentage of EHR time spent after hours (6:00 P.M.–6:00 A.M.).
Holmgren et al.[59]: time spent in documentation between 5:30 P.M. and 7:00 A.M. on weekdays and any time on weekends.
Jhaveri et al.[63]: after-hours time.
Krawiec et al.[70]: time spent in documentation chart review after-hours (7:00 P.M. until 8:00 A.M.).
Lam et al.[74]: time spent charting after scheduled clinic hours.
Lo et al.[79]: proportion of time spent in after-hours usage.
Lou et al.[81]: time spent after hours 6:00 P.M.–6:00 A.M.
Mani et al.[85]: time spent 7:00 P.M.–7:00 A.M.
Marmor et al.[87]: average time in the EHR after work hours.
Micek et al.[89]: time spent on the EHR outside of scheduled patient hours.
Mishra et al.[92]: time spent on EHR documentation (during nonclinic hours on weekdays and on weekends).
Nguyen et al.[98]: time spent in the EHR outside of scheduled hours.
Ong et al.[102]: time spent in the EHR after work.
Overhage et al.[103]: time spent in the EHR after hours (between 6:00 P.M. and 6:00 A.M. local time on weekdays and anytime on weekends)
Patel et al.[137]: time spent in the EHR during unscheduled hours and during "pajama time" (defined as time spent in the EHR on weekdays outside 7:00 A.M.–5:30 P.M. and on weekends).
Rittenberg et al.[111]: mean time spent in the EHR outside scheduled hours, outside scheduled days, and outside 7:00 A.M.to 7:00 P.M.
Rotenstein et al.[113]: time spent outside scheduled hours.
Rotenstein et al.[114]: time spent after hours per visit.
Ruan et al.[115]: time spent outside 7:00 A.M.–7:00 P.M. or during pajama time (5:00 P.M.–7:00 A.M.), and time spent on unscheduled days.
Saag et al.[116]: time spent in the EHR on days without appointments or after work hours on days with appointments.
Sim et al.[120]: time spent outside 7:00 A.M.–7:00 P.M, pajama time (5:30 P.M.–7:00 A.M.), and time on unscheduled days.
Tai-Seale et al.[125]: average time spent in the EHR via remote access (assumed to be Work Outside of Work), further broken down into time spent in messages and documentation.
Tajirian et al.[124]: median time spent on the EHR after hours.
Tang et al.[126]: time spent outside 7:00 A.M.–7:00 P.M, pajama time (5:30 P.M. –7:00 A.M.), and time on unscheduled days.
Tran et al.[129]: time spent in the EHR after hours (between 7:00 P.M. and 7:00 A.M. on scheduled days and total minutes on unscheduled days, further broken down into clinical review, documentation, inbox, and orders).
Heaton et al.[54]: time spent in postshift documentation by an in-person time-motion observer.

Abbreviations: EHR = Electronic Health Record; EMR = Electronic Medical Record.

**Box D.2. Studies reporting subjective measures of documentation burden from work outside of regular working hours**

Adler-Milstein et al.[1]: perceived burden of EHR time at home assessed by a 5-point scale.
Benson et al.[16]: estimated time spent on EHR tasks while at home, with categories of minimal, modest, and high/excessive.
Congelosi et al.[25]: self-reported time spent in the EMR on days off, after 6:00 P.M. on weekdays, or on weekends.
DiAngi et al.[31]: self-reported time spent per week in the EHR outside routine work hours (i.e., 8:00 A.M.–6:00 P.M. Monday through Friday), using a survey with responses on a 5-point scale (from none to excessive). This study also examined self-reported time spent per week precharting outside routine work hours (i.e., 8:00 A.M.–6:00 P.M. Monday through Friday).
Ehrlich et al.[37]: response to survey questions about frequency of entering data into the medical record on workday evenings/nights, entering data into the medical record on nonclinical days, and entering data into the medical record on days off (never, rarely, sometimes, usually, all the time).
Flanagan et al.[40]: survey of physicians reporting if they required additional after-clinic hours (and how many hours) to complete their documentation tasks.
Gaffney et al.[44]: self-reported amount of time spent documenting outside office hours.
Gardner et al.[46]: self-reported time spent on EHR at home in categories (minimal/none, modest/satisfactory, moderately high/excessive).
Gilman et al.[49]: self-reported time spent after hours, assessed on a 5-point scale (response options no time, very little, just right, more than expected, too much).
Harris et al.[53]: self-report of whether able to complete work during regular work hours and time spent on the EHR at home (response categories minimal/none, modest/satisfactory, and moderately high/excessive).
Jhaveri et al.[63]: survey asked clinicians to estimate at-home EHR time per week and at-home EHR time per clinic session.
Kroth et al.[71]: self-assessed amount of time spent on EHR at home in categories (poor, marginal, satisfactory, good, optimal).
Kroth et al.[72]: agreement with spending moderately high or excessive time on the EHR at home.
Linzer et al. [78]: self-assessed amount of time spent on the EMR at home.
Meltzer et al.[91]: perceived time spent in the EHR at home.
Olson et al.[101]: self-reported time spent on the electronic medical record (EMR) at home in categories (satisfactory, excessive).
Peccoralo et al.[106]: self-reported time spent on the EHR outside the workday.
Rassolian et al[110]: rating of amount of time spent on the EMR at home.
Rotenstein et al.[112]: self-reported mean number of hours spent documenting after hours.
Sharp et al.[118]: self-reported time spent on the EHR at home.
Sinsky et al.[121]: physicians kept a diary and self-reported after hours (8:30 P.M.–7:00 A.M.) work activity (including time spent in the EHR) for 7 consecutive days.
Tajirian et al.[124]: self-reported time spent after hours (6:00 P.M.–6:00 A.M.).
Taylor et al.[127]: number of hours spent charting after hours.

Abbreviations: EHR = Electronic Health Record; EMR = Electronic Medical Record.

**Box D.3. Studies reporting objectively assessed measures targeting efficiency**

Timely completion of documentation: Edwards et al.[35] and Sockolow et al.[122]: time to completion of clinical documentation data; Jhaveri et al.[63]: number of days from the patient visit until the clinical note was signed; Mishra et al.[92]: percent completion of visit documentation within the next business day.
Time to chart/encounter closure : Gidwani et al.,[48] Edwards et al.,[35] Florig et al.,[41] Fouquet et al.,[42] and Perotte et al.[107]: time from appointment start to the physician signing the chart note, marked by timestamps.
Percentage of visits closed same day: Apathy et al.,[8] Baxter et al.,[136] Beiser et al.,[15] Goldstein et al.,[51] Kadish et al.,[65] Nguyen et al.,[97] Ruan et al.,[115] and Tran et al.[129]
Percentage of clinical encounters that were closed on the same day as the visit: Cross et al.,[26] Mosquera et al.,[93] Parker et al.,[104] Tang et al.[126], and Patel et al.[137]
Percentage of charts closed within 72 hours: Lam et al.[74]
Time spent in the EHR relative to expected time based on clinical workload: Adler-Milstein et al.[1]
Timely inbox completion: Nguyen et al.,[97]: inbox turnaround time; Rittenberg et al.,[111]: mean turnaround time to respond to inbox messages; Ruan et al.,[115]: turnaround time for inbox response; Tran et al.,[129]: days until inbox messages are reported as done and number of messages still incomplete at the end of the reporting period.
Documentation compliance: Raney et al.[109]: measured by inclusion of 8 different domains within a chemotherapy document.
Number of steps in healthcare staff workflow: Bliven et al.[18]
Mean nursing admission database dataset completion rate: Horn et al.[60]
Time to completion of results, time to completion of prescription requests, and time to completion of patient messages: Zallman et al.[135]

Abbreviations: EHR = Electronic Health Record.

**Box D.4. Studies reporting subjective usability assessments**

Berg et al.[17]: assessed satisfaction with time demands associated with the EHR.
DiAngi et al.[31]: assessed level of ease in using various EHR functions (e.g., documenting a visit, placing orders, sending in-basket messages, responding to in-basket messages (further stratified by message type), closing an encounter, cosigning notes) on a 5-point scale from very easy to very difficult.
Hsieh et al. 2016[62]: assessed satisfaction with EHR content, functionality, effectiveness, and usability on a 5-point scale.
Kadish et al.[65]: assessed confidence in the EHR overall and in five key activities—placement of orders (excluding chemotherapy), documentation, chemotherapy ordering, clinical review, and inbox message management, using a 5-point scale.
Marckini et al.[86]: assessed perceived reasonableness of time spent on clerical tasks within the EHR.
Rotenstein et al.[112]: asked whether documenting in the medical record system is very or somewhat easy.
Tell et al.[128]: evaluated "technostress" (stress experienced by end users in organizations attributed to EHR) on a 5-point scale (1 = do not agree at all/no technostress to 5 = fully agree/high technostress levels).
Windle et al.[133]: used a single-item satisfaction score using a 5-point scale.

Abbreviations: EHR = Electronic Health Record.

**Box D.5. Studies providing evidence of association between documentation burden and burnout**

Adler-Milstein et al.[1] reported perceived burden of EHR time at home assessed by a self-perceived 5-point scale and found EHR time associated with exhaustion but not cynicism among primary care clinicians.
Al Qahtani et al.[6] evaluated EHR-induced stress among nurses in Saudi Arabia via a questionnaire, and found that 22% had minimal EHR-induced stress, 42% had mild EHR-induced stress, 20% had moderate EHR-induced stress, and 16% had severe EHR-induced stress.
Arora et al.[10] found that pediatric residents and fellows in the United States generally agreed that documentation/billing adds to their stress (23.2% strongly agree, 47.5% agree, 22.8% neutral, 4.6% disagree and 1.9% strongly disagree).
Attipoe et al.[11] found in qualitative analysis involving primary care pediatricians that physicians used coping strategies for stress related to EHR Work Outside of Work including reducing FTE and setting goals on days off.
Benson et al.[16] reported on the impact of the EHR on gastroenterology and hepatology clinicians, finding that EHR-related tasks added to the frustration of their day (30% strongly agree, 57% agree, 9% disagree, 4% strongly disagree). In addition, they found that 87% agreed that the EHR interferes with personal time/family life and 74% felt that the EHR interferes with social time/social life.
Carlson et al.[20] evaluated pediatrics physician self-report of stress related to documentation, with a baseline level of 66.7% of attending physicians and 59.1% of resident physicians reporting high stress with documentation.
Chen et al.[23] assessed the burden of EHR alerts in an outpatient oculoplastics practice in the United States. They found that alert-related burden and fatigue were common and were associated with frequently overriding of alerts by clinicians.
DiAngi et al.[31] reported on the stress level at an academic medical center since the implementation of its EHR, finding a mean of 2.7 on a 5-point scale from 1 = significantly worsened to 5 = significantly improved.
Ebbers et al.[34] used a validated survey instrument to study the experience of clinicians at an outpatient cancer care center in the Netherlands. They found that only 23% agreed that there is enough time to properly document patient data in the EHR.
Fouquet et al.[42] assessed satisfaction with documentation among Emergency Department physicians and found a mean satisfaction level of 2.91 (median 2) on a 1-5 scale.
Frintner et al.[43] found among pediatricians that higher reported EHR burden was associated with lower scores on career and life satisfaction measures and on multiple measures of work-life balance. Three-quarters of participants reported that EHR documentation was a major or moderate burden on a 4-point scale from no to major burden.
Gardner et al.[46] reported that 69.8% of responding physicians across multiple settings in Rhode Island reported EHR-related stress.
Goldberg et al.[50] interviewed 27 primary care physicians and found that high levels of documentation, inefficiencies of EHR, high patient volume, and expectations for responding to patient emails and telephone calls contributed to burnout.
Harris et al.[53] reported that insufficient time for documentation was associated with burnout among APRNs (adjusted odds ratio: 3.72, 95% CI [confidence interval]: 1.78 to 7.80), as was the perception that the EHR added to daily frustration (adjusted odds ratio: 2.17, 95% CI: 1.02 to 4.65).
Kroth et al.[72] analyzed data from three academic medical centers in the United States. They found that 74.5% of responding clinicians reported time pressure for documentation, 50.4% felt they had insufficient personal time, and 49.6% reported marginal or poor control of their workload.
Lilly et al.[76] found that doubling of clinical note length was associated with a 10% increase in burnout prevalence and that specialties reporting higher prevalence of burnout had larger increases in EHR-related documentation burden (measured as note length), consistent with local critical care clinician observations.
Linzer et al.[78] analyzed themes from open-ended survey questions pertaining to EMR stress/documentation burden in a National study of academic medical centers. Comments focused on excessive evening/weekend documentation time, concerns that the EMR focused on payers rather than patients, and observations that EMR requirements decreased volume of care and compensation. Clinicians stated that the joy of medicine was diminished due to the EMR.
Lou et al.[81] reported among resident physicians at one institution on the relationship between burnout and workload. Increased total EHR time, increased patient load, and increased chart review time in the preceding month were associated with higher burnout scores. They found no association between after-hours EHR time or inbox time and burnout.
Meltzer et al.[91] found that increased EHR usage outside work hours was associated with increasing burnout symptoms among primary care clinicians.
Mosquera et al.[93] assessed the association of time spent writing notes with depersonalization, emotional exhaustion, and overall engagement among psychiatrists in outpatient practice, finding a statistically significant association with depersonalization. They also assessed the association of the frequency of same-day visit closure with levels of engagement, compassionate satisfaction, and sense of personal accomplishment, finding statistically significant associations with levels of engagement and sense of personal accomplishment.

Olson et al.[101] found that physicians who reported spending excessive time on the EMR at home had an increased risk of burnout (odds ratio: 1.99). Physicians who perceived a lack of sufficient time for documentation also had an increased risk if burnout (odds ratio: 5.83).
Peccoralo et al.[106] reported on thresholds of excessive time on the EHR outside the workday (>90 minutes) and overall clerical tasks (>60 minutes) associated with increased risk for burnout, as well as reduced work life integration and professional satisfaction, among clinical faculty across specialties at a large academic medical center in the United States.
Rassolian et al.[110] examined survey data from a National sample of family medicine physicians. They reported that less control over workload (82.8% vs. 35.1%), lack of sufficient time for documentation (61.0% vs. 21.1%), stress due to their job (91.4% vs. 38.4%), and more time spent on electronic medical records at home (62.1% vs. 38.7%) were each associated with burnout (all $P < .001$).
Sharp et al.[118] evaluated the perception of EHR burden among pulmonary and critical care fellows, finding that 42% reported that the EHR impacts their joy in medicine in a negative way.
Tajirian et al.[124] found that 62.5% of attending physicians and 72% of resident and fellow physicians agreed that the EHR adds to their daily frustration.
Tran et al.[129] evaluated the relationship between time spent in various EHR tasks and burnout among healthcare professionals working in primary care clinics. Results demonstrated complex relationships between EHR use and burnout. More time managing the inbox and working in the EHR after hours were associated with burnout.
Yuan et al.[134] found among nephrology trainees that 39% of fellows agreed or strongly agreed that the EMR increased their stress when seeing outpatients.

Abbreviations: EHR = Electronic Health Record; EMR = Electronic Medical Record; APRN = Advanced Practice Registered Nurse; CI = Confidence Interval; FTE = Full-Time Equivalent.

**Box D.6. Studies reporting decreased satisfaction with EHR**

Carlson et al.[20] reported among pediatricians that self-reported satisfaction with documentation was high for only 11.1% of attending physicians and 20.5% of resident physicians.

De Hoop et al.[29] identified several dissatisfiers in the EHR contributing to documentation burden in a study of physicians at a large university medical center in Germany: (1) Use of multiple health information technology systems with limited integration and the resulting spread and fragmentation of information; (2) high documentation burden, aggravated by manual "double documentation" of the same patient information; (3) poor integration of new data, particularly from diagnostics, such as laboratories, into workflow resulting in a risk of missing important information; (4) large limitations on health information exchange between healthcare centers, requiring time-consuming manual selection, and sending of specific patient information; (5) fragmentation of work due to extensive multitasking and frequent interruptions.

DiAngi et al.[31] reported on satisfaction with the EHR at an academic medical center since the implementation of its EHR, finding a mean of 3.0 on a 5-point scale from 1 = significantly worsened to 5 = significantly improved.

Ebbers et al.[34] used a validated survey instrument to study the experience of clinicians at an outpatient cancer care center in the Netherlands. They found that only 44% indicated that they can always find the information they need in the EHR and 32% thought the EHR was user-friendly.

Gidwani et al.[48] reported on family medicine physician satisfaction with multiple aspects of charting in the EHR (charting time, chart quality, and chart accuracy), evaluated on a 1-7 scale from least to most satisfied. Median scores were 4, 5, and 6 for charting time, chart quality, and chart accuracy, respectively.

Horn et al.[60] reported on measured EHR documentation satisfaction among pediatrics medical surgical nurses assessed on a 5-point Likert scale (1 = strongly disagree to 5 strongly agree). The baseline mean satisfaction score was 3.14.

Hsieh et al.[62] evaluated staff nurse satisfaction with EHR charting content, functionality, effectiveness, and usability on a 5-point Likert scale (1 = very dissatisfied to 5 = very satisfied). Baseline mean satisfaction scores were 3.4, 3.5, 4.4, and 3.7 across these dimensions, respectively.

Kroth et al.[71] generated themes relating to satisfaction with the EHR from focus groups primarily involving primary care physicians. Stressors and dissatisfiers included click boxes and too many clicks in general, note bloat (from cut and paste entry); the intrusive presence of the EMR at home, limited interoperability between hospitals and EMR systems, difficulty locating or documenting key information within charts, and inefficiency relating to redundancy.

McIlreevy et al.[90] reported on nurse satisfaction with questions included on the Adult Admission history form within the EHR measured on a 1-5 scale from unsatisfied to satisfied. Baseline mean satisfaction was 3.01.

Peccoralo et al.[106] evaluated frustration with the EHR among clinical faculty across specialties at a large academic medical center in the United States. More than half (50.7%) endorsed that the EHR added frustration to their day.

Rotenstein et al.[112] compared satisfaction with the EHR in physician-owned practices versus nonphysician-owned practices. Overall, 64.5% of physicians reported being satisfied with their EHR (68.1% among physicians working in physician-owned practices and 58.5% among physicians working in nonphysician-owned practices).

Abbreviations: EHR = Electronic Health Record; EMR = Electronic Medical Record.

**Box D.7. Studies reporting EHR usability from clinician/healthcare professional perspective**

Benson et al.[16] reported on whether the EHR improved clinical workflow for gastroenterology and hepatology clinicians, finding that 4% strongly agreed, 48% agreed, and 48% disagreed.
Congelosi et al[25] evaluated self-perceived impact of the patient portal on workflow for clinical staff in multiple roles at an academic medical center. Baseline results included 42% agreeing that the patient portal was easily integrated into their workflow.
DiAngi et al.[31] reported on the level of ease in using various EHR functions (e.g. documenting a visit, placing orders, sending in basket messages, responding to in basket messages (further stratified by message type), closing an encounter, cosigning notes) on a 5-point scale (1 = very difficult to 5 = very easy). Baseline means ranged from 2.3 to 3.4.
Kadish et al.[65] evaluated medical oncology clinician confidence in using the EMR overall and in key specific activities—placement of orders, documentation, clinical review, and inbox message management. At baseline, 58% felt confident using the EMR overall. Confidence in the specific activities ranged from 61% to 78%.
McIlreevy et al. 2021[90] reported on nurse-rated perception of the usability of an Adult Admission history form within the EHR, measured on a 1-5 scale. Baseline mean usability was 3.31.

Abbreviations: EHR = Electronic Health Record; EMR = Electronic Medical Record.

**Box D.8. Studies reporting on workload**

Adler-Milstein et al.[1] reported perceived burden of EHR time at home assessed by a self-perceived 5-point scale and found EHR time associated with exhaustion but not cynicism among primary care clinicians.
Congelosi et al.[25] evaluated self-perceived impact of the patient portal on workload for clinical staff in multiple roles at an academic medical center. Baseline results included 76% agreeing that the patient portal increased their workload.
De Groot et al.[28] reported on Dutch community nurses' views on the relationship of self-reported time spent on clinical documentation and administrative tasks with perceived high workload. More than half (52.3%) endorsed perceived high workload from clinical documentation at least regularly, and 57.9% endorsed perceived high workload from organizational documentation at least regularly.

Abbreviations: EHR = Electronic Health Record.

**Box D.9. Studies reporting on satisfaction with practice**

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|---|
| Benson et al.[16] reported on whether the EHR improved their job satisfaction for gastroenterology and hepatology clinicians, finding that 17% agreed, 52% disagreed, and 31% strongly disagreed.<br>Congelosi et al.[25] evaluated self-perceived impact of the patient portal on professional satisfaction for clinical staff in multiple roles at an academic medical center. Baseline results included only 9.8% agreeing that the patient portal increased their professional satisfaction, with 60.7% disagreeing.<br>Gilman et al.[49] assessed physician satisfaction with clinical work tasks. At baseline, 52% felt they spent too much time completing visit documentation and another 36% felt the time they spent was more than expected. Overall, 50% were dissatisfied with documentation effort and only 2% were very satisfied with documentation effort. |

Abbreviations: EHR = Electronic Health Record.

# Appendix E. Validity of Documentation Burden Measures by Included Studies

**Box E.1. Studies reporting objective measures of work activities occurring outside of usual clinical time**

| Author, Year | Content | Response Process | Internal Structure | Relations to Other Variables | Consequences |
|---|---|---|---|---|---|
| Adler-Milstein et al., 2020[1] | Partially | Yes | Partially | Yes | Yes |
| Ahlgrim et al., 2016[2] | No | Yes | No | Yes | No |
| Ahn et al., 2017[3] | No | No | Partially | No | No |
| Alissa et al., 2022[4] | No | Partially | Partially | No | No |
| Al Qahtani et al., 2021[5] | Partially | Yes | No | Yes | No |
| Anderson et al., 2020[6] | No | Yes | Partially | No | No |
| Apathy et al., 2023[7] | No | No | Partially | No | No |
| Apathy et al., 2023[8] | No | Yes | Partially | Yes | Partially |
| Arndt et al., 2017[9] | Partially | No | Yes | No | No |
| Arora et al., 2018[10] | No | No | No | No | No |
| Attipoe et al., 2022[11] | Partially | No | Partially | No | No |
| Aziz et al., 2017[12] | Partially | No | Partially | No | No |
| Bartek et al., 2023[13] | Partially | No | Partially | Yes | Yes |
| Baugh et al., 2020[14] | Yes | Yes | Yes | Yes | Yes |
| Beiser et al., 2021[15] | Partially | No | Partially | No | No |
| Benson et al., 2023[16] | Yes | Yes | Yes | Yes | Yes |
| Berg et al., 2020[17] | No | Partially | Partially | No | No |
| Bliven et al., 2016[18] | No | No | Partially | No | No |
| Byrne et al., 2016[19] | No | Partially | No | No | No |
| Carlson et al., 2015[20] | No | No | No | Partially | Partially |
| Chaparro et al., 2020[21] | Partially | No | Partially | No | No |
| Chen et al., 2020[22] | No | No | No | Partially | No |
| Chen et al., 2023[23] | No | No | Partially | No | No |
| Collins et al., 2018[24] | No | No | Partially | No | No |
| Congelosi et al., 2023[25] | No | No | No | No | No |
| Cross et al., 2023[26] | No | No | Partially | No | No |
| Cox et al., 2018[27] | No | No | Partially | Yes | No |
| De Groot et al., 2022[28] | Yes | Yes | No | Yes | Partially |
| De Hoop et al., 2021[29] | Partially | Partially | Partially | Partially | Partially |
| Dela Cruz et al., 2015[30] | No | No | Partially | No | No |
| DiAngi et al., 2019[31] | Partially | Partially | No | Yes | No |
| Dibbs et al., 2022[32] | No | No | No | No | No |
| Earls et al., 2017[33] | No | Partially | No | Yes | Yes |
| Ebbers et al., 2022[34] | Partially | No | Yes | No | No |
| Edwards et al., 2023[35] | No | No | No | No | No |
| Ehrler et al., 2021[36] | No | Partially | Partially | No | Yes |
| Ehrlich et al., 2016[37] | Partially | No | No | No | Yes |
| Feely et al., 2023[38] | No | Partially | Partially | No | No |
| Ferguson et al., 2023[39] | Partially | Partially | No | No | No |
| Flanagan et al., 2019[40] | Yes | Yes | No | No | No |
| Florig et al., 2021[41] | No | No | Partially | No | No |

| Author, Year | Content | Response Process | Internal Structure | Relations to Other Variables | Consequences |
|---|---|---|---|---|---|
| **Fouquet et al., 2021**[42] | Partially | Partially | No | No | Partially |
| **Frintner et al., 2021**[43] | Partially | Partially | Partially | Yes | Yes |
| **Gaffney et al., 2022**[44] | Partially | No | No | Yes | Yes |
| **Gali et al., 2019**[45] | Partially | Partially | Partially | No | No |
| **Gardner et al., 2019**[46] | Partially | No | No | Yes | Yes |
| **Gesner et al., 2022**[47] | Partially | No | No | Yes | Yes |
| **Gidwani et al., 2017**[48] | Partially | No | No | Partially | No |
| **Gilman et al., 2023**[49] | Partially | No | No | Yes | No |
| **Goldberg et al., 2023**[50] | Partially | Yes | No | Yes | Yes |
| **Goldstein et al., 2019**[51] | Partially | No | Partially | No | No |
| **Golob et al., 2015**[52] | No | No | No | No | No |
| **Harris et al., 2018**[53] | Yes | No | No | Yes | Yes |
| **Heaton et al., 2018**[54] | No | No | Yes | No | Yes |
| **Ho et al., 2023**[55] | No | No | Partially | No | No |
| **Hilliard et al., 2020**[56] | Partially | No | Partially | Yes | Yes |
| **Holmgren et al., 2021**[57] | Partially | No | Partially | No | No |
| **Holmgren et al., 2022**[58] | Partially | No | Partially | No | No |
| **Holmgren et al., 2022**[59] | No | No | Partially | Yes | No |
| **Horn et al., 2021**[60] | Partially | No | Partially | Partially | No |
| **Hripcsak et al., 2011**[61] | Partially | Partially | Partially | Yes | Yes |
| **Hsieh et al., 2017**[62] | Partially | Partially | Partially | Yes | Partially |
| **Jhaveri et al., 2021**[63] | Partially | Partially | Partially | No | No |
| **Joukes et al., 2018**[64] | Partially | Partially | Partially | Partially | Yes |
| **Kadish et al., 2018**[65] | Partially | Partially | Partially | No | No |
| **Kannampallil et al., 2018**[66] | Partially | Partially | Partially | No | Yes |
| **Karp et al., 2019**[67] | Partially | No | Partially | No | No |
| **Kesler et al., 2022**[68] | Partially | No | Partially | No | No |
| **Khan et al., 2022**[69] | Partially | No | Partially | No | No |
| **Krawiec et al., 2020**[70] | Partially | No | Partially | No | Yes |
| **Kroth et al., 2018**[71] | Yes | Yes | No | Yes | Yes |
| **Kroth et al., 2019**[72] | Partially | Yes | No | Yes | Yes |
| **Kumah-Crystal et al., 2021**[73] | No | No | No | No | No |
| **Lam et al., 2021**[74] | Partially | Partially | Partially | Yes | Yes |
| **Li et al., 2023**[75] | No | Partially | Partially | No | No |
| **Lilly et al., 2019**[76] | Partially | No | No | Yes | Yes |
| **Lindsay et al., 2022**[77] | Partially | No | Partially | No | No |
| **Linzer et al., 2016**[78] | No | No | No | No | Yes |
| **Lo et al., 2022**[79] | Partially | Partially | Partially | Partially | No |
| **Loszko et al., 2023**[80] | Partially | No | Partially | No | No |
| **Lou et al., 2022**[81] | Yes | Yes | No | Yes | Yes |
| **Ludley et al., 2023**[82] | Partially | No | Partially | No | No |
| **Mamykina et al., 2012**[83] | Partially | No | Yes | No | Yes |
| **Mamykina et al., 2016**[84] | Partially | No | Yes | No | No |
| **Mani et al., 2023**[85] | Partially | Partially | Partially | Partially | Yes |
| **Marckini et al., 2019**[86] | Partially | Partially | No | Yes | Yes |
| **Marmor et al., 2018**[87] | Partially | No | Partially | Yes | No |
| **Melnick et al., 2020**[88] | Partially | Partially | Partially | Yes | Yes |
| **Micek et al., 2022**[89] | Partially | Partially | Partially | Yes | No |

| Author, Year | Content | Response Process | Internal Structure | Relations to Other Variables | Consequences |
|---|---|---|---|---|---|
| **McIlreevy et al., 2021**[90] | Partially | Partially | No | No | No |
| **Meltzer et al., 2022**[91] | Partially | Partially | Partially | Yes | Yes |
| **Mishra et al., 2018**[92] | Partially | No | No | Partially | No |
| **Mosquera et al., 2021**[93] | Partially | Partially | Partially | Partially | Partially |
| **Moy et al., 2020**[94] | Partially | Partially | Yes | No | Yes |
| **Moy et al., 2021**[95] | Partially | Partially | Yes | No | Yes |
| **Munyisia et al., 2012**[96] | Partially | No | No | No | No |
| **Nguyen et al., 2022**[97] | Partially | Partially | Partially | No | No |
| **Nguyen et al., 2022**[98] | Partially | No | Partially | No | No |
| **Nguyen et al., 2023**[99] | No | No | No | No | No |
| **Nguyen et al., 2023**[100] | No | No | No | No | No |
| **Olson et al., 2019**[101] | Yes | Partially | Yes | No | Yes |
| **Ong et al., 2021**[102] | Partially | No | Partially | No | No |
| **Overhage et al., 2020**[103] | Partially | No | No | No | No |
| **Parker et al., 2021**[104] | No | No | No | No | No |
| **Patel et al., 2023**[105] | No | No | No | No | No |
| **Peccoralo et al., 2021**[106] | Yes | Partially | No | Partially | Yes |
| **Perotte et al., 2022**[107] | No | No | No | No | No |
| **Phillips et al., 2021**[108] | No | No | No | No | No |
| **Raney et al., 2020**[109] | Yes | No | No | No | Yes |
| **Rassolian et al., 2017**[110] | Yes | No | No | No | Yes |
| **Rittenberg et al., 2022**[111] | Partially | No | Partially | No | No |
| **Rotenstein et al., 2022**[112] | No | No | No | No | No |
| **Rotenstein et al., 2022**[113] | No | No | No | No | Yes |
| **Rotenstein et al., 2023**[114] | No | No | No | No | No |
| **Ruan et al., 2022**[115] | No | No | No | Yes | No |
| **Saag et al., 2019**[116] | No | No | Partially | Yes | No |
| **Shanafelt et al., 2016**[117] | Yes | Yes | No | Yes | Yes |
| **Sharp et al., 2021**[118] | Yes | Yes | No | No | Yes |
| **Shuaib et al., 2017**[119] | No | No | No | Yes | No |
| **Sim et al., 2023**[120] | Partially | No | Partially | No | No |
| **Sinsky et al., 2016**[121] | Partially | No | Partially | Partially | No |
| **Sockolow et al., 2012**[122] | Partially | No | Partially | No | No |
| **Sutton et al., 2020**[123] | Partially | No | Partially | No | No |
| **Tajirian et al., 2020**[124] | Yes | Yes | Yes | No | Yes |
| **Tai-Seale et al., 2017**[125] | No | No | Partially | No | No |
| **Tang et al., 2023**[126] | Partially | No | Partially | No | No |
| **Taylor et al., 2019**[127] | No | No | Partially | Partially | No |
| **Tell et al., 2023**[128] | No | No | No | No | No |
| **Tran et al., 2019**[129] | Yes | Yes | Partially | No | Yes |
| **Verma et al., 2020**[130] | Partially | No | No | No | No |
| **Vogel et al., 2015**[131] | No | No | No | No | No |
| **Wang et al., 2019**[132] | No | No | No | No | No |
| **Windle et al., 2021**[133] | No | No | No | No | No |

| Author, Year | Content | Response Process | Internal Structure | Relations to Other Variables | Consequences |
|---|---|---|---|---|---|
| **Yuan et al., 2020**[134] | Partially | No | No | No | No |
| **Zallman et al., 2021**[135] | Partially | No | No | No | No |

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