Anticipating Ambulatory Automation: Potential Applications of Administrative and Clinical Automation in Outpatient Healthcare Delivery

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Workflow automation involves utilizing an array of technologies to facilitate the completion of specific daily tasks. In the business and financial sectors, the implementation of automation has had transformative and beneficial effects including improved quality of services, lower costs, and expanded accessibility. While workflow automation has begun to enter health care, the introduction has been slow, leaving much room for optimization. In health care, daily workflow for physicians may involve handling electronic health records (EHRs), administrative tasks, patient coordination, and researching of clinical evidence. Clerical burdens and administrative tasks are commonly cited as factors that contribute to physician burnout and frustration, which may lead to reduced time for patient interaction, decreased career satisfaction, and diminished delivery of high-quality care.[1–3] In this article, we explore areas of workflow within ambulatory, outpatient health care that would potentially benefit from the implementation of automation. We also propose potential solutions to encourage more efficient outcomes in administrative and clinical practice workflows, which have the ability to enhance the delivery of more humanistic medical care.

Clinical Documentation

The timely completion of clinical documentation is critical for providing efficient care and for enhancing communication between care providers. Yet, documentation is often incredibly time intensive and requires attention to detail. Studies have shown that physicians who spend more time documenting clinical encounters into EHR were more likely to report burnout and stress.[3,4] Wu et al have proposed that focusing on EHR-based solutions would most likely mitigate physician burnout.[4] Traditionally, physicians have employed modalities such as medical scribes, dictation, transcription services, or simply typing notes while talking with the patient, to complete documentation for clinical encounters in electronic medical records. Each of these respective methods has limitations. For example, medical scribes require training which involves a learning curve and can have quality variability. Additionally, this shifts the burden onto other personnel and can increase costs. Transcription and dictation services are not optimized for efficiency and are prone to many errors including spelling and contextual mistakes. Clinicians often need to subsequently proofread and edit or even rewrite these notes. Directly typing notes while talking with the patient can detract from the clinical interaction, affecting the patient–doctor relationship. This also forces the physician to multitask and diminish their concentration. Furthermore, the creation of clinical notes may be challenging to do while examining patients and may require additional equipment and space in the exam room rendering this method capital- and resource-intensive.

One proposed automation-driven solution is for a digital scribe to be implemented into practice.[5] van Buchem et al proposed a possible structure of a digital scribe which would include a microphone to record the clinical interaction, and simultaneously implement automatic speech recognition technology and natural language processing (NLP).[5] NLP would be applied to the transcribed dictation to improve the accuracy of speech recognition software by automatically detecting errors.[6] Advantages of NLP are multifold—including offering high fidelity with voice and data capture, operability in real-time during physician–patient interactions, limited additional equipment or devices in the point of care interaction, and lack of another person to be physically present at the time of the clinical encounter—all of which have the potential to enhance the patient–doctor relationship and preserve patient autonomy.[6]

Administrative Tasks

A recent study by Willis et al suggested that up to 45% of tasks in the primary care clinics interviewed and observed could be automated with existing available technology.[21] For example, many general physicians are required to read through lengthy documents from hospitalizations and determine aspects that are most relevant to their current care. Text summarization technologies offer a potential solution to this problem (►Table 1).[21] This approach utilizes machine learning to select the most crucial information from a given text and creates a shortened and more digestible body of text, which saves the user time. Additionally, the application of text summarization can be extended and customized to the needs of different specialties, training machine learning algorithms on critical areas of focus in prior documentation relevant to a particular clinical field.[8,10,11] NLP is a currently available form of technology that can be utilized to discover previously missed or improperly coded patient conditions including hierarchical condition category codes.[6,7] However, improperly coded information could also be a limitation, relying on incorrect inputs that result in inappropriate decisions which are perpetuated over time. Thus, the importance of dynamic adaptation and ongoing learning of any automation system strategies will be critical to their successful implementation.

Patient Communication

Chatbots are algorithm-powered software applications able to conduct conversations through text or voice-based interfaces and offer a potential automation solution for ambulatory care delivery. This technology is particularly valuable because it enhances patient care beyond the physician's work hours, expanding access for patients to the health care system.[12] Chatbots can serve a multitude of functions to augment aspects of health care including organizing patient pathways, medication management, and offering solutions for simple medical problems.[12] Some services utilizing chatbot technology offer patients an artificial intelligence (AI) consultation based on personal medical history and common medical knowledge and will subsequently propose the next course of action or refer them to a physician if required.[12] Furthermore, the potential impact of automation has been highlighted during the recent COVID-19 pandemic. Recently, Mass General Brigham introduced an AI-based chatbot to quickly distinguish between possible COVID-19 cases and less concerning conditions.[13] The Centers for Disease Control and Prevention also utilizes an AI-based chatbot on their Web site to screen for COVID-19 infections.[14] Chatbots present an opportunity for customization by specialty and may be useful as an adjunct to providing on-call or after-hours coverage and enhance access

Table 1 Categories of technologies and their applications, advantages, and limitations

Technology	Applications	Advantages	Disadvantages/Limitations
Natural language processing (NLP)[5–9]	Clinical documentation Speech recognition Clinical decision support Clinical trial matching hierarchical condition category (HCC) coding	High fidelity with voice and data capture Able to operate in real time during clinical encounters Does not require extra equipment/additional personal	Improper coding can lead to incorrect decision making Useful data can only be extracted if it is easy to identify Struggles with words with multiple meanings Must tailor the NLP program to medical sublanguage
Text summarization[8–11]	Medical consultation Clinical documentation Clinical decision support Summarizing clinical encounters from Secondary care facilities	Reducing time required for physician to read medical texts	Shortened body of text may potentially lead to clinical errors Limitations with contextual words Many clinical texts are ungrammatical with incomplete sentences which leads to limitations
Chatbot[12–18]	Medication management Patient pathway organization On-call/after-hour coverage Digital therapeutics Cognitive behavior therapy Health care companion Rapid information Retrieval Scheduling appointments	Increased cost savings Reduced waiting times On-call/after-hour coverage Enhances access beyond normal care hours Collecting patient feedback Prompt medical advice Scalability	Typically execute specific tasks but not unrelated tasks Lack of empathy
Artificial neural network (ANN)[8,19,20]	Classification of data Imaging analytics and diagnostics Predictive analysis	Adjunct to clinical decision making Earlier diagnosis/detection Beneficial to communities with limited access to doctors/specialists Potentially able to infer relationship between data	Challenges with training artificial intelligence (AI) due to difficulty accessing robust data sets Currently ready for pure automation and requires physicians working in tandem Unexplainable decision making

beyond the normal care hours in the day to better serve patients. Overall, the advantages of chatbots include low costs, scalability, consistency, all day services, and most importantly, will allow physicians to focus on more complicated conditions and cases.[15–17]

Clinical Decision Support

Advancements in clinical decision support would further enhance workflow in the clinic.

Machines that serve as decision support provide guidance to the primary person responsible for completing the task. A Clinical Monitoring List was implemented in select EHRs as a primary patient monitoring tool to enhance the workflow of pharmacists.[18] Esteva et al employed deep convolutional neural networks to classify dermatologic lesions with results comparable to fully trained dermatologists.[22] Similarly, AI software has been demonstrated to be able to classify certain radiographic images.[19] In the clinic, physicians often find themselves researching information from clinical evidence resources while simultaneously caring for patients. This can become inefficient due to time constraints, leaving some questions potentially unanswered.[20] Studies on text summarization have demonstrated its utility in clinical information extraction and may serve as a potential decision support aid.[8,23] NLP could be applied to extract information from clinical encounters for text summarization and offer clinical decision support by helping to identify a correct diagnosis.[8,23]

Implications

With the potential advancements and solutions, it is important to evaluate how such technologies would be received by stakeholders. Studies have shown that both the public and physician perception of AI is generally positive.[9,24–26] Anxiety about the technology from patients, however, stems from concerns of data privacy and loss of human interaction.[25] For clinicians, hesitations toward AI may arise from concerns about its cost-effectiveness, worries of job displacement, skepticism of its reliability, and from lack of fully understanding how the technology works.[26,27] Nelson et al evaluated patient perception toward the use of AI in skin cancer screenings and found that patients were receptive to the use of AI in the context of a synergistic relationship between human and machine.[25] These insights require further research and exploration as technological solutions to clinical care practice become increasingly able to be integrated into care delivery settings.

Within the health care space, automation has the potential to develop and further optimize to augment workflow automation as well as the clinical experience, and the ambulatory setting provides a particularly well-suited environment for its integration given the number of complex processes that could be streamlined. The use of automation for other tasks may enhance the bandwidth and mental energy for physicians to invest in challenging diagnostic cases, provide further refinement and knowledge building in terms of generation of learning data sets, and ultimately focus on the delivery of more humanistic medical care. Additionally, as automation technology continues to advance, it is important that stakeholders such as patients are receptive to the evolving landscape, and all parties involved in health care delivery consider both the opportunities and pitfalls of potential automation of clinical care delivery.

Clinical Relevance Statement

There is potential for automation to enhance workflow within health care in addition to the clinical experience. Currently available technologies such as chatbots, natural language processing, and text summarizations could further develop to alleviate certain tasks among clinicians to allow them to focus their attention on patient interactions.

Multiple Choice Questions

1. According to this article, which of the following is an example of how chatbots are currently utilized?
   a. Screening for infectious disease symptoms.
   b. Classification of patient images.
   c. Researching clinical evidence guidelines.
   d. Clinical documentation of patient encounters.

   Correct Answer: Answer a is correct. Some hospitals currently have been implementing an automated chatbot to screen for COVID-19. These tools offer patients a method to help distinguish symptoms of the infectious disease and offer additional information and next steps.

2. Which of the following technologies could potentially aid physicians with reading through lengthy documents by highlighting relevant information and automating the process?
   a. Clinical decision support.
   b. Text summarization.
   c. Chatbots.
   d. Telehealth.

   Correct Answer: Answer b is correct. Clinicians often need to read through dense documents from secondary care facilities and be able to sift through and find relevant information. This is often tedious and can become mentally draining overtime. Text summarization uses machine learning to highlight the most crucial information from a given text and create a shortened version which reduces the time required. While text summarization potentially offers a solution to this problem, there are some current limitations to the technology such as challenges with contextual words and word disambiguation.

3. Which of the following could be potentially utilized to overcome the current limitations of clinical documentation described in the article?
   a. Medical scribes.
   b. Natural language processing (NLP).
   c. Dictation services.
   d. Chatbots.

Correct Answer: Answer b is correct. Traditional methods of clinical documentation involve medical scribes, dictation services, or having the physician type out the note while talking with the patient. There are multiple limitations to these strategies including quality variability among medical scribes, inefficiencies/errors with dictation services, and diminishing the patient–physician interaction. NLP can be applied to improve the accuracy of speech recognition by automatically detecting errors. NLP offers multiple advantages and can enhance the patient–doctor relationship and preserve patient autonomy.

Protection of Human and Animal Subjects

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Conflict of Interest

None declared.

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