

Physician Well-being and the Future of Health Information Technology

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Abstract

The issue of clinician burnout has become a growing concern in health care, with an increased emphasis on health information technology as a contributing factor. Technology-mediated stresses have arisen with the electronic health record, and we can anticipate new and different impacts from future information tools. This article discusses technology's pivotal role in physician well-being, not only in the quality of its design but also through its capacity to enable future models of care that are more manageable for physicians and more effective for patients. Three general aims along with specific efforts are proposed to benefit physician well-being in technology-mediated work.

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Clinician burnout is a growing concern in health care,¹⁻⁵ with affected physicians potentially struggling with emotional exhaustion, cynicism, and a low sense of personal accomplishment from work.^{2,5} Beyond the individual physician, there are impacts on health care delivery, including quality and safety,^{6,7} absenteeism, engagement, and patient care.⁸ Although there are myriad potential contributors to burnout,^{1,2,4,9,10} technology, particularly the introduction of the electronic health record (EHR), has been increasingly implicated.¹¹⁻¹³

Now we face a cognitive era of health care information technology (HIT) with a great expansion of information accompanied by new information tools that impact care decisions. Machine learning, predictive analytics, pharmacogenomics, remote monitoring data, and so on, are all poised to create new capabilities but also new complexities,¹⁴ with each new tool carrying “the promise of positive change and the risk of further increasing clinicians’ work stresses and burnout.”^{2(p.219)}

There is an urgency to understand how to preserve well-being in technology-mediated work in health care at multiple levels. This article explores the relevance of information technology to well-being at the level of informational tasks, the broader level of physician roles, and ultimately the greater sphere of our model of care. Three aims are offered to

support physician well-being in technology-mediated work, along with proposed next efforts.

AIM TO DESIGN TECHNOLOGY FOR A WELL WORKFORCE

Well-being at the User Interface: The EHR and Beyond

The impact of the EHR on physicians has been substantial, with overwhelm and disengagement as common themes. Physicians report increased long hours,^{15,16} usability frustration,^{11,17} and a growing volume of activities that “other staff could perform.”^{18,19} Progress notes have become large and laborious to create and review^{11,12}; the in-basket has grown to overwhelming size^{7,15}; care reminders have become excessive and intrusive²⁰⁻²²; and there is a growing burden of metrics²³ often bearing uncertain benefit.²⁴⁻²⁷ These added tasks compete with time for patient interaction,^{13,16,28} potentially decreasing the meaningful work that is essential to physician engagement.^{29,30} As Del Carmen et al¹ suggest, the increasing burnout rates “may also be the result of an increasing mismatch between physicians interests with medicine and the growing demands placed on them that subtract meaning and joy from practice (p. 6).”

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However, it would be shortsighted to imagine that simply fixing the EHR will prevent technology-related burnout. We are embarking on a cognitive era of HIT in which HIT will take on new and more influential roles, adding unprecedented volumes of information and informational capabilities. These new forms and amounts of information have the potential to be unfamiliar, biased, overwhelming, ambiguous, and conflicting.

This next phase of HIT brings fundamentally different challenges along with new well-being considerations. The EHR's initial purpose was to take familiar paper records and processes and computerize them into a digital record. In contrast, next-generation HIT aims to create "cognitive interface" such that the traditional tasks of chart review, literature search, risk assessment, diagnostics, and medical decision making can somehow accommodate the rapidly expanding volumes and forms of information. In general terms, the EHR was concerned with the physical, external tasks of information work whereas cognitive-era HIT engages with internal thought processes. For example, a decision support tool aims to augment a physician's internal processes of selecting and evaluating information, proposing and challenging diagnoses, and deliberating between options and trade-offs. It is crucial that such tools not only be clinically appropriate but must also preserve the well-being of its users, minimizing information overload, decision fatigue, decision regret, and other potential impacts on well-being.

Designing Technology for a Well Workforce

Looking ahead, our greatest progress in HIT design will not come through the increasing power of computers alone, but through a refined understanding of the factors in design that support the well-being and effectiveness of humans in informational tasks.

This points to various opportunities for research and design. To reduce overwhelm, tools are needed to filter, prioritize, and frame information for users and their clinical questions. Other approaches may be needed to address complexity, ambiguity, or inaccuracy. For example, an artificial intelligence tool may need to be explainable^{31,32} so that a nontechnical physician can comfortably assume responsibility for its assumptions. Strategies

may be helpful to resolve conflicts, for example, when a predictive analytical tool implies an action that differs from the clinical practice guideline. Methods of mutual oversight between humans and technology are also crucial, given that humans and computers can each contribute unique errors and biases³³ in decision making and other health care tasks.

New tools must be human-centered, that is, that address the real human challenges of information work such as weighing trade-offs between options, challenging or confirming suspicious data, reaching decision closure and satisfaction, and creating defensible documentation. In this work, we must begin to characterize the factors of cognitive work that threaten well-being such as information overload, ambiguity, complexity, task frustration, decisional conflict, and interruption and offer design principles and methods that avoid these impacts.

In creating this next level of interaction design, an existing body of research involving human-human collaboration as well as human-computer models of collaboration³⁴⁻⁴⁰ may all be relevant along with ongoing human-computer interaction research. Humanistic decision support might build on insights from decision-making research across topics such as decisional conflict,⁴¹ debiasing,^{42,43} patient/physician shared decision making,⁴⁴ decision regret,⁴⁵⁻⁴⁸ decision closure,^{49,50} and ambiguity and uncertainty.^{51,52}

The importance of physician involvement in the design and implementation of HIT cannot be overstated. With the EHR, Gawande⁵³ points out that "design choices were more political than technical" and that ultimately physician influence in these decisions became greatly diminished. Greater collaboration between designers and practicing physicians is essential, as described in the International Organization for Standardization standard for human-centered design (ISO 9241-210).⁵⁴ With human-centered design, the "multidisciplinary skills and perspectives" of users are applied "throughout design and development" and ongoing improvements are made in an iterative fashion.^{54,55} Physicians can also inform designers of their needs and challenges through formal methods including usability testing⁵⁶⁻⁵⁸ and cognitive work analysis.^{59,60}

Although this implies several new efforts, it is likely that physician well-being, technology acceptance, and good decision making are all outcomes of the same work.

AIM TO UNDERSTAND THE ESSENTIAL FUTURE ROLES FOR PHYSICIANS

The EHR and Its Impact on the Tasks of the Physician-Patient Encounter

The impact of HIT goes beyond the computer interface, also shaping roles and responsibilities in health care tasks. Unlike the paper chart, the EHR has the power to inform and to enforce. For example, through alerts and hard stops, it is possible to adhere to an increasing number of clinical guidelines or regulatory demands.⁶¹ When the EHR's ability to enforce is combined with health care's flipped business model (ie, placing its experts on the front line), the physician-patient encounter becomes an irresistible venue for new tasks or goals. This allows encounter tasks to accumulate in ways that can be uncoordinated and overwhelming.

Although the EHR encounter may offer a venue for many stakeholder interests, these interests are not necessarily coordinated for the sake of the physician in the encounter. Alerts may be added to EHR encounters to serve population health, quality assurance, risk management, customer service, billing, or research goals, yet the sum result may be an overload of alerts such that some are ignored or clicked through, perhaps without any real attention to priority.^{20,21,62} Various stakeholders may each assert their own documentation expectations but do so without cooperation toward having a chart that is easy for doctors or patients⁶³ to review. Coding imperatives may come from clinical, quality, research, or billing perspectives, yet with little unified guidance for the physician who must ultimately enter something in a box.

This trend also turns a blind eye to the zero-sum reality of a patient-physician encounter. Doing more of one thing means doing less of another, and these trade-offs may not be explicitly considered when tasks are added. One subtle but crucial trade-off is health care's capacity to innovate. These overwhelmed encounters place physicians in a defensive (yet powerful) position in which

they are likely to resist new tools simply out of self-preservation.

In short, the physician-patient encounter, arguably the most important event in health care, seems to lack the advocacy, strategy, or intentional design to manage current priorities or to make space for future ones. A strategy of approaching encounter expectations from a perspective of constraints is essential. For example, acknowledging the time constraint should press us to prioritize, redistribute, or automate encounter tasks. Consideration of the limited attention of physicians drives us to prioritize or reduce alerts so that critical information is not ignored. Acknowledging cognitive constraints compels us to design tools to filter, summarize, and frame information to suit encounter needs, and so on.

Understanding the Essential Future Roles for Physicians

When we consider where the physician "fits" within the next era of health care, we might reflect on what made them so essential in the past. It is not the routine delivery of care for which we need a physician, but rather for the many gray areas and exceptions that occur in health care. Often a test result does not match the clinical picture, the complexity of a case surpasses a clinical guideline, or a first-line therapy must be abandoned because of a patient's unique characteristics, preferences, or situation. What was needed then and now is physicians who can exercise medical knowledge and depart from a "textbook approach" to accommodate the exceptions and complexities of real health care.

Future health care may involve artificial intelligence tools, pharmacogenomics, oversight of automated "e-visits," review of cardiac and other biometric monitoring, review of chronic disease trackers or journals, population surveillance, applying predictive models, and so on. These new technologies and their information will also fit imperfectly with patient needs. Physician involvement is critical in the safe and reasonable use of such tools.

There is an adaptation problem, however, in that a physician may not be able to manage all the new information and technologies of health care, even within their own specialty. In many cases, teams will serve as custodians of specialized knowledge and technical

capabilities. Physicians and other health care professionals within formal and informal teams will serve as expert resources for each other. The physician's expert role would be a familiar one: handling exceptions, making decisions when information is uncertain or conflicted, providing a human touch as a medical authority, and supporting patients in making difficult health care decisions in accordance with their values.

It would be a stagnating move to keep physicians busy with routine protocol-driven care, health maintenance or EHR-driven "clerical tasks."¹¹ With physicians preoccupied with such tasks (and defensive toward new ones), there is a real risk that health care will be slow in applying new technologies or that they will be applied without refinement by physicians. In a future in which physicians and other health care workers are effective and fulfilled in their work, their roles must fit their unique strengths and not be defined by process conveniences, tradition, or misaligned financial incentives.

Also, there is some urgency to conceptualize the future of physician work now, not only to inspire HIT design but also for the sake of medical training regarding HIT. Without a working model of the future, we may find ourselves training new physicians to do things that computers do increasingly well while leaving them unprepared for their role in supervising, interacting with, or training in advanced information systems. As the future accelerates toward us, the question "What is physician work?" must become a perennial one. Both physician well-being and health care efficacy are likely outcomes of answering this question skillfully.

AIM TO DESIGN TECHNOLOGY FOR THE HEALTH CARE WE NEED, NOT THE HEALTH CARE WE HAVE

The Evolving Landscape of Health Care and Our Model of Care

In addition to any impact on burnout, a concerning possibility is that these overwhelmed encounters represent a bottleneck between the needs of patients and the capabilities of health care. As our care model delivers much of its care through physician encounters, then whatever limits doctors have, whether

in time or abilities, become the limits of health care overall. This may be especially true in regard to the increase in chronic conditions. Reducing mortality for many of these conditions is overwhelmingly dependent on nonmedical interventions,⁶⁴ yet our health care system relentlessly arranges these interactions with physicians. Now, up to half the patients a physician faces each day is suffering from a chronic condition⁶⁵ for which a doctor's brief, episodic, directive, medication-based interventions are a poor fit for the ongoing, multidisciplinary, in-depth, individualized, behaviorally focused efforts that such conditions may require. It is not difficult to imagine this mismatch as a contributor to overtesting, overprescribing, and burnout.

Compounding this problem, our model is also relatively blind to opportunities for early intervention. With its emphasis on diagnostic thresholds, it misses the subtle biological, behavioral, social, or environmental changes that might lead to chronic conditions such as obesity, chronic pain, depression, diabetes, and addiction. As we view our patients through our keyhole of episodic symptom-oriented encounters, we may overlook thousands of patients who, in the evolving situations of their lives, are quietly crossing tipping points^{66,67} into lifelong chronic conditions. These conditions will demand most health care's financial resources⁶⁸ and likewise place a cumulative demand on its workers as this population grows.

Importantly, it is not simply the physicians' effectiveness or well-being that is at risk. Wherever care models poorly match care needs, it impacts patients, caregivers, and all health care workers. The effectiveness and well-being of all participants must be the focus as we evolve our model of care and its accompanying culture.

Designing Technology for the Health Care We Need

Health care must take a longer, broader, and more precise view of its patients. It must consider health trajectories over the lifespan and intervene usefully in prediagnostic window periods as well as with postdiagnostic trends. It must engage patients with a broader perspective of well-being that considers the interplay of physical and mental health. It

must intervene with precision, considering a patient's unique genetics, environments, preferences, and behaviors.

Along with this, our model must evolve from one that is oriented around physicians delivering services in encounters to one that orients health care more directly around the patient, intervening effectively both within and beyond traditional encounters, and leveraging a spectrum of health care workers, methods, and technologies to do so.

The health record itself must evolve from a physician's chart to a collaborative information system that is able to (1) coordinate the efforts of a team; (2) provide shared views of problems, efforts, and progress; (3) provide an informational lens for each participant that suits their role (including the patient); and (4) make team efforts and their outcomes measurable toward clinical, financial, regulatory, and organizational imperatives.

Health care information technology is essential to this longer, broader, more precise approach to chronic conditions. The ability to work with prediagnostic or postdiagnostic disease trajectories, precision care, behavioral interventions, and so on, requires an EHR that can usefully represent them. To monitor and intervene with chronic conditions, tools are needed for assessing disease risk trajectories along with patient-facing tools for disease monitoring, self-care, mental health management, caregiver-delivered interventions, and more.

A HUMANISTIC APPROACH TO TECHNOLOGY AND THE CHALLENGES IT FACES

It is becoming evident that the decisions that are made now about HIT will have broad and potentially long-lasting impacts on the effectiveness of health care and the well-being of its workers. An international consortium of Human-Computer Interaction experts⁶⁹ suggests that with technology design we should be "working strategically towards becoming more driven by humanistic concerns than deterministic ones....(p. 1235)" The 3 aims proposed here are intended to elaborate on that goal. However, their fulfillment is far from inevitable, as these aims face the momentums of medical culture, organizational structures, payment models, technology design, and so on. A forward-looking

leadership approach is needed that strives to balance the immediate imperatives of health care against the broader vision of new models of care and a well workforce. This balancing act occurs across 2 veins of effort. The first involves the opportunities in creating and choosing these technologies. The second involves our leadership at the intersection between users, their technologies, and most especially the information that they produce.

Opportunities at the Crossroads of HIT Design

Every new information technology faces a crossroads in relation to our care models. A design can be innovative, intending to shift the model of care, or constitutive, that is, embodying and perpetuating our traditional model.^{70,71} The EHR was mostly constitutive.⁷¹ Yet this choice did not come from any assurance that our model of care was better than team-based approaches, nor from any hubris that physicians could forever be the main conduit for health care's growing information, treatments, behavioral interventions, preventive care, and technology advances. A constitutive design was simply the most straightforward approach, and perhaps it was as much change as our health care system could bear at that time.

However, health care itself is overdue for many changes, and it may need to be our technology strategy that catalyzes this effort. Many issues have been described including fragmented care, lack of necessary care, variable quality, poor coordination, and patients given contradictory information.⁷² Largely, these result from health care that is organized around the narrow foci of care venues, specialties, physician encounters, and other siloed structures that create arbitrary and artificial gaps in the continuity and consistency of a patient's care. Emerging models will have to reduce care silos, shift the health care culture from a "doctor-fits-all" approach, and engage the talents of traditional and new health care workers in new roles.

However, these concerns have been voiced for decades, with traditional models held firmly in place by incentives, organizational structure, patient enculturation, medical education, quality and productivity measures, and so on. Although hopeful islands of progress have been made in health care, these issues persist

TABLE. Efforts to Support Well-being in Technology-Mediated Work

Design technology for the health care we need

Generate a collaborative vision of next-generation health care

- Establish workgroups of technology and industry experts to assess potential models of care and their requirements.

Use team-based care and technology to support care innovation

- Enhance coordination through integrated interprofessional care plans with goals, steps to reach them, and overall progress.
- Generate evidence to improve team-based models.
- Support patient-created data and remote monitoring.

Align human and technology resources with chronic conditions

- Support a longitudinal view of a patient's treatments, disease progression or remission, etc. Support registry management.
- Establish chronological models for various conditions. Use tools to analyze risk trajectories and respond to window periods or stages of disease with timely targeted interventions. Augment human interactions with technology-driven checkups to monitor for physical or mental health changes.
- Integrate nonmedication interventions into care plans including individualized behavioral interventions, caregiver roles, and technology "prescriptions."

Understand the essential roles for physicians

Align physician roles with future care models

- Discern the essential and compelling roles for physicians in future models of care.
- Design HIT to support and quantify noncounter physician activities toward quality, productivity, and other health care imperatives.

Develop leadership and strategies to reduce a physician bottleneck

- Coordinate and prioritize encounter expectations from a perspective of the time, attention, and cognitive constraints of physicians in encounters.
- Orient health care information and tasks increasingly around the patient vs "through" physicians.

Educate new physicians for emerging roles

- Assess trends in HIT and develop core curriculum for human-computer collaboration in health care.
- Train doctors in the use and oversight of AI-enhanced risk prediction, decision support, diagnostics, surveillance, etc.

Design technology for a well workforce

Develop foundational principles and methods

- Research the intermediates of well-being and burnout in HIT, ranging from simple usability issues to satisfaction with advanced collaborative technology interactions.
- Establish fundamental principles, goals, and methods in HIT design that lead to guidelines, standard use cases, and evaluation methods.
- Use terms and make reference to design taxonomies to enculturate well-being as a normative design consideration.

Define the desirable features of HIT for well-being

- Define the desirable features of HIT design that serve both well-being and effectiveness and that can be used in product evaluation and comparison by purchasers or health care leaders.

Establish accountability for well-being in the work environment

- Establish leadership accountable to the work environment, especially HIT impacts. This is contrasted with, but complementary to, current resiliency-focused efforts.

Monitor HIT for human impacts and remediate

- Assess HIT impacts not only for outcomes but for efficiency, user stress, etc. Seek feedback from physicians and objective measures via audit logs etc.
- Increase the overlap between design and implementation to allow for change in technologies that fall short in effectiveness or humanistic design.

AI, artificial intelligence; HIT, health care information technology.

in many ways.⁷³ What is new, however, is technology's potential to serve as a platform for developing new care models. Health care information technology offers the possibility of integration and continuity: multidisciplinary care plans that are shared across providers and specialties, interventions from prediagnosis through severe chronic disease, consistent information across sources, continuity from clinic to hospital to aftercare, televisits and apps that

can bring interdisciplinary team members to the patient, and much more.

Health care information technology design must be proactive in envisioning next-generation health care through an ongoing dialogue with health care leaders, physicians, and other domain experts far ahead of the actual changes in practice. Establishing new care models against the momentum of old ones will require tools that not only support

this team-based care but also capture its outcomes and offer potential new measurements of productivity and quality. Realistically, if a shift in the model of care is to occur, it will be because the technology strategy made it not only possible but more likely.

Leadership to Support Well-being at the Intersection of Users and Technologies

Managing technology and its information from a well-being perspective may find itself at a practical disadvantage when competing with other interests. For example, adding a clinical alert may immediately improve a certain metric, but removing or deprioritizing that same alert may not improve burnout in any immediate or even measurable way.

In leadership, there is a reasonable tendency to “look where the light is,” emphasizing efforts that have a clear and measurable impact in the short term and that meet operational goals for which a chain of leadership is immediately accountable. In contrast, leading from a well-being perspective requires advocacy where data are sparse, where research may be immature, and where concepts are psychological and perhaps vague. Facing the accelerating changes in technology, insightful leadership involves weighing any compelling new capabilities against their potential impacts on well-being and, wherever possible, find innovative solutions so that such a trade-off is unnecessary.

Perhaps through such pioneering efforts it will be both apparent and appreciated by the next generation of doctors that we invested in their well-being in technology-mediated work. Not that we could apply a perfect science to this effort, but that we were curious and intentional, that we applied the best evidence that could be found and our best judgment where there was none, and that we invested not only in our short-term goals but also in a long-term vision of well-being for all the participants of health care.

Toward a forward-looking approach to technology and well-being, several areas of effort are proposed (Table).

CONCLUSION

The well-being of physicians depends on health care delivery models that are aligned with the needs of patients, compelling and

suitable physician roles in those models, and information technologies that support those roles well. Toward these aims, the importance of a humanistic and forward-looking technology strategy cannot be overstated.

Abbreviations and Acronyms: EHR = electronic health record; HIT = health care information technology

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