Keith,

First, I sincerely apologize for the strident tone (but not the substance) of my last post. I agree that improving EHRs is a “collaborative journey” requiring shared good faith efforts from clinicians, clinical informaticians, software developers, UX experts, and regulators. I want to be part of that journey, and I don’t mean to incite conflict or bash anybody. One purpose of Dr. Verghese’s article is to explain how “taking care of sick folks” is an intensely human process whose complexity is not well or easily encompassed by current algorithmic methods. Clinicians and software engineers have been trying to reach a shared understanding of how care processes proceed and how to make them more evidence-based for decades. Yet a majority of clinicians still find the EHR user experience to be very poor, and many software engineers still think that clinicians are too lazy and technophobic to become proficient with EHRs. Clearly, we are not communicating well enough or executing user-centered design principles well enough to produce a software product whose primary target audience perceives it to be both useful and usable. Normally the competitive pressures of a free market would speed development of solutions. Unfortunately, the current EHR ecosystem is NOT a free market. Rather it is oligopolistic, profit focused, heavily entangled with an illogical "regulatory" system, and suffering from a severe case of path dependency. So, it’s up to us to do better. Let’s start the collaboration process right here and communicate about some of the points you make in more depth.

*[You claim the data is there, most of the studies I've read cite a paucity of data. Both provider and consumer of services are more satisfied when the technology doesn't get in the way of the interactions that both feel are more important.  In that, I think we can agree.]* I am attaching a list of ten recent papers analyzing the many ways that EHRs interfere with physician-patient interactions and distract clinician attention. In a 15-minute office visit, a clinician is expected to make eye contact, listen actively and empathetically, process nonverbal cues, elicit medical history, keep laboratories, allergies, and medication lists in mind, and formulate differential diagnoses all while documenting granularly enough to support an ICD-10 code and entering all the structured data required by the EHR. It’s like texting while driving (not a good idea either). One can (and many physicians do) defer the EHR data entry until the end of the clinic day, but then the clinician’s memory may not be as detailed, and the activities lengthen the workday and disrupt work-life balance leading to burnout.

*[In my experience, most EHR user experiences (or workflows) are highly customized by the provider organization, and for the most part, EHR vendors are very challenged in providing the user experience skills needed to implement the desired workflows effectively.]* Clinical workflows are inherently nonlinear, interruptive, specialty specific, and often highly individualized. EHRs often start with a hard-coded, idealized, linear, one-size-fits-all model of health care delivery, often requiring clinicians to work with data whose content and ordering are not relevant to the patient currently under care, not adjusted to a patient’s specific clinical situation, and/or not organized to fit the way clinicians think based on their training and experience. This is tremendously frustrating for clinicians, so of course provider organizations do use system configuration options and user personalization tools to achieve the flexibility necessary for clinicians to get any work done at all. The cost of this can be a smoking hole in someone’s foot, but that’s rare. Since local customizations do have such a significant effect on EHR functioning, it would make sense for software developers to keep databases of best configuration practices, safety improvements, methods clinicians like, big usability wins, etc. to incorporate in next generation products, to recommend and disseminate to customers, and to publish to the world. But they would rather prioritize intellectual property protection over healthcare for the common good.

*[As I've said, I've seen organizations work through this, change the way they use the EHR, and change the patient / physician experience with a computer in the room in ways that are successful.]* Yes, there are well-described approaches to mitigate these problems (e.g. JAMA Intern Med 2016;176:128-129), but physicians vary significantly in their ability to compensate for the communication barriers imposed by health IT. Should it really be the customer’s responsibility to do this? Should we pay and train clinicians to learn how? Does the fact that the software’s deficiencies can be overcome by a user’s dedicated hard work imply that it’s a good product? *[It wasn't magic, it didn't happen overnight.  It was for him and for his organization, a seven-year journey that he went through from just getting started with the EHR until when I saw him last, where he was still working through issues but was mostly satisfied]* Is there any other industry where a product which required seven years of modification and tuning in order to finally function properly would remain on the market? What effects did your physician’s struggles with the EHR have on his ability to provide best care until he got it working right?

*[If your EHR is a Windows 95 GUI slapped on a billing and administrative database, I'm sorry, that sucks]* All current EHR’s are precisely that, which is why they suck. All data must be entered and reconciled by human users, one agonizing bit at a time, using mouse and keyboard, consuming enormous amounts of time. To graduate beyond the Windows 95 era, we will need to use natural language processing, artificial intelligence, and machine learning methods to simplify and automate recording the data for each clinical encounter, leaving the clinician free to focus on the patient and think about medicine. Imagine the “clinic of the future” where there is no front desk staff. The patient is logged into their patient portal on their phone. It knows that they’ve arrived at the clinic and alerts the clinical staff to start the rooming process. It assigns them a room and they just go straight there. The clinician comes in and activates the ambient listening and large display on the wall. They walk through the visit with the patient, just interacting normally. The system can tell who is speaking, what is a clinical action, what belongs in a note, and queues up orders and documentation for when the visit is done. The clinician never touches a keyboard or mouse, the patient feels like they’re actually interacting with their doctor. I can see your eyes rolling and the image of pie in the sky forming in your brain, but we can do this if we all work together. In fact, it’s critical to get started on this now.

*[I've seen several estimates that indicate that there's about one UX professional per 20 software developers within most software development organizations.  How many UX professionals do healthcare providers employ?]* The job of healthcare providers and organizations is to take the best possible care of sick folks. After a hospital network has spent north of $1 billion to implement an enterprise level EHR (e.g. Harvard, U. Penn, Duke), why should they have to employ UX professionals to get it to work right? However, the one UX professional per 20 software developers quote is absolutely the heart of the issue. Every EHR software developer claims they employ user-centered design methodology. But they vary greatly in their understanding, implementation, and consistent use of UCD methods (e. g. Ratwani RM et al. J Am Med Inform Assoc2015;22:1179-1182 and J Am Med Assoc 2015;314(10):1070-1071). By and large the UCD efforts are underresourced, frequently overruled, and not nearly as succesful as we need them to be. In the past year I served as a provider educator and at-the-elbow trainer during the implementation of a major vendor EHR. We encountered literally dozens of UX errors that could not possibly have made it into a final product if they had been shown to a panel of experienced clinicians during a properly conducted UCD process. Doing UCD correctly requires personnel and resources, and it slows development cycles. So again we arrive at profit motive vs healthcare for the common good, and guess who wins? As Jon Patrick wrote elsewhere in this thread, successful clinical information systems can only come about when the user community is intimately involved in the design so that workflows, data flows, screen designs, information architecture, and navigation are optimized. It will take more than lip serivce for this to happen. EHR developers need to provide well trained adequately staffed UX departments with real influnence in final product design. Healthcare organizations should also contribute by providing compensated professional time and encouragement for experienced clinicians in multiple specialties to participate in user testing and the rounds of iterative development which are indispensable in true UCD and lead to sucessful products.

*[Getting it there is a collaborative journey though, or at least I would hope so.]* Absolutely! We are at a crtitcal point in the evolution of health IT. I’m looking to collaborate with Keith and anyone else who is eager to think with disruptive creativity, strike out a new path, and start solving the real problems. Finally, my apologies to Keith and the list members for the brain dump.

**Effect of EHRs on Physician-Patient Interaction and Physician Well Being**

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3. Sinsky C, Colligan L, Li L, et al. Allocation of physician time in ambulatory practice: A time and motion study in 4 specialties. Ann Intern Med 2016;165:753-760.

4. Toll E. The cost of technology. J Am Med Assoc 2012;307:2497-2498.

5. Farber NJ, Liu L, Chen Y, et al. EHR use and patient satisfaction: What we learned. J Fam Pract 2015;64:687-696.

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9. Street, RL, Liu, L, Farber, NJ, et al. Keystrokes, mouse clicks, and gazing at the computer: How physician interaction with the EHR affects patient participation. J Gen Intern Med 2017;33(4):423-428.

10. Hochman, M. Electronic Health Records: A “quadruple win,” a “quadruple failure,” or simply time for a reboot? J Gen Int Med 2018;33(4):397-399.