Humanism in medicine is characterized by a respectful and compassionate relationship between physicians and other members of the clinical team and patients. Health professionals within the medical community, however, feel that the principles of humanism in medicine have not been a point of emphasis for information and computer technology in healthcare. There is concern that the electronic health record is eroding the patient-clinician relationship and distancing clinicians from their patients. New analytic technologies, on the contrary, by taking over repetitive and mundane tasks, can provide an avenue to make medical care more patient-centered by freeing clinicians’ time, and the time of the whole clinical care team, to engage with patients. Technology such as advanced speech recognition that optimizes clinicians’ workflow could revitalize the patient-clinician relationship and perhaps also improve clinician well-being. Digital phenotyping can gain invaluable additional data from patients using technology that is already used for personal reasons by the majority of patients. The digital transformation of healthcare has the potential to make healthcare more humane and personalized, however, several important steps are needed to avoid the pitfalls that have come with prior iterations of information technology in medicine such as a heightened emphasis on data security and transparency. Both patients and clinicians should be involved from the early stages of development of medical technologies to ensure that they are person-centric. Technologists and engineers developing healthcare technologies should have experiences with the delivery of healthcare and the lives of patients and clinicians. These steps are necessary to develop a common commitment to the design concept that technology and humane care are not mutually exclusive, and in fact, can be symbiotic.

New analytic technologies, on the contrary, by taking over repetitive and mundane tasks, can provide an avenue to make medical care more patient-centered by freeing the healthcare teams’ time to engage with patients. Furthermore, predictive analytics, which enable personalized estimates of risk and benefit, are intrinsically more attuned to individual differences than many current guidelines that are based on the average experiences of large groups of patients. However, for technology to enrich rather than undercut the patient-clinician relationship, medical humanity will need to be at the core of the design thinking behind emerging technologies and software. And more importantly, considerable effort will be needed to plan for how the technology improves the quality of human interactions rather than merely focusing on efficiency, both among team members and with patients and their families.

If humanistic design thinking is emphasized, technology has the potential to recapture the promise of both more effective and efficient healthcare and allow clinicians to be more attentive to their patients. If employed effectively, advances in predictive analytics and information technology could be used to improve clinical workflow, enhance our understanding of patient’s emotional state and human needs, and lead to a new era of humanism in medicine.

The patient-clinician interaction, whether in-person or through other means, has become increasingly complex. However, while the clinic visit in general has increased in duration contrary to general perception, the lengthening of the visit has been outpaced by the increase in the complexity of the health and medical problems patients and their families must consider. Clinicians typically spend more time practicing “desktop medicine” than spending face-to-face time with patients in the outpatient setting. On average, two-thirds of time spent practicing desktop medicine is used to write progress notes, while the rest of the time is used for telephone encounters, sending secure messages and writing prescriptions. In the inpatient setting too, an increasing proportion of time is spent...
The digital transformation of healthcare has the potential to make healthcare more humane and personalized, however, several important steps are needed to avoid the pitfalls that have come with prior iterations of information technology in medicine. Both patients and clinicians should be involved from the early stages of development of medical technologies to ensure that they are person-centric. Emphasis needs to be placed on simplifying communication among members of the healthcare team. Technologists and engineers developing healthcare technologies should have experiences with the delivery of healthcare and the lives of patients and clinicians. These steps are necessary to develop a common commitment to the design concept that technology and humane care are not mutually exclusive, and in fact, can be symbiotic. Technology, if harnessed and developed correctly, can emphasize presence, rather than distancing providers from their patients.

**AUTHOR CONTRIBUTIONS**

All three authors were involved in drafting the manuscript, in the background research and in critical revisions of the drafts. All authors take full responsibility for the contents of this article.
ADDITIONAL INFORMATION

Competing interests: Dr. Warraich declares no competing interests. Dr. Califf is employed as a scientific advisor by Verily Life Sciences (Alphabet), and reports receiving personal fees from Merck. Dr. Krumholz is the founder of Hugo, a personal health information platform, and is a recipient of research agreements from Medtronic and from Johnson & Johnson (Janssen) through Yale University to develop methods of clinical trial data-sharing; is the recipient of a grant from the US Food and Drug Administration and Medtronic through Yale University to develop methods for post-market surveillance of medical devices; works under contract with the US Centers for Medicare & Medicaid Services to develop and maintain performance measures; chairs a cardiac scientific advisory board for UnitedHealth; is a participant/participant representative of the IBM Watson Health Life Sciences Board; and is a member of the advisory board for Element Science and the physician advisory board for Aetna. Dr. Califf is employed as a scientific advisor by Verily Life Sciences (Alphabet). Dr. Krumholz is the founder of Hugo, a personal health information platform.

Publisher's note: Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

REFERENCES

1. Arnold P. Gold foundation frequently asked questions, http://www.gold-foundation.org/about-us/faq/ (2018).
2. Pearl, R. M. in Harvard Business Review. Harvard Business Publishing, Cambridge, MA (2017).
3. Simpkin, A. L., Dinardo, P. B., Pine, E. & Gauflberg, E. Reconciling technology and humanistic care: lessons from the next generation of physicians. Med. Teach. 39, 430–435 (2017).
4. Peckman C, Kane L, Rosensteel S. Medscape EHR Report 2016: physicians rate top EHRs, https://www.medscape.com/features/slideshow/public/ehr2016 - page=19 (August 25, 2016).
5. Abbo, E. D., Zhang, Q., Zelder, M. & Huang, E. S. The increasing number of clinical items addressed during the time of adult primary care visits. J. Gen. Intern. Med. 23, 2058–2065 (2008).
6. Tai-Seale, M. et al. Electronic health record logs indicate that physicians split time evenly between seeing patients and desktop medicine. Health Aff. (Millwood) 36, 655–662 (2017).
7. Oxentenko, A. S., West, C. P., Popkave, C., Weinberger, S. E. & Kolars, J. C. Time spent on clinical documentation: a survey of internal medicine residents and program directors. Arch. Intern. Med. 170, 377–380 (2010).
8. Shanafelt, T. D. et al. Relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction. Mayo Clin. Proc. 91, 836–848 (2016).
9. Zhou, L. et al. Analysis of errors in dictated clinical documents assisted by speech recognition software and professional transcriptionists. JAMA Open 1, e180530 (2018).
10. Chiu, C. et al. Speech recognition for medical conversations. arXiv 1711, 07274v1 (2017).
11. Martinelev, E., Mencattini, A., Daprat, E. & Di Natale, C. Strength is in numbers: can concordant artificial listeners improve prediction of emotion from speech? PLoS One 11, e0161752 (2016).
12. Insel, T. R. Digital phenotyping: technology for a new science of behavior. JAMA 318, 1215–1216 (2017).
13. Ahn, S. J., Bailenson, J. N., Fox, J. & Jabon, M. E. in Handbook of Emotions and Mass Media (eds Doeveling, K., von Scheve, C., & Konijn, E. A.) 349–369 (Routledge: London, UK, 2010).
14. Lien, T. in LA Times (March 20th, 2018. http://www.latimes.com/business/technology/la-fi-tn-facebook-information-dominance-20180320-story.html).
15. Silice, M. A. et al. Using relational agents to promote exercise and sun protection: assessment of participants’ experiences with two interventions. J. Med Internet Res 20, e48 (2018).
16. King, A. C., Bickmore, T. W., Campero, M. I., Pruitt, L. A. & Yin, J. L. Employing virtual advisors in preventive care for underserved communities: results from the COMPASS study. J. Health Commun. 18, 1449–1464 (2013).
17. Angwin, J., Larson, J., Mattu, S., Kirchner, L. in ProPublica. https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing (2016).

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article’s Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit http://creativecommons.org/licenses/by/4.0/.

© The Author(s) 2018