By Jonathan P. Weiner, Susan Yeh, and David Blumenthal

DOI: 10.1377/hlthaff.2013.0680
HEALTH AFFAIRS 32,
NO. 11 (2013): 1998–2004

The Impact Of Health Information Technology And e-Health On The Future Demand For Physician Services

Jonathan P. Weiner (jweiner@jhsph.edu) is a professor of health policy and management and health informatics at the Johns Hopkins Bloomberg School of Public Health and director of the Johns Hopkins Center for Population Health IT, in Baltimore, Maryland.

Susan Yeh is a doctoral candidate in health policy and management at the Johns Hopkins Bloomberg School of Public Health.

David Blumenthal is president of the Commonwealth Fund, in New York City. From 2009 to 2011 he was the national coordinator for health information technology at the Department of Health and Human Services.

ABSTRACT Arguably, few factors will change the future face of the American health care workforce as widely and dramatically as health information technology (IT) and electronic health (e-health) applications. We explore how such applications designed for providers and patients will affect the future demand for physicians. We performed what we believe to be the most comprehensive review of the literature to date, including previously published systematic reviews and relevant individual studies. We estimate that if health IT were fully implemented in 30 percent of community-based physicians' offices, the demand for physicians would be reduced by about 4–9 percent. Delegation of care to nurse practitioners and physician assistants supported by health IT could reduce the future demand for physicians by 4–7 percent. Similarly, IT-supported delegation from specialist physicians to generalists could reduce the demand for specialists by 2–5 percent. The use of health IT could also help address regional shortages of physicians by potentially enabling 12 percent of care to be delivered remotely or asynchronously. These estimated impacts could more than double if comprehensive health IT systems were adopted by 70 percent of US ambulatory care delivery settings. Future predictions of physician supply adequacy should take these likely changes into account.

Most health policy analysts predict that the United States will experience a shortage of physicians as the population ages and many currently uninsured Americans obtain access to care with coverage provided through the Affordable Care Act.[1–4] In addition to major changes in health care financing and organization, the transformation of the US health care system's digital infrastructure will be profound. In part because of the "meaningful use" provisions in the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009, as many as 72 percent of active office-based physicians already have an electronic health record (EHR) system on their desks. Only a decade ago the figure was about 10 percent.[5,6] It is likely that the majority of patients' interactions with the health care system will soon be digitally mediated.[7]

In this article we explore how providers' health information technology (IT) systems and electronic health (e-health) and mobile health (m-health) applications for consumers will affect the future demand for physicians. Major questions include the following: Will digital communication between provider and consumer, including the use of e-mail and e-health self-management tools, decrease or increase the demand for physician services? How will an IT-supported workflow change providers' productivity? Will digital-

ly supported clinical decision support systems make it possible for clinicians with fewer years of training to care for patients with complicated conditions? Will telemedicine and remote electronic patient monitoring help ameliorate provider shortages in some rural locations?

This article does not fully answer these important questions. However, our analysis should help clarify the issues and advance the debate. We focus on the potential impact of IT and e-health on the future demand for physicians. We do not focus on the important but separate issue of how clinicians should best be trained for their increased use of IT, nor on the training of specialized health informatics professionals. We review the current state of health IT and e-health; develop frameworks and paradigms useful in understanding issues at the intersection of the health IT domain and health care workforce planning; provide what we believe is the most comprehensive review so far of the scientific evidence regarding the impact of health IT on key workforce demand and productivity factors; offer informed estimates of the potential direction and magnitude of IT's impact on the future demand for physicians; and suggest areas for future research and policy analysis.

Given the extreme complexity of health IT and workforce dynamics, we limit the scope of this article to the care provided in community-based physician offices, which accounts for about 75 percent of physician-provided care.[8] For the sake of this analysis, we consider this care to also include services provided by nurse practitioners and physician assistants.

In some cases, we consider separately the impact of health IT on primary care generalist physicians and on specialists. However, we do not focus on specific specialties, other types of health professionals—besides physicians, nurse practitioners, and physician assistants—in the ambulatory care setting, or institutionally based care.

We recognize that there is considerable interplay between health IT, the organizational structure of health care delivery systems, and financial incentives. For example, capitated or budgeted organizations in which physicians are effectively salaried have been among the earliest US adopters of EHRs and other comprehensive health IT.[9–11] Today health IT innovations are arguably key components of patient-centered medical homes and accountable care organizations. Although we touch on this issue, given the scope of this article we do not fully disentangle the complex interrelationships among health IT, fiscal and structural transformations of the health care system, and physician productivity.

As noted, we synthesize the health informatics and health services research evidence that bears on the issue of health IT's impact on the future demand for physicians. Few narrowly focused controlled trials have been conducted, but there have been numerous evaluation studies of health IT and e-health interventions in office-based ambulatory clinic settings. We did not perform a complete systematic review of the literature. However, we shed light on this issue by extracting findings from previous systematic reviews as well as germane individual studies. We provide further details about the review process we used, a discussion of our findings, and a summary of important articles in the online Appendix.[12]

Background And Context

WORKFORCE POLICY During the past decade, US nursing, medical, and osteopathic schools have expanded the overall number of training slots, with nurse practitioner and physician assistant programs in particular achieving high growth rates.[1–4,13] Even with this growth in clinician output, for a variety of reasons discussed elsewhere in this special issue of *Health Affairs*, most health policy analysts believe that there will soon be a shortage of primary care physicians and providers in certain medical specialties, particularly in some geographic areas.[1–4,14–17]

In this article we neither criticize nor support current estimates of potential workforce shortfalls developed by others. Instead, we seek to offer insights into how forecasts of supply adequacy, based almost entirely on past patterns of practice, should be modified if health IT and e-health substantively change the face of US health care delivery.

THE NEW DIGITAL PRACTICE MILIEU The US health care system has reached a digital tipping point: As many as 72 percent of office-based physicians now have an EHR system on their desks, although the level of adoption varies across regions and care settings.[18] Surveys indicate that in 2012 fewer than 35 percent of office-based physicians used a comprehensive health IT system, and we estimate that fewer than 5 percent of US patients are cared for by a network of providers having fully interoperable EHRs, a digitally mediated clinical workflow, and two-way doctor-patient electronic communication.[5,18]

It is also estimated that 17 percent of all US consumers now use e-health tools and that 85 percent would like to communicate with their providers using e-mail or secure messaging systems.[19] Furthermore, it is estimated that 56 percent of all office-based physicians now have ways to let their patients access lab test results and other information electronically.[18]

72%

Have an EHR

As many as 72 percent of office-based physicians now have an electronic health record system on their desks.

Appendix Exhibit A-1[12] presents a model of the digital practice milieu that will soon encompass both the provider (supply) side and the patient or consumer (demand) side of the health care system. This model, developed by the lead author of this article,[20] takes into account the following critical contexts: On the supply side, particularly in patient-centered medical homes, accountable care organizations, and other integrated delivery system settings, the provider is usually part of a multidisciplinary, digitally integrated virtual team; and on the demand side, the patient is usually part of a family, social networks, and the broader community at large.

Surrounding the provider and consumer concentric rings in the model are the types of e-health and health IT that currently—or in the near future will—support and mediate the information flow in advanced health care systems (Appendix Exhibit A-1).[12] Information or communication technology, which includes wired and wireless telephone and broadband Internet networks, will link providers and consumers in many ways and thus is central to the model.

Other core technologies include the provider-controlled EHR, the consumer-controlled personal health record, and the web portal—so named because it is the web-based entry point for patients wishing to access personal information from a provider's EHR system.

The Intersection Between Health IT And Workforce Planning

In the remainder of this article we assess several ways in which health IT and e-health could—and probably will—have a substantial impact on the supply and demand sides of the market for physician services. Appendix Exhibit A-2[12] provides our conceptual paradigm that identifies several key health IT or e-health components and suggests how they could affect that market. The market components include the consumer who uses services that require physicians (or nurse practitioners or physician assistants) and the provider who delivers the services. The model depicts several key intermediating aspects of care delivery, including care location, synchronicity (real time or not), clinician type, service content, and levels of productivity. Text in the Appendix[12] describes this paradigm further and suggests some of the ways that e-health and health IT will mediate changes in the demand for and efficiency of the health care workforce.

What The Evidence Says

To inform our assessment of the impact of health IT and e-health on the factors outlined in Appendix Exhibit A-2,[12] we reviewed health informatics and health services research literature. We searched for relevant systematic reviews and stand-alone studies through June 2013 using MEDLINE, CINAHL Plus, the Cochrane Database of Systematic Reviews, and the Agency for Healthcare Research and Quality's database on health IT impact on care workflow.[21]

Our MEDLINE search produced 7,606 articles, of which 134 met our criteria. The Appendix[12] includes information on our review methods, a detailed discussion of what we found, and a tabular summary offering specific details about key articles.

Given the gaps in the literature and the limited methodological rigor of many studies, there is room for further empirical research on health IT's impact on health care workforce market dynamics. However, the current knowledge base provides substantial evidence supporting the premise that consumer and provider IT systems will significantly affect the way office-based care is delivered in the future—which in turn will have a strong impact on future demand for physicians.

Exhibit 1 provides an overview of the important implications suggested by the evidence we identified through our review of the literature. The basis for our assessments and a series of caveats are presented in the literature review in the Appendix.[12] In the following section we place the assumed impacts shown in Exhibit 1 in a broader workforce planning and policy context.

Health IT's Impact On The Future Demand For Physicians

The impact of health IT on the future demand for physicians will depend on how rapidly electronic systems are adopted and how fully care delivery is transformed by its digitalization.[2] The transformation could occur to a significant degree by 2020, but it is also possible that health IT adoption will not be widespread until later. The likelihood that health IT adoption will not progress at all beyond its present status, we believe, is nil.

To help assess the bottom-line implications of expanded use of health IT on the future demand for physicians, we describe two alternative scenarios for the future, based on different levels of health IT adoption and our literature review and judgments. Exhibit 2 shows our assessment of the potential impact of full implementation of comprehensive health IT systems—including interoperable EHRs, clinical decision support, provider order entry, and patient web portals with secure messaging. Because no one predicts full implementation within the US at any time

EXHIBIT 1

Assessments Of The Impact Of Health Information Technology (IT) On Future Demand For Physicians

Type of health IT	Potential effect	Evidence to date	Assumed impact
Consumer e-health or m-health tools	Decreased demand because more self-care is mediated by e-health	Some modest evidence for lower demand, some evidence of reduced inpatient and ED care	Less than 5% decrease in demand, less use of ED and inpatient care in integrated delivery systems
Consumer-provider digital communication	More e-contacts and less demand for in-person visits; more asynchronous care; increased provider productivity associated with e-care	Substantial evidence that office visits can be reduced by 10–20% in integrated settings, but increased time required to answer e-mail; some evidence for increased patient activation	When fully adopted, estimated decrease of 15% in in-person contacts, estimated 10% decrease in provider time required
Telemedicine or remote care	Less face-to-face care; increased delegation from physician to nurse practitioner or physician assistant and from specialist to primary care provider; increased productivity	Substantial evidence that telemedicine is effective and leads to more off-site care; more care can be delegated to lower-level providers; less specialist time is needed	Substantial proportion (perhaps 10–25%) of care can be provided by remote provider; substantial proportion (perhaps 10–25%) of care can be delegated to less specialized clinician
Digital clinical workflow (use of electronic health record, clinical decision support, or provider order entry)	Increased efficiency and productivity, more delegation	After short-term decrease in productivity, reasonable evidence for increased productivity and efficiency; impact on delegation not generally assessed, but most settings rich in health IT delegate at higher levels than clinical settings without IT integration	Overall increased provider efficiency (perhaps 5–10%); health IT systems are intrinsic part of models that support team collaboration and delegation

SOURCE Authors' review of literature. **NOTES** The online Appendix (see Note 12 in text) contains a literature synthesis, and Appendix Exhibit A-3 provides a summary of key articles. ED is emergency department.

soon, our two scenarios present the impact on physician demand of "low" adoption (30 percent use of comprehensive systems) and "high" adoption (70 percent use).

The issue of delegation of care supported by health IT is both complex and important. Few

EXHIBIT 2

Estimates Of How Health Information Technology (IT) Could Affect Future Demand For US Physicians Under Various Scenarios

Type of impact of health IT	Estimated range of effects with full health IT implementation	Estimated decrease in national demand for or percent of care provided by physicians, given: 30% penetration of full health IT	70% penetration of full health IT
GAIN IN EFFICIENCY (AMOUNT OF GAIN, DECREASE IN DEMAND)			
From consumer use of e-health, e-mail, and other communication technology	5–15% gain	2–5%	4–11%
From provider workflow changes	5–10% gain	2–4%	4–8%
Total	10–25% gain	4–9%	8–19%
SUPPORT OF DELEGATION (AMOUNT OF DELEGATION, DECREASE IN DEMAND)			
From physician to nurse practitioner or physician assistant[a]	10–20% delegation	4–7%	8–15%
From specialist to generalist physician[a]	5–15% delegation	2–5%[b]	4–11%[b]
Total	15–35% delegation	6–12%	12–26%
INCREASE IN REMOTE OR ASYNCHRONOUS CARE (PERCENT OF CARE PROVIDED BY PHYSICIANS)			
Remote care[c]	5–15% of care	2–5% of physician care	4–11% of physician care
Asynchronous care[d]	10–20% of care	4–7% of physician care	8–15% of physician care

SOURCE Authors' analysis. [a]Assuming there is an adequate supply of providers to whom work is being delegated. This is likely to be the case for physicians' delegation to nurse practitioners or physician assistants, but it may not be the case for specialists' delegation to generalist physicians. [b]Specialists. [c]Not face-to-face but in real time. [d]Not face-to-face and not in real time.

studies have focused on the degree to which IT serves to increase rates of delegation. However, the general body of research on clinical decision support and telemedicine that we summarized in our review found that settings with mindful operational integration of health IT are able to delegate care to nurse practitioners and physician assistants at a far higher rate than other systems can. There are, of course, many factors not related to health IT that can also lead to increased delegation of care, including economic incentives and the availability of practitioners.[1,13,22]

Exhibit 2 presents estimates of how health IT might serve to increase delegation—both from physicians of all types to nurse practitioners and physician assistants and from specialists to generalist physicians. More research is needed, and the trend of increased delegation by specialists to primary care doctors could be slowed by a scarcity of generalist physicians. However, our estimates are supported by the literature, which shows that a proportion of care can be delegated away from specialists when "e-referral" modules are used. That is, when generalists can have a brief digital consultation with a specialist using such systems, some percentage of in-person visits to specialists can be avoided.

8–15%

More patients

Efficiency gains from health IT should enable physicians to meet the demands of about 8–15 percent more patients than would be the case without health IT.

In our low adoption scenario, we estimated that delegation of care supported by health IT would lead to an estimated 4–7 percent decrease in demand for primary care doctors and an approximately 2–5 percent decrease in demand for specialists (Exhibit 2). These figures do not include the concomitant increase in demand for the providers to whom care is delegated. In other words, the demand for nurse practitioners and physician assistants would rise as the use of physicians declined.

Similarly, a greater number of generalists would be required to enable specialists to delegate care to generalists. That number of generalists would be roughly equivalent to the number freed up by the delegation of some primary care physician services to nurse practitioners and physician assistants. Therefore, under this scenario the net demand for primary care doctors would not change.

An additional effect of health IT could be to increase the proportion of care that could be provided remotely and asynchronously (Exhibit 2).

Implications For Future Workforce Policy

The analysis we offer suggests that health IT, in conjunction with the associated transformation of care, will have a substantial impact on the future demand for physicians. By 2020 or 2025, as comprehensive health IT and e-health spread to the majority of care settings in United States, the evidence suggests that efficiency gains will enable physicians to meet the demands of about 8–15 percent more patients than would be the case without health IT. We believe that IT can contribute to a 5–12 percent decrease in the demand for all physicians by supporting the delegation of care to nonphysicians. Furthermore, in settings where an adequate number of generalist physicians are available, we believe that IT-supported specialist-to-generalist delegation could contribute an additional 3–8 percent decrease in the demand for specialists.

The above figures represent our estimates of the potential national impact of various levels of health IT adoption. They are based on the approximate midpoints of our forecasts presented under the two scenarios in Exhibit 2. The impact in an integrated delivery system or region attaining 100 percent use of advanced health IT systems would probably be higher.

The likely impact of health IT on the issue of place is quite interesting. An interoperable EHR system and remote care systems could help address shortages of providers in rural communities and elsewhere. We estimate that with support from health IT, 5–10 percent of real-time "office-based care" could be delivered by providers whose patients are not actually in the physician's office (Exhibit 2). Additionally, 5–15 percent of care could involve interactions between consumers and providers not only from separate locations, but at different points in time. If 20 percent or more of providers delivering care within a community did not reside in the same town, state, or even country as the patient, this could have major implications on regional and worldwide workforce policy.

Digitally mediated shifts in the time or space dimension of care delivery could also affect physicians' participation in the workforce. For example, some physicians might postpone their retirement if they could telecommute to work part time. Therefore, increased use of health IT might extend the future practice life of providers beyond what is the norm today.

It is not our goal to offer numeric estimates of the degree to which health IT will contribute to a greater balance or imbalance between physician supply and demand that diverge from widely accepted forecast models such as that of the Association of American Medical Colleges[17] or the federal government.[2] However, the estimates we describe here do support the premise that health IT, both on its own and as part of an overall transformation of the health care system, will contribute to a substantial decrease in the demand for both generalist and specialist physi-

cians. Moreover, IT is likely to have a considerable impact on regional shortages of primary care providers. We believe it is essential that all future workforce forecasting and planning activities explicitly consider the effects of health IT and e-health that we identify in this article.

Discussion

We have attempted to identify and synthesize the best available relevant literature, but the depth, breadth, and quality of the evidence is limited. It should also be acknowledged that the predictions of future demand and supply that we or anyone else offer are composites of evidence, frames of reference, and judgment. Furthermore, the frameworks used and judgments made involve a blending of technical, organizational, financial, and political knowledge and assumptions. Thus, our goal has not been to predict a future that we consider certain. Our intent instead is to spur further discussion and the consideration of outcomes that could result from a rapid increase in the use of EHRs, e-health, and other health IT.

Our discussion has focused on the community-based health care delivery sector, which—as noted above—accounts for approximately 75 percent of physician-provided care in the United States.[8] It is likely that the impacts of health IT on providers based in hospitals and other institutions will be similar, but they could be different.

We believe that for the key areas we have identified, there is some degree of consensus in the literature. However, research has been based mainly on early adopters of health IT, some results are mixed, and there are a few studies with contrary findings. For these reasons, and because the health IT domain is changing rapidly, it is critical that other literature syntheses be undertaken to validate our forecasts. More important, the available evidence base needs to be extended considerably.

To that end, we recommend that health services researchers, specialists in health IT and informatics, and workforce planners collaborate to design well-controlled and tightly focused investigations that address some of the key issues and questions we raise in this article. We recommend that future evaluative research not focus just on provider productivity or efficiency. Instead, the emphasis should be on holistic population-based impacts of alternative workforce models brought about by care supported by health IT.[23,24]

In this article we offer a range of estimates under two scenarios of health IT adoption. Some health IT policy analysts may believe that we have been too ambitious in our forecasts of the range (30–70 percent) of adoption of IT or its effects once fully adopted. Others may believe that we have been too conservative, because e-health and IT are major disrupters that will change consumer-clinician interactions in profound ways surpassing anything seen in the past.[25] In our analysis, we have attempted not to be completely bounded by past models of care. However, most experience to date is based on a relatively small number of early-adopter settings.

Whether adoption of health IT is gradual or disruptive, will we ever be able to make reliable projections of workforce demand for ten to thirty years hence, if health care continues to be invaded by digital and "big data" apps as dynamic as those now common outside of medicine? We should use great caution if we rely on the past (before the arrival of transformative health IT) to plan for the future. We may need to fundamentally reexamine our notions of consumer-provider interactions. For example, human-machine interactions may change so dramatically that people can longer be neatly divided into categories such as patient, clinician, and support staff.

A separate but related issue is worth noting: how best to train the next generation of clinicians to use health IT as part of their core tool kit.[26,27] There will be a need for people who can interact effectively with hardware and software. This group will include computer-savvy doctors and nurses, computer scientists with clinical degrees, "whiz kids" in start-up technology companies, and online consumer support technicians who may live in another country. There will also be a need for people who can develop and make use of new predictive analytics that take advantage of big data in the e-health "cloud" and enable bottom-up innovation and new organizational models that include health IT as part of every function.

The consumer's role will also be different in the future. Patient-centered provider teams will need to take advantage of data that are generated before, during, and after a visit (whether face-to-face or remote) and that come from numerous nontraditional, community-based sources. Every practice will need to have an online "consumer navigator" available around the clock to answer questions and digitally manage the patient's EHR.

Conclusion

At its heart, workforce planning and forecasting is not a technical enterprise. Determining what a nation's workforce should, could, or will look

like ten to thirty years in the future is fraught with conceptual and political challenges and choices. That is not to say these difficult decisions should be made on an evidence-free basis.

Arguably, few trends will change the future face of American health care as widely as health IT and e-health. It is essential that workforce planning analyses provide policy makers and stakeholders with evidence and ideas that support rational decision making and preparation for a future that is likely to be dramatically different from the past. ■

The opinions expressed in this article are those of the authors and not the Johns Hopkins University or the Commonwealth Fund. Joyce Hines assisted in the preparation of this manuscript. The authors are grateful to three anonymous peer reviewers for their constructive input.

NOTES

1 Iglehart JK. Expanding the role of advanced nurse practitioners—risks and rewards. N Engl J Med. 2013; 368(20):1935–41.
2 Health Resources and Services Administration. The physician workforce: projections and research into current issues affecting supply and demand [Internet]. Rockville (MD): HRSA; 2008 Dec [cited 2013 Oct 2]. Available from: http://bhpr.hrsa.gov/healthworkforce/reports/physwfissues.pdf
3 Mann S. Addressing the physician shortage under reform [Internet]. Washington (DC): Association of American Medical Colleges; 2011 Apr [cited 2013 Oct 2]. Available from: https://www.aamc.org/newsroom/reporter/april11/184178/addressing_the_physician_shortage_under_reform.html
4 Iglehart JK. Health reform, primary care, and graduate medical education. N Engl J Med. 2010;363(6): 584–90.
5 Hsiao C-J, Hing E. Use and characteristics of electronic health record systems among office-based physician practices: United States, 2001–2012 [Internet]. Hyattsville (MD): National Center for Health Statistics; 2012 Dec [cited 2013 Oct 2]. (NCHS Data Brief No. 111). Available from: http://www.cdc.gov/nchs/data/databriefs/db111.pdf
6 Blumenthal D. Implementation of the federal health information technology initiative. N Engl J Med. 2011;365(25):2426–31.
7 Or CKL, Karsh BT. A systematic review of patient acceptance of consumer health information technology. J Am Med Inform Assoc. 2009; 16(4):550–60.
8 Lewin Group. The state-level economic impact of office-based physicians. Falls Church (VA): Lewin Group; 2011.
9 Chen C, Garrido T, Chock D, Okawa G, Liang L. The Kaiser Permanente electronic health record: transforming and streamlining modalities of care. Health Aff (Millwood). 2009;28(2):323–33.
10 Garrido T, Jamieson L, Zhou Y, Wiesenthal A, Liang L. Effect of electronic health records in ambulatory care: retrospective, serial, cross sectional study. BMJ. 2005;330(7491):581.
11 Byrne CM, Mercincavage LM, Pan EC, Vincent AG, Johnston DS, Middleton B. The value from investments in health information technology at the U.S. Department of Veterans Affairs. Health Aff (Millwood). 2010;29(4):629–38.
12 To access the Appendix, click on the Appendix link in the box to the right of the article online.
13 Auerbach DI. Will the NP workforce grow in the future? New forecasts and implications for healthcare delivery. Med Care. 2012;50(7): 606–10.
14 Weiner JP. Expanding the US medical workforce: global perspectives and parallels. BMJ. 2007;335(7613): 236–8.
15 Iglehart JK. Grassroots activism and the pursuit of an expanded physician supply. N Engl J Med. 2008;358(16): 1741–9.
16 Goodman DC, Fisher ES. Physician workforce crisis? Wrong diagnosis, wrong prescription. N Engl J Med. 2008;358(16):1658–61.
17 Association of American Medical Colleges. The complexities of physician supply and demand: projections through 2025 [Internet]. Washington (DC): AAMC; 2008 Nov [cited 2013 Oct 2]. Available from: https://members.aamc.org/eweb/upload/The%20Complexities%20of%20Physician%20Supply.pdf
18 Jamoom E, Beatty P, Bercovitz A, Woodwell D, Palso K, Rechtsteiner E. Physician adoption of electronic health record systems: United States, 2011 [Internet]. Hyattsville (MD): National Center for Health Statistics; 2012 Jul [cited 2013 Oct 2]. (NCHS Data Brief No. 98). Available from: http://www.cdc.gov/nchs/data/databriefs/db98.pdf
19 Ricciardi L, Mostashari F, Murphy J, Daniel JG, Siminerio EP. A national action plan to support consumer engagement via e-health. Health Aff (Millwood). 2013;32(2):376–84.
20 Weiner JP. Doctor-patient communication in the e-health era. Isr J Health Policy Res. 2012;1(1):33.
21 Agency for Healthcare Research and Quality. Health information technology: research [Internet]. Rockville (MD): AHRQ; [cited 2013 Oct 2]. Available from: http://healthit.ahrq.gov/health-it-tools-and-resources/workflow-assessment-health-it-toolkit/research
22 Weiner JP. Prepaid group practice staffing and U.S. physician supply: lessons for workforce policy. Health Aff (Millwood). 2004;23:w4-43–59. DOI: 10.1377/hlthaff.w4.43.
23 Sochalski J, Weiner J. Health care system reform and the nursing workforce: matching nursing practice and skills to future needs, not past demands. Appendix F in: Institute of Medicine. The future of nursing: leading change, advancing health. Washington (DC): National Academies Press; 2011. pp. 375–400.
24 Green LV, Savin S, Lu Y. Primary care physician shortages could be eliminated through use of teams, nonphysicians, and electronic communication. Health Aff (Millwood). 2013;32(1):11–9.
25 Topol E. The creative destruction of medicine: how the digital revolution will create better health care. New York (NY): Basic Books; 2012.
26 Masys DR. Effects of current and future information technologies on the health care workforce. Health Aff (Millwood). 2002;21(5):33–41.
27 Blumenthal D. Expecting the unexpected: health information technology and medical professionalism. In: Rothman D, Blumenthal D, editors. Medical professionalism in the new information age. New Brunswick (NJ): Rutgers University Press; 2012. p. 8–22.