

11-2017

The New Diagnostic Team

Mark L. Graber
Stony Brook University

Diana Rusz
Society to Improve Diagnosis in Medicine

Melissa L. Jones
CentraCare Health, St. Cloud Hospital, melissa.jones@centracare.com

Follow this and additional works at: <https://digitalcommons.centracare.com/articles>



Part of the [Other Medical Specialties Commons](#)

Recommended Citation

Graber, Mark L.; Rusz, Diana; and Jones, Melissa L., "The New Diagnostic Team" (2017). *Articles*. 69.
<https://digitalcommons.centracare.com/articles/69>

This Article is brought to you for free and open access by the Posters and Scholarly Works at DigitalCommons@CentraCare Health. It has been accepted for inclusion in Articles by an authorized administrator of DigitalCommons@CentraCare Health. For more information, please contact schlepers@centracare.com.

Opinion Paper

Mark L. Graber*, Diana Rusz, Melissa L. Jones, Diana Farm-Franks, Barbara Jones, Jeannine Cyr Gluck, Dana B. Thomas, Kelly T. Gleason, Kathy Welte, Jennifer Abfalter, Marie Dotseth, Kathleen Westerhaus, Josanne Smathers, Ginny Adams, Michael Laposata, Tina Nabatchi, Margaret Compton and Quentin Eichbaum

The new diagnostic team

<https://doi.org/10.1515/dx-2017-0022>

Received April 29, 2017; accepted September 8, 2017; previously published online October 5, 2017

Abstract: The National Academy of Medicine (NAM) in the recently issued report Improving Diagnosis in Health Care outlined eight major recommendations to improve the quality and safety of diagnosis. The #1 recommendation was to improve teamwork in the diagnostic process. This is a major departure from the classical approach, where the physician is solely responsible for diagnosis. In the new, patient-centric vision, the core team encompasses the patient, the physician and the associated nursing staff, with each playing an active role in the process. The expanded diagnostic team includes pathologists, radiologists, allied health professionals, medical librarians, and others. We review the roles that each of these team members will need to assume, and suggest “first steps” that each new team member can take to achieve this new dynamic.

Keywords: diagnosis; diagnostic error; teamwork.

***Corresponding author: Mark L. Graber**, Society to Improve Diagnosis, New York, NY, USA; 5 Hitching Post, Plymouth, MA 02360, USA; RTI International, Research Triangle Park, NC, USA; and Stony Brook University, New York, USA, E-mail: graber.mark@gmail.com

Diana Rusz: Society to Improve Diagnosis in Medicine, Chicago, IL, USA

Melissa L. Jones: Sr. Performance Improvement Clinical Consultant; CentraCare Health, St Cloud, MN, USA

Diana Farm-Franks: Senior Clinical Analyst; Fairview Health Services, Minneapolis, MN, USA

Barbara Jones: Library Engagement/Missouri Coordinator; National Network of Libraries of Medicine, Mid Continental Region, Columbia, MO, USA

Jeannine Cyr Gluck: Director Library and Knowledge Services, Middlesex Hospital, Middletown, CT, USA

Dana B. Thomas: WakeMed Health and Hospitals, Raleigh, NC, USA

Kelly T. Gleason: Johns Hopkins School of Nursing, Baltimore, MD, USA, E-mail: dthomas@wakemed.org

Kathy Welte and Marie Dotseth: Minnesota Alliance for Patient Safety, Minneapolis, MN, USA, E-mail: mdotseth@mnpatientsafety.org (M. Dotseth)

Introduction

Who is responsible for diagnosis? The classical answer was the physician, who accepted the challenge of interpreting a patient's signs and symptoms to the best of his or her abilities, using their own knowledge and intellect. The 1970's image of Marcus Welby, MD comes to mind, thoughtfully considering a case, hand on chin. This paternalistic model has been the norm for at least the past several centuries.

The landmark report Improving Diagnosis in Health Care, published by the National Academy of Medicine (NAM) in 2015 envisions a very different model for diagnosis, based largely on the observation that the paternalistic model is associated with an unacceptable incidence of diagnostic error, probably in the range of 10% or more. As envisioned by the NAM report, successful diagnosis in the 21st century increasingly will be a team-based activity, based on a new, patient-centric model. This team will leverage the knowledge and skills of all the interprofessional

Jennifer Abfalter: Clinical Nurse Specialist; Meeker Memorial Hospital, Litchfield, MN, USA

Kathleen Westerhaus: Westerhaus Consulting, Minneapolis, MN, USA

Josanne Smathers: Office of Academic Affairs, and Hospital-Based Services, University of Texas Medical Branch (UTMB), Galveston, TX, USA

Ginny Adams: Coverys, East Lansing, MI, USA

Michael Laposata: University of Texas Medical Branch, Galveston, TX, USA

Tina Nabatchi: Maxwell School of Citizenship and Public Affairs, Syracuse University, Syracuse, NY, USA, E-mail: tnabatch@syr.edu

Margaret Compton: Department of Pathology, Microbiology, and Immunology, Vanderbilt University Medical Center, Nashville, TN, USA

Quentin Eichbaum: Department of Pathology, Microbiology and Immunology, Division of Transfusion Medicine, Department of Medical Education and Administration, Vanderbilt University Medical Center, Vanderbilt University School of Medicine, Nashville, TN, USA, E-mail: quentin.eichbaum@Vanderbilt.edu

Goal 1: Facilitate more effective teamwork in the diagnostic process among health care professionals, patients, and their families

Recommendation 1a: In recognition that the diagnostic process is a dynamic team-based activity, health care organizations should ensure that health care professionals have the appropriate knowledge, skills, resources, and support to engage in teamwork in the diagnostic process. To accomplish this, they should facilitate and support:

- Interprofessional and intra-professional teamwork in the diagnostic process.
- Collaboration among pathologists, radiologists, other diagnosticians, and treating health care professionals to improve diagnostic testing processes.

Recommendation 1b: Health care professionals and organizations should partner with patients and their families as diagnostic team members and facilitate patient and family engagement in the diagnostic process, aligned with their needs, values, and preferences. To accomplish this, they should:

- Provide patients with opportunities to learn about the diagnostic process.
- Create environments in which patients and their families are comfortable engaging in the diagnostic process and sharing feedback and concerns about diagnostic errors and near misses.
- Ensure patient access to electronic health records (EHRs), including clinical notes and diagnostic testing results, to facilitate patient engagement in the diagnostic process and patient review of health records for accuracy.
- Identify opportunities to include patients and their families in efforts to improve the diagnostic process by learning from diagnostic errors and near misses.

Figure 1: The National Academy Report Recommendations.
Courtesy of National Academies of Medicine Report, 2015 [1].

staff involved in the case, and will involve the patient as an active team member [1].

Believing that the quality of diagnosis will be so highly dependent on effective teams, the NAM report focused on this as its first recommendation (Figure 1). Thus, the mandate to develop and use effective teams is clear, but what does this look like in practice? The goal of this article

is to suggest next steps individuals and organizations can consider for implementing this new vision.

The National Academy envisions the core of this team to be a dyad involving the patient and his or her family, on the one hand, and the major members of the primary care team, the physician and nursing staff, on the other hand. Additional medical professionals may become involved

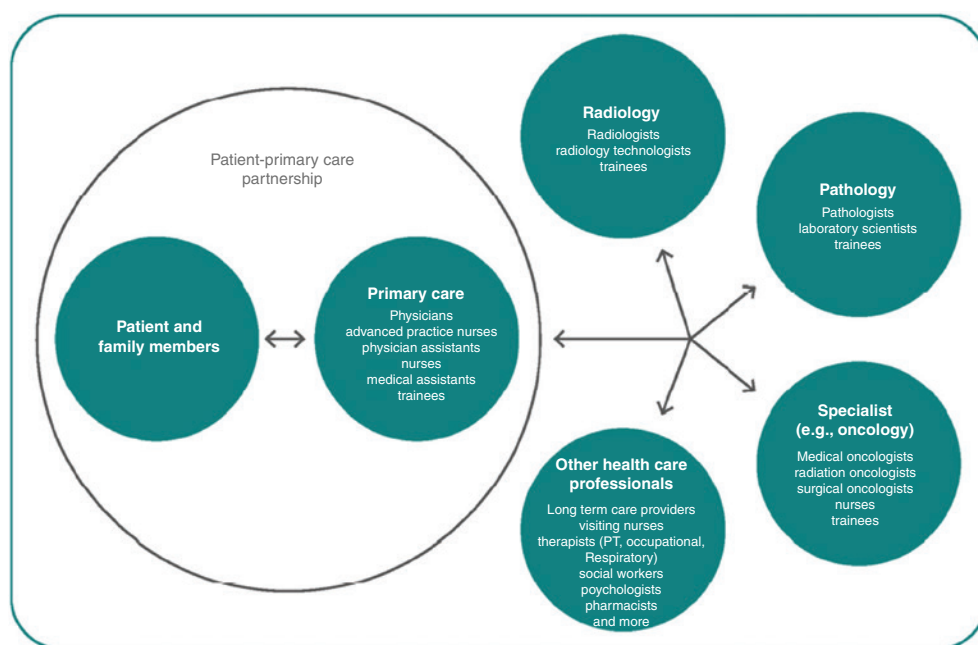


Figure 2: The expanded diagnostic team: other medical professionals that support the diagnostic process.
National Academies of Medicine Report, 2015 [1].

as the case requires, including radiologists, pathologists, subspecialists, pharmacists, allied health providers, and others (Figure 2). Our goal in this paper is to move beyond the concept and the graphics to explore in more detail the roles that each of these team members can play, and what changes each will need to make to transition from their traditional role in the paternalistic model to the dynamic, interprofessional model envisioned in the NAM report. This report grew out of the discussions on “The New Diagnostic Team”, held at the 2016 Partnering for Safer Care conference sponsored by the Minnesota Alliance for Patient Safety. Stakeholders who were not directly involved in this meeting (pharmacy, librarians, pathology, radiology) were invited separately. Many, but certainly not all of the stakeholder groups participating in diagnosis were included.

Front line providers – the physician, physician assistant, or advance practice nurse

Most diagnoses are made in ambulatory care, and these settings, primary care, pediatrics, family medicine and emergency medicine, are the areas where the new diagnostic teams should be created and used. On the new team, the diagnostic process may still be led by a physician, but increasingly it will be someone else. Physician assistants, nurse practitioners, and other advanced practice nurses are rapidly moving into frontline positions and assuming responsibility for diagnosis. Regardless of whether it is a physician or an advanced practice provider who leads the process, that individual will need to adapt to a new working model that takes advantage of each team member’s particular expertise and involvement. Special training may be needed to prepare team leaders for this role; it does not come naturally. This creates a need for new curricula in both undergraduate and postgraduate training to provide this interprofessional perspective. For physicians in practice who are used to functioning independently in a more directive fashion, learning to work effectively as a team leader may be more of a challenge, because their traditional approach to medical practice, and how they relate to their patients, is so ingrained. Learning to effectively manage the diagnostic team will require several other novel activities:

- Specifically inviting the other team members to participate actively. Team members will not be comfortable

participating unless they are invited and encouraged to do so.

- Specifically requesting feedback on performance. Team performance can improve to the extent that it receives feedback. Internal reviews are one way to start, but external feedback should be sought and considered at every opportunity. This may come through patient surveys or comments, or through feedback provided by other clinicians involved in caring for the same patient.
- Interacting directly with laboratory and radiology professionals. Too much information is lost when the EMR becomes the only communication channel between front line clinicians and the professionals in these diagnostic support services.
- Regularly seeking input and participation from team members. Unless they are involved, the team members will not feel empowered or respected. As a start, physicians will need to either read nursing notes, interact with them directly, or both. This may require a negotiation over what note content is necessary to provide value. Similarly, the physician leader needs to regularly communicate with every other member of the team, or the team itself will not be a functional entity.

The patient

At the center of the diagnostic team is the patient [2, 3]. In the new diagnostic team, the patient takes on an expanded role, best described as a partnership. Historically, the patient has been a passive recipient of the diagnosis. The culture of “Doctor knows best” illustrates an image of power and an unequal relationship. Patient engagement is beginning to shape a new and very different relationship between the patient and the health care team.

Social network theory provides a framework for understanding the team’s interactions around the patient [3, 4]. There are seven key observable behaviors that characterize effective relational coordination, focusing on the quality of communication (timely, frequent, accurate, and effective in problem solving) and role relationships (having shared goals, shared knowledge, and mutual respect) [5, 6]. Translating these principles into practice may be more difficult for a patient’s diagnostic journey than in treatment settings, where the pathways are more clear-cut, and many patients with a given diagnosis share the same management approach. In diagnosis, what exactly is the goal, what exactly are we asking the patient to do, and what does shared decision-making look like

[3]? Besides contributing to the timeliness and accuracy of establishing the diagnosis, engaged patients can act as their own safety net, helping to catch problems that might otherwise lead to harm [2].

The benefits of actively engaged patients are significant at both the individual and systems level. Hibbard and Green found that patients with higher activation levels were more likely to receive preventative screenings, achieve clinical goals, such as reaching high-density lipoproteins and triglyceride targets, and were less likely to be obese or smoke [7]. These patients were also less likely to seek emergency room care or be hospitalized. Similarly, engaged patients have better surgical outcomes [5]. The National Patient Safety Foundation Report, “Nothing about Me without Me” is a call to action for health care organizations to involve patients and families in both the health care process and in patient safety programs [8]. The patient is uniquely positioned to notice gaps or inconsistencies in practice. The effects of patient and family engagement in improving safety and quality are gaining wide acceptance and support. While limited research has been done to demonstrate the influence of patient and family involvement in the diagnostic process, it is reasonable to predict that the benefits of engagement would extend to diagnosis and that providers and organizations that encourage and empower patients to be an active participant in the process are likely to reduce errors.

Diagnosis is a complex, multi-step process. There are many opportunities for patients to influence the process. According to Singh and Sittig, a safer diagnosis includes five dimensions: the patient-provider encounter and initial diagnostic assessment, diagnostic test performance and interpretation, follow-up and tracking of test results, referrals and consultations, and patient-related factors [9]. Patients have unique expertise in their experience of symptoms and can play an active role in each phase of the diagnostic process.

An important first step is to explicitly invite the patient and family to be a partner in the diagnostic team. This is not a comfortable or familiar role for most patients. A recent report outlined several barriers identified by patients, including difficulty with communication, inability to access patient portals and other health records, restricted general and specific medical/health knowledge, and lack of trust in providers, among others [10]. Several campaigns exist to overcome these barriers. The Agency for Healthcare Research and Quality (AHRQ)’s “Questions are the Answer” [11], and The Joint Commission’s, Speak Up™ campaign [12] are leading examples of tools to encourage dialogue and collaborative problem solving. Patients should also be empowered to seek provider relationships

in which courage, trust and respect are mutual. Sometimes this means a second opinion or discussing expectations at the initial encounter to “try each other on for fit”. The patient-provider relationship is a personal experience and it is reasonable that before entering this relationship time is spent to assure its effectiveness.

The importance of each patient accepting responsibility for his or her own health and diagnosis should not be understated. No one knows the medical history or experience better than the patient. And yet, patients may be reluctant to assume the role of historian in recording and recounting their symptoms, previous surgeries, significant procedures and medications. Ideally, electronic records someday will be connected across providers and health plans. However, until they are, patients can coordinate the transfer of their test results, medical notes, and diagnostic conclusions to the health care team. Patients can access portals and obtain copies of electronic medical record to the extent it is available. They can note any inaccuracies or may identify questions that will need follow-up. While full access to medical records, including progress notes, is not yet the norm, healthcare is clearly moving in that direction. Healthcare providers, organizations, and systems should work to support such efforts.

Patients have more access to health information than ever before, including search engines and symptoms checkers. There are several tools available to help patients prepare for an office visit. “The Patient’s Toolkit for Diagnosis”, developed by the Society to Improve Diagnosis in Medicine (SIDM) offers a structured approach for patients to record their symptoms, medications, a visit summary, and instructions for follow-up or other needed appointments [13]. Another tool, You: Your Own Best Medicine has been developed by the Minnesota Alliance for Patient Safety [14]. The tool provides a web application or form for patients to list their medications, warning signs, test results and recommendations. By preparing well before a medical appointment, patients will be more comfortable asserting themselves and asking questions such as, “What else could this be?”, one of the universal antidotes to prevent diagnostic errors [15].

Putting the patient at the center of the diagnostic team requires focused attention on the part of each team member. It also requires that health systems and organizations value this work and create a culture and processes that encourage and support patient-centered care. The anticipated rewards in the form of more efficient and effective care and fewer errors are worth the effort. While not all patients or families may choose to be highly engaged as a team member, many will embrace the opportunity and will help build this new path to partnership.

The nurse

Although the patient and the physician constitute its core, the new diagnostic team will not achieve its full potential without involving key nursing staff as full-fledged members. Through their unique relationship with both the patient and the physician, nursing staff are ideally situated to both support the diagnostic process and monitor its outcomes. Nurses can improve diagnosis in many ways:

- With open access to both parties, they are able to ensure that communication is accurate and effective. Did the patient effectively communicate his/her problems to the physician? Did the physician hear and understand the problems correctly?
- Nurses often spend as much or more time with the patient than the physician, and in continuity settings develop a rich understanding of the patient's needs, expectations, values, and preferences. Nurses can help ensure that there is mutual understanding, agreement, and satisfaction with the goals of the medical engagement and its direction and progress.
- Within their medical training and experience, nurses can monitor whether the patient's course is consistent with the presumed diagnosis, and call to attention anything out of the ordinary that might suggest that the diagnosis needs to be revised or reconsidered. They become part of the diagnostic safety net.
- Nurses can play a valuable role in coordinating care, ensuring follow-up is appropriate, and helping arrange follow-up and communication with the physician if it is needed.

The starting place for better teamwork and interprofessional collaboration on diagnosis must be an effort to understand and acknowledge the importance of each other's practice. Inarguably, physicians and nurses have different training and qualifications, yet similarity and overlap does indeed exist. There is a shared base knowledge, a shared understanding of anatomy and physiology, shared use of references such as Micromedex or the Physicians' Desk Reference (PDR) and an increasingly shared respect for each other's profession [16]. Part of this deeper understanding includes consideration of how the nursing diagnosis informs, and is informed by the medical diagnosis. The two diagnosis processes are not totally independent; they are interdependent, and can and should interact and complement each other. The nurse-physician relationship needs to evolve to support this change and this level of interaction, and will require increased trust and a resolve to hear and be heard [17].

Collaborative care rounds

Collaborative care rounds provide a model for incorporating nurses into the diagnostic process. Collaborative care rounds can enhance and augment traditional rounding to reduce diagnostic error by integrating the documentation of assessments, the diagnosis, and the plan of care among and between clinical disciplines. In ambulatory settings, team "huddles" can provide similar benefits. Collaborative rounds and huddles both combat the "electronic siloing" inadvertently created by the use of electronic medical records (see "The electronic health record" section below).

Work in this direction has started, with some success. The University of Kentucky Albert B. Chandler Hospital has introduced Inter-Professional Teamwork Innovation Model (ITIM) using a team to include the bedside nurse, physician, pharmacist and care-facilitator in the rounding process. Each member of the rounding team has a role and is expected to actively participate, complementing each other and providing a unified care plan [18]. Innovations such as this and other pilot programs will contribute to long-term success and grassroots change of practice which will further lead to improved outcomes for patients. As trust builds through increasing collaboration and learning to consider all members of the care team with an ear for diagnostic input, patients and families will be the overall direct winners.

The need to reform nursing education

To ideally prepare nurses for their new roles on the diagnostic team, multiple changes in the pre-licensure nursing curriculum will be essential. Nurses describe knowledge deficits in the diagnostic process as a barrier to their effective participation, and providing education to nurses specific to diagnosis resulted in higher confidence in identification and management of the diagnosis [19]. Requiring content specific to the diagnostic process in the pre-licensure curriculum will build a foundation for new graduate nurses to enter practice empowered to participate in the diagnostic team. This content has yet to be fully defined, but at a minimum should include an orientation to how diagnostic errors arise and can be avoided by attention to the cognitive- and system-related factors that predispose to error.

Ideally, this education and training would be provided in an interprofessional manner. The NAM report suggests that working through complex diagnostic cases as a team be a requirement of licensing bodies of health professions

[1]. Efforts are already being made to increase interprofessional education [20, 21]. These efforts must be leveraged to include content specific to the diagnostic process. These opportunities could demonstrate to nursing students how the diagnostic process works and how they can contribute, and could demonstrate to medical students a new perspective of what nurses offer in the diagnostic process. The NAM report recommends that new curricula be created in schools of medicine and schools of nursing to address diagnostic error [1], and these new training models should lay the foundation for nursing students and medical students to work together on a diagnostic team.

This collaboration and increased inter-professional dependency must come to the field through distinct steps. As formal education processes at the university level for both medicine and nursing adopt interactive cooperation between professions, those entering the healthcare environment will do so with a presupposed respect and interest in what each professional can bring to the art and science of diagnosis. Foundational barriers may fall, as others have throughout the history of healthcare. The shared vision of improved patient outcomes will prevail to the betterment of both physician and nurse. Through mutual respect – better diagnosis is possible [22].

Allied health professionals

Allied health professionals (AHPs), a group including clinical laboratory scientists, medical technologists, physical therapists, occupational therapists, speech-language pathologists, respiratory therapists, and other non-physician, non-nursing medical professionals, have long been recognized as valuable members of the health care team. Many AHPs provide functional diagnoses and prognoses within the scopes of their respective practice acts, but historically, the realm of medical diagnosis has been excluded. Restrictions imposed by state practice acts as well as by sociocultural norms that recognize the physician as having the role of master diagnostician may be largely responsible.

Because many of these professionals spend more time with the patient on average than physicians, often over a span of time where monitoring of changes in patient status is readily observed, AHPs have the opportunity to notice subtle differences in patient presentation from one interaction to the next. Furthermore, many AHPs have developed high levels of expertise, with many attaining very specialized knowledge and examination skills by working with specific patient populations, participating in continuing education and training, and pursuing independent

study. For many AHPs, this skill set and knowledge base includes the ability to recognize signs and symptoms, or diagnostic test results, that may not be consistent with an assigned medical diagnosis.

Clinical pharmacists in particular deserve special consideration as members of the diagnostic team. They have frequent interactions with their patients, and in many cases have a long-term relationship, creating the opportunity for pharmacists to see important changes in physical or functional status. Pharmacists can therefore play an important role in detecting diagnostic errors, the more so because patients may have more contact time with their pharmacist than they do with other members of the diagnostic team.

Thomas and Newman-Toker demonstrated the value of leveraging AHP expertise in the diagnosis of patients presenting to the ED/acute care hospital with acute onset of dizziness/vertigo [23]. Their paper highlights the specific case example of the role of a vestibular physical therapist (PT) in assisting diagnostic accuracy. For five representative patient examples, the information provided by the PT resulted in a change in the diagnosis, following input by the PT based on her detailed clinical examinations and history-taking.

Including AHPs as participants in the diagnostic process requires a paradigm shift for all members of the healthcare team. AHPs must be able to confidently back up opinions with objective, unbiased data to support whether signs and symptoms could include or exclude certain medical diagnoses. They must expect that some attempts to provide relevant information concerning medical diagnosis to physicians may not be received enthusiastically or may not be acknowledged at all. Maintaining a calm and professional demeanor, providing education/training/resources/references when requested, and focusing on patient-centered care may help AHPs navigate as they enter this new territory.

Physicians also play a role in optimizing input from AHPs to improve diagnostic accuracy. Physicians should understand and appreciate the breadth of knowledge and skill possessed by AHPs. Utilization of AHP expertise represents an untapped resource readily available to most physicians to improve the diagnostic process.

The medical librarian or information scientist

Medical librarians are integral members of the new diagnostic team, providing support in a number of ways.

Several researchers have looked at the contribution of medical librarians to patient care. Most notably, studies done by Marshall and others attempted to quantify the outcomes of literature searches on medical care [24, 25]. Of more than 16,000 clinician survey respondents, 80% said they had handled some aspect of patient care differently due to the information received. Of these, 29% indicated that it was a diagnosis that had been changed. In 2013, Marshall revisited this research question [25]. This time, 75% of respondents handled patient care differently, 25% of them related to diagnosis. Thirteen percent reported that they avoided or reduced the possibility of a misdiagnosis. A range of hospitals, both urban and rural, community and academic were included in the studies. Bjerre, in her analysis of questions asked at the point of care at an academic health center, found similar proportions [26].

In some hospitals or academic medical centers, a medical librarian is a part of the rounding team. Much of the work evaluating the effectiveness of this service has been done in Canada and the UK. In the Aitken study at the University of Calgary, 44% of the clinical care team members reported that the literature they obtained by themselves using skills taught by a librarian helped change a diagnosis, as did 36% of the literature obtained for them by the librarian [27]. In a recent UK study with 10 librarians representing 16 organizations over a 6-month period, questionnaire results (43% response rate) showed 88 incidents reporting a direct contribution to diagnosis [28].

One author (JCG) sampled information provided in support of Cancer Care Conferences in her own institution, an American College of Surgeons Commission on Cancer-accredited Community Cancer Center. Oncologists/pathologists asked for information in support of diagnostic decisions in 13, or 31% of 42 gastrointestinal cases presented over the last 12 months. Information provided for Cancer Care Conferences consists of case-specific evidence-based literature compiled into a handout for each attendee. Thus, all participants have a common basis of evidence for reference.

A substantial part of medical librarians' work is performing mediated searches on behalf of the clinical staff. Questions arise every day in the practice of medicine and librarians understand where and how to find the best answers [29]. Many of these questions arise in the course of diagnostic evaluations: What is the best test to order? What is the appropriate testing sequence? Librarians look to a range of sources, among them standards and guidelines of professional societies, systematic reviews and clinical trials.

Librarians not only can locate and evaluate content in terms of quality of evidence, but often contribute substantially to its creation. The PubMed interface to the MEDLINE database contains an automated set of filters for finding diagnostic, treatment, etiology and prognostic information for a given condition. The Clinical and Health Services Research Queries team headed by Brian Haynes, MD at McMaster University included a librarian who worked with the associated physicians to develop the PubMed queries. Medical librarians use them regularly, and often teach medical students and others to effectively apply them. The success of systematic reviews depends heavily on the quality of the literature search. Those including a librarian or information specialist as an author have been correlated with significantly higher-quality searches [30]. Because the completeness of the reference list is paramount, librarians develop exhaustive search strategies, or hedges, to help with retrieval, and share these freely among colleagues. Sometimes they intensively study the search process itself, as seen in articles by Beauregard [28] among others.

Librarians also help make available decision-support tools (e.g. VisualDx, Dxplain, and Isabel) in their institutions. They work with clinicians to assess needs, arrange for and conduct trials of the products, evaluate features, and choose the most appropriate product. They negotiate the license terms, then may work with IT to integrate the tools into the clinical workflow. Librarians then promote the product and train others to use it. They also recognize the diagnostic content of more general point-of-care databases, including Dynamed Plus and Up to Date, which often suggest the most appropriate work-up of patients.

Some librarians create resources and make them available for clinical staff to use directly, often from within the electronic health record. Fowler and colleagues were actively involved in the development of such a tool [31]. It enables clinicians to review and consider multiple possible diagnoses to explain their patients' symptoms. This project was initiated by a new chief medical information officer at the hospital, who considered librarians integral to the plan. The pilot project combined a commercially available diagnostic decision support tool with modules created by the librarians. Interestingly, physicians in the focus groups preferred the library-created components of the tool to those from the vendor's product, in part because they were easier to use, and the results included useful resources that they did not usually think to consult.

Historically, librarians have been associated with a place – the library – and with managing the resources kept within those walls. With the advent of newer information technologies and online resources, information

becomes much more universally accessible. This may lead to a lack of appreciation for the skills a qualified librarian can bring to the diagnostic problem [27].

As outlined by the Medical Library Association, core competencies for health science librarians include [32]:

- Understanding the information needs of health practitioners, researchers, administrators, educators, students, patients, and health care consumers;
- The ability to identify published evidence relevant to questions in clinical practice;
- The ability to locate, organize and critically evaluate research literature; and
- Understanding and using new technological solutions to access electronic information.

These skills, applied to the diagnostic process, are the heart of the librarian's contribution.

Radiologists, pathologists, and the diagnostic management team

Medical imaging and laboratory testing are integral elements of most diagnostic evaluations, and both radiologists and pathologists are critical members of the diagnostic team. The American College of Radiology has taken concrete steps to promote this concept through their Imaging 3.0™ initiative [33], by promoting radiologists' collaboration with clinicians and patients at every step of the imaging process.

Laboratory medicine can benefit from the same approach, and the role model for this is the concept of

a diagnostic management team (DMT), a collaborative effort among medical experts centered around a particular diagnostic discipline in pathology (e.g. hemato-pathology, coagulation, microbiology) with the goal of enhancing diagnostic accuracy. A DMT may also include health professionals from other health-associated disciplines such as primary care, radiology, nursing and biomedical informatics.

Pathologists are occasionally regarded as ancillary to the diagnostic process. The DMT reasserts pathologists' central role in the diagnostic process by re-emphasizing their critical role in test selection and result interpretation, and by improving communication and the flow of diagnostic information between expert pathologists and treating physicians. Removal of a "wall" separating pathologists from treating physicians is a metaphor frequently used to describe this improved communication of the DMT (Figure 3).

By improving diagnostic accuracy, the DMT aims to avoid unnecessary, costly and inappropriate diagnostic testing as well as avoidance of inappropriate and costly medical treatment. Given the increasing complexity of diagnostic testing and the concomitant scope for diagnostic error, treating physicians need to be in more direct consultation with pathologists about test selection and result interpretation. Likewise, pathologists could enhance their diagnostic performance both by giving feedback about test selection, interpretation and errors to treating physicians, and by receiving regular feedback about these issues from clinicians. More accurate pathologic diagnosis should reduce medical error [34, 35].

Evidence from hematopathology has shown that the DMT optimizes complex diagnostic testing and leads to

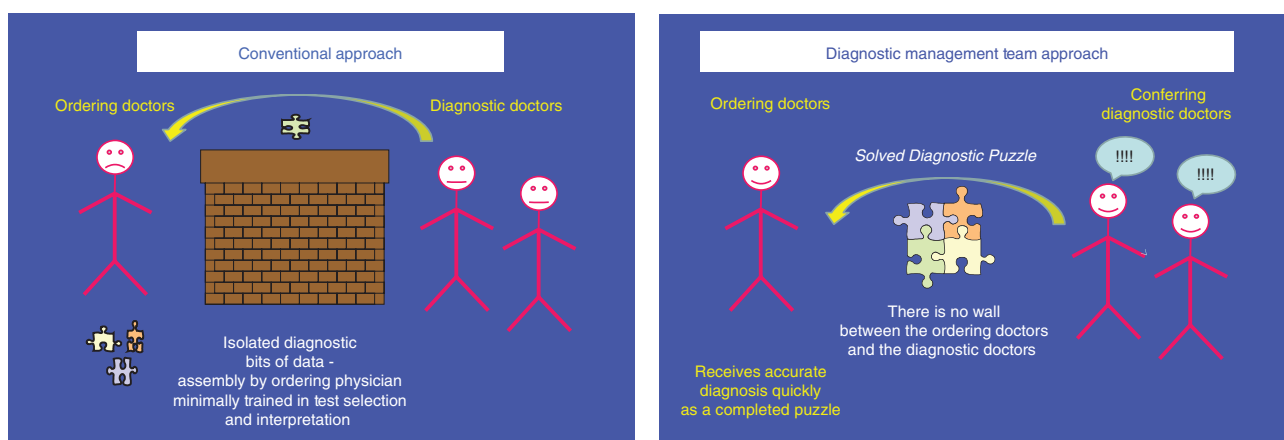


Figure 3: The Diagnostic Management Team breaks down the communication barrier wall between clinicians and expert laboratory consultants. (M Laposata).

reduced test utilization, the ordering of more appropriate test, and to decreased costs [36].

The electronic health record

Although not a team member per se, the impact of the electronic health record is so profound that it deserves equal attention. What role does the electronic medical record play in supporting the new diagnostic team? At the present time, the impact is largely negative, the result of the electronic siloing created as an unintended consequence of EHR implementation [37]. As emphasized by Wachter and many others, the EHR has become the de facto norm for communication in health care, leading each member of the team to work independently, in their own silo [38]. With regard to communication between physicians and nurses, the Ebola case in Texas amply illustrates the deleterious effect of electronic siloing on diagnosis: A patient with fever and headache related to an emergency department nurse his recent travel to an endemic region for Ebola, but the physician seeing the patient failed to get this history, or extract it from the nursing note [39]. As a result, the patient was discharged home with a diagnosis of sinusitis, exposing dozens of people to Ebola infection and delaying his own diagnosis before returning 2 weeks later with a fatal outcome. Upadhyay suggests that face-to-face communication including critical input from those best situated to observe and contribute to the big picture status of the patient as a part of collaborative rounding might have prevented this tragic scenario [39].

Current implementations of the EHR not only isolate physicians from the nursing staff, but also distance physicians from other key members of the diagnostic team, specifically radiology and pathology professionals. The face-to-face communication that was once the norm in the course of a diagnostic evaluation has been replaced by opaque orders and formulaic reports, both of which lack the rich detail that was inherent when providers talked with each other. Pharmacists have been similarly isolated, now having to guess what the physician is trying to accomplish instead of having the opportunity to discuss this first hand. The new diagnostic team needs to realize, appreciate and prioritize the value of face-to-face interaction among clinicians, physicians, nurses, pharmacists, and others in their efforts to provide optimal care to patients with ever more complex clinical problems [37].

On a brighter note, the EHR may someday promote better teamwork. A novel EHR-based wiki-style approach, as an example, increases the occurrence of face-to-face

interaction among clinicians and helps reduce the siloing of electronic communication and documentation of care [40]. This application may improve communication and care coordination among clinicians caring for complex patients, which ought to lead to reduced diagnostic error and improved quality and safety within multidisciplinary disease management programs.

Discussion

From the very start of the modern patient safety movement, teamwork has been promoted as an effective strategy to improve performance. This was one of the first and most important recommendations that emerged in response to the patient safety crisis identified in the original Institute of Medicine (IOM) in 1999, *To Err is Human* [41]. Specifically, the Quality Interagency Coordination (QuIC) Task Force recommended that the principles of Crew Resource Management (CRM), the team-building program originating in aviation safety, be adapted for use in medicine [42].

In response, a host of team training initiatives have evolved across the spectrum of medical specialties, notably in anesthesiology, surgery and the surgical specialties such as trauma surgery and labor and delivery services. The most widely-disseminated program is Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS), sponsored by the Agency for Healthcare Research and Quality [43]. Over 1.5 million medical professionals have participated in TeamSTEPPS training, including 75% of medical trainees [44].

Team training has become the norm in aviation and is credited with being one of the key factors responsible for the extraordinary success improving the safety of air travel [45]. The available evidence suggests that team training will improve patient safety in medicine as well. A current systematic review summarized the evidence on team training on health care outcomes, and concluded that team-based interventions significantly reduced adverse events and mortality in surgical settings and intensive care units [46].

There are reasons to believe that working in teams may be especially beneficial when it comes to diagnosis:

1. Working in teams is especially effective in dynamic, complex environments. Clearly diagnosis fits these descriptions.
2. Breakdowns in communication and teamwork are identified in two thirds of all medical errors and are the most common system-related problem encountered in regard to diagnostic errors [47].

3. Second opinions are an effective way to detect diagnostic errors and working in teams provides the opportunity to regularly obtain this kind of input [48].

To the best of our knowledge, there are no published studies that have examined the impact of team training or teamwork on diagnostic performance. Possibly relevant are studies that measured the impact of team training in general medical settings, but the results of these studies are mixed. One study in a pediatric emergency room found that team training reduced notable patient safety events [49]. In contrast, a systematic review of interdisciplinary team care interventions identified 30 studies, and found a weak impact on complications of care (reduced in 5 of 10 studies) but generally no impact on length of stay, readmissions, or mortality [50].

A notable aspect of the existing literature evaluating team performance, is that the teams being studied to date have generally NOT involved the patient. Will patients be interested and able to participate as a partner in the diagnostic process? A large, ongoing research project is

providing novel and interesting data on this question by bringing together engaged healthcare consumers and healthcare professionals and discussing these questions in a deliberative format [51]. Specifically, a diverse group of health care consumers were brought together for an intensive deliberative workshop where they addressed three interrelated deliberative questions: (1) What role(s) are patients willing and able to play in preventing, identifying, and reporting diagnostic error? (2) What strategies should be pursued to better enable patients to play those roles? (3) What systems and structures should be in place to allow patients to effectively assume these roles? The group produced a set of deliberative recommendations (Table 1) that were then tested with another, larger group of healthcare consumers, as well as with two groups of healthcare providers. In general, both healthcare consumers and professional found the recommendations to be understandable, usable, and potentially impactful on improving diagnosis. In the longer term, SIDM will use the recommendations generated in this project to develop strategic plans, policy statements, and research agendas

Table 1: Patient-focused recommendations for reducing diagnostic error.

Recommendation 1 – Present symptoms clearly and completely

- Be truthful about your symptoms and other behaviors when telling your doctor about your history to ensure information is accurate
- Be prepared to discuss your symptoms. For example, eight characteristics of symptoms are quantity, quality, aggravating factors, alleviating factors, setting, associated symptoms, location, and timing

Recommendation 2 – Assert yourself in the relationship

- Be clear, concise, and persistent in communicating your symptoms and concerns
- Ask detailed questions of your doctor, including a plan to arrive at a diagnosis so the doctor remains engaged and focused on your concerns. For example, “could these symptoms indicate something else or an additional issue?”
- Notify your healthcare provider if your condition worsens, does or does not improve, or if new symptoms develop
 - The treatment plan could change based on new information and potentially a new diagnosis
 - Potential new urgency could affect the healthcare provider’s level of attention
 - If you are concerned about the accuracy of the diagnosis, seek a second opinion

Recommendation 3 – Coordinate your care

- Find a primary care provider/family doctor so that they can better coordinate and manage your healthcare
- Enlist a patient advocate, as needed, to assist you in coordinating care
- Have your primary care provider manage all your records to ensure they are accessible to other providers
- Seek out a health system where different doctors work together frequently, share consistent information, and coordinate services effectively

Recommendation 4 – Ensure accurate records and tests

- Maintain and update your own medical record, which includes test results, doctor notes, images, communication with providers, and other information pertinent to your medical history
- If you have access to your electronic medical records or a patient portal, use that. If you do not have access, ask for a physical copy of your records and/or any recent updates
- If you notice a factual inaccuracy with your medical record, advocate and insist to have the error corrected

Recommendation 5 – Manage your care

- Ensure communications and expectations are clear between you and your healthcare provider
 - Throughout the relationship, follow through on your health care provider’s recommendations regarding the course of action to reach an accurate diagnosis. For example, completing lab tests, going to appointments with specialists, taking medications as prescribed
 - Follow up with your healthcare provider after appointments to obtain test results to ensure proper testing was conducted. Thus, both patient and healthcare provider are accountable
-

regarding patient engagement in reducing diagnostic error.

Beyond the recommendations, data from this project reveal that healthcare consumers who participated in the study experienced statistically significant and positive impacts on several individual-level measures, including patient activation, trust in doctors, health literacy, awareness of the seriousness of diagnostic error, and beliefs that patients can play a meaningful role in the diagnostic process [51].

A challenge that will inevitably arise in diagnostic teamwork is how to optimize communication amongst the medical team members, and the patient. Interdisciplinary conferences and meetings offer a possible model for how to achieve optimal communication. Tumor boards, multidisciplinary rehabilitation meetings and the like allow all of the team members to have input on each case and coordinate care.

Where should we begin? Every practice and organization has its own unique assets and structure, and it would

Table 2: Best first steps to develop diagnostic teams.

Patients	Front-line providers	Nurses	Radiologists and pathologists	Allied health providers	Medical librarians
<ul style="list-style-type: none"> – Commit to finding the right doctor, the right partnership – Be informed, advocate for yourself, and be actively involved in your health and healthcare. Have another person present to listen and advocate for you as well – Ensure that your care is coordinated. Facilitate communication between providers as necessary and ensure test results are communicated. Ensure your records are accurate and are available for providers – Present symptoms completely and clearly. Be a good historian – Encourage the provider to think broadly. Ask “what else could this be?” 	<ul style="list-style-type: none"> – Encourage patients to be pro-active in their care; Make sure they know when and how to get back in touch if symptoms persist, change, or do not respond to treatment – Encourage nursing staff you work with to let you know if what they see does not fit with the diagnosis, or if they sense a communication breakdown with the patient; Read their notes, or better, talk to them about every patient – Speak directly with the Radiologist who is reporting new, important findings. Speak directly with the Pathologist who reads biopsies on your patients – Invite allied health providers to contact you if they have important observations about your patients – Let your medical librarian help research questions that arise during care 	<ul style="list-style-type: none"> – Help ensure that communication between patients and the medical team has been effective and comprehensive – Monitor the patient’s medical condition and consider whether it really fits well with the assigned diagnoses; if not, speak with the responsible providers – If you are making diagnoses yourself, consider all the items under “Front Line Providers” – you are one of them! – Ignore the dictum that diagnosis is not in your scope of practice. Everyone who touches the patient is an important member of the diagnostic team and needs to participate actively 	<ul style="list-style-type: none"> – Talk as much as you can with the providers requesting your services. You know MUCH more about the patient than you communicate in your reports, and providers know more than they put in their requests – Make it easy for providers to contact you. Make sure front line providers know who you are and that you are interested in interaction to improve patient care – Ask for follow-up. Let providers know that if one of your reports does not fit or is found to be wrong, to let you know – Help providers decide on the best tests to order, and how to interpret results. Make it easier for them to get your advice 	<ul style="list-style-type: none"> – Consider yourself an active member of the diagnostic team – Be aware of ALL the patient’s active problems, and be aware of symptoms or signs that might indicate a diagnosis is wrong – Do not hesitate to contact the patient’s primary or specialty provider if you have concerns about one of their diagnoses. Fresh eyes catch mistakes – Help ensure patients understand their diagnoses, and conversely, that their providers understand the patient’s symptoms and preferences 	<ul style="list-style-type: none"> – Get out of the library and go where the real medical questions arise – on the wards and in the clinics – Volunteer to participate in the root cause analyses done at your organization; Almost all adverse events involve a problem with knowledge or its application – Establish a service for patients in your organization to help them research their assigned diseases, and alternatives. Or work with SIDM’s national program – Make sure the frontline clinicians know who you are, and that you are ready and willing to help them research clinical questions; Make access easier

be very appropriate for efforts to improve teamwork be individualized accordingly. Recommendations on ‘first steps’ for each of the major stakeholder groups is presented in Table 2.

Summary

Although evidence that teamwork can improve diagnosis is limited, it has convincingly been found to be a highly effective and practical strategy for improving performance in aviation and in many health care settings, particularly in surgical and intensive care settings. The recommendations from the NAM to develop and use teamwork to improve diagnosis represents a unique opportunity with substantial potential to improve the diagnostic process, and help prevent diagnostic error.

Standing in the way are a host of challenges, beginning with the question of which party is going to make teamwork a reality. Many of the early proposals to reduce diagnostic error focus on physicians and healthcare systems, but have had limited implementation because both parties are reluctant to accept ownership [52, 53]. Healthcare organizations view diagnostic error as the responsibility of its physician staff, who in turn believe that they are practicing at exceptionally high levels [54]. As evidence of this dilemma, physicians typically fail to participate in incident reporting systems [55], underuse decision support resources [56], and are generally unable to recognize cases where their clinical judgment was incorrect [57].

Many other barriers exist that will make achieving teamwork in medicine more difficult than it was in aviation. First, diagnosis typically plays out over time, and the team members may change, or may operate in different geographic locations. Second, unlike commercial aircraft, each patient is different and presents his or her own challenges. Third, diagnosis by its nature is uniquely complex, with uncertainty an inherent element at every step of the diagnostic process. Finally, there are a host of forces in medical practice today that work against developing effective teams, including production pressure, physical and sociological isolation of the various professions, and the ever-expanding tendency of the electronic medical record to ‘silo’ the prospective members of these teams. Implementation science enables innovations to be translated into practice [58], but recognizes the complexity of the process, and the reluctance of the medical community to adopt insights from the social sciences.

The key to advancing the team concept may lie with patients; Patients represent a large, untapped, and

critically important resource for influencing and improving the quality of diagnosis, and may be the secret ingredient needed to making rapid and significant gains in diagnostic safety. Particularly in healthcare organizations willing to accept them as full partners in the diagnostic process, engaged patients can simultaneously serve as a formidable force in helping reducing the risk of diagnostic error, and as a part of the safety net we need to catch these errors before they lead to harm.

Author contributions: All the authors have accepted responsibility for the entire content of this submitted manuscript and approved submission.

Research funding: Supported in part by the Josiah Macy Jr Foundation.

Employment or leadership: None declared.

Honorarium: None declared.

Competing interests: The funding organization(s) played no role in the study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the report for publication.

References

- Balogh EP, Miller BT, Ball JR. Improving diagnosis in health care. Washington, DC: National Academies Press, 2015.
- McDonald K, Bryce C, Graber M. The patient is in: Patient involvement strategies for diagnostic error mitigation. *BMJ Qual Saf* 2013;22:Part 2:30–6.
- McDonald K. The diagnostic field’s players and interactions: from the inside out. *Diagnosis* 2014;1:55–8.
- Berkman L, Glass T, Brissette I, Seeman T. *From social integration to health: durkheim in the new millenium*. *Social Sci Med* 2000;51:843–57.
- Gittell J, Fairfield K, Biebaum B, Head W, Jackson R, Kelly M, et al. Impact of relational coordination on quality of care, postoperative pain and functioning, and length of stay: a nine-hospital study of surgical patients. *Med Care* 2000;38:807–19.
- Relational Coordination Research Collaborative. Validation of the RC Survey. Available at: <https://rccr.brandeis.edu/survey/validation-and-survey-items.html>. 2017. Accessed: 27 Aug 2017.
- Hibbard J, Greene J. *What the evidence shows about patient activation: better health outcomes and care expectations; Fewer data on costs*. *Health Aff* 2013;32:207–14.
- National Patient Safety Foundation. National Agenda for Action: Patients and Families in Patient Safety Nothing About Me, Without Me. 2000. Available at: <https://www.patientresearchexchange.org/stories/detail/nothing-about-me-without-me>.
- Singh H, Sittig DF. Advancing the science of measurement of diagnostic errors in healthcare: the safer Dx framework. *BMJ Qual Saf* 2015;24:103–10.
- Nabatchi T. Strategic report for the society to improve diagnosis in medicine: what actions might patients be willing and able to take in order to improve diagnostic quality? 2016. Available

- at: tnabatch@syr.edu; see also <https://jefferson-center.org/patient-dx/>.
11. Agency for Healthcare Research and Quality. Questions are the Answer. Available at: <https://www.ahrq.gov/patients-consumers/patient-involvement/ask-your-doctor/index.html>. Accessed: 27 Aug 2017.
 12. The Joint Commission. Speak Up Initiatives. 2002. Available at: <https://www.jointcommission.org/speakup.aspx>. Accessed: 27 Aug 2017.
 13. Society to Improve Diagnosis in Medicine. The Patient's Toolkit for Diagnosis. Available at: www.improvediagnosis.org/page/PatientToolkit. Accessed: 27 Aug 2017.
 14. Minnesota Alliance for Patient Safety. You, Your Own Best Medicine. Available at: <http://ownbestmedicine.mn/about/>.
 15. Graber ML. Minimizing diagnostic error-ten things you could do tomorrow. *Inside Medical Liability* 2014;1st Quarter:22–6.
 16. Ulrich B. Gender diversity and nurse-physician relationships. *Virtual Mentor* 2010;12:41–5.
 17. Lindeke LS, Sieckert A. Nurse-Physician workplace collaboration. *Online J Issues Nurs* 2005;10:5.
 18. Beard G, Dent JM, Keim-Malpess J, Muller AG, Nelson N, Brashers V. Perceptions of teamwork in the interprofessional bedside rounding process. *J Healthcare Qual* 2017;39:95–106.
 19. Wand AP, Thoo W, Sciuriaga H, Ting V, Baker J, Hunt GE. A multifaceted educational intervention to prevent delirium in older inpatients; a before and after study. *Int J Nurs Stud* 2014;51:974–82.
 20. Interprofessional Education Collaborative. Core Competencies for Interprofessional Collaborative Practice. 2011. Available at: https://www.aamc.org/download/186750/data/core_competencies.pdf. Accessed: 11 Apr 2017.
 21. Macy Foundation. Team-Based Competencies. Building a Shared Foundation for Education and Clinical Practice. Available at: <http://macyfoundation.org/publications/publication/team-based-competencies-building-a-shared-foundation-for-education-and-clin>. Accessed: 11 Apr 2017.
 22. Tschannen D, Keenan G, Aebersold M, Kocan MJ, Lundy F, Averhart V. Implication of nurse-physician relations: report of a successful intervention. *Nurs Econ* 2011;29:127–37.
 23. Thomas DB, Newman-Toker DE. Diagnosis is a team sport – partnering with allied health professionals to reduce diagnostic errors: a case study on the role of a vestibular therapist in diagnosing dizziness. *Diagnosis* 2016;3:49–59.
 24. Marshall JG. The impact of the hospital library on clinical decision making: the Rochester study. *Bull Med Libr Assoc* 1992;80:169–78.
 25. Marshall JG, Sollenberger J, Easterby-Gannett S, Morgan LK, Klem ML, Cavanaugh SK, et al. The value of library and information services in patient care: results of a multisite study. *J Med Libr Assoc* 2013;101:38–46.
 26. Bjerre LM, Paterson NR, McGowan J, Hogg W, Campbell CM, Viner G, et al. What do primary care practitioners want to know? A content analysis of questions asked at the point of care. *J Contin Educ Health Prof* 2013;33:224–34.
 27. Aitken EM, Powelson SE, Reaume RD, Ghali WA. Involving clinical librarians at the point of care: results of a controlled intervention. *Acad Med* 2011;86:1508–12.
 28. Beauregard JM, Lyon JA, Slovis C. Using the literature to evaluate diagnostic tests: amylase or lipase for diagnosing acute pancreatitis? *J Med Lib Assn* 2007;95:121–6.
 29. Ely JW, Osheroff JA, Ebell MH, Chambliss ML, Vinson DC, Stevermer JJ, et al. Obstacles to answering doctors' questions about patient care with evidence: qualitative study. *Br Med J* 2002;324:710.
 30. Queries PC. PubMed clinical queries. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/clinical>. Accessed: 11 Apr 2017 from 1.
 31. Fowler SA, Yaeger LH, Yu F, Doerhoff D, Schoening P, Kelly B, et al. Electronic health record: integrating evidence-based information at the point of clinical decision making. *J Med Lib Assn* 2014;102:52–5.
 32. Medical Library Association. Professional Competencies for Health Sciences Librarians. 2007. Available at: www.mlanet.org/page/competencies. Accessed: 11 Apr 2017.
 33. American College of Radiology. Imaging 3.0 initiative. 2016. Available at: <https://www.acr.org/Advocacy/Economics-Health-Policy/Imaging-3>. Accessed: 27 Aug 2017.
 34. Laposata M, Cohen MB. It's our turn: implications for pathology from the institute of medicine's report on diagnostic error. *Arch Pathol Lab Med* 2016;140:505–7.
 35. Laposata M, Dighe A. "Pre-pre" and "post-post" analytical error: high-incidence patient safety hazards involving the clinical laboratory. *Clin Chem Lab Med* 2007;45:712–9.
 36. Seegmiller AC, Kim AS, Mosse CA. Optimizing personalized bone marrow testing using an evidence-based, interdisciplinary team approach. *Am J Clin Pathol* 2013;140:643–50.
 37. Stoller JK. Electronic siloing: an unintended consequence of the electronic health record. *Cleve Clin J Med* 2013;80:406–9.
 38. Wachter RM. The digital doctor; hope, hype and harm at the dawn of medicine's computer age. New York, NY: McGraw Hill Education, 2016.
 39. Upadhyay D, Sittig DF, Singh H. Ebola US patient zero: lessons on misdiagnosis and effective use of electronic health records. *Diagnosis* 2014;1:283–7.
 40. Naik A, Singh H. Electronic health records to coordinate decision making for complex patients: what can we learn from wiki? *Med Decis Making* 2010;30:722–31.
 41. Institute of Medicine, editor. To Err is human, building a safer health system. Washington, DC: National Academy Press, 1999.
 42. Eisenberg JM, Foster NE, Meyer G, Holland H. Federal efforts to improve quality of care: the Quality Interagency Coordination Task Force (QuIC). *Jt Comm J Qual Improv* 2001;27:93–100.
 43. Agency for Healthcare Research and Quality. TeamSTEPS. Available at: <https://www.ahrq.gov/teamsteps/index.html>. Accessed: 27 Aug 2017.
 44. Beach S. Annual medical school graduation survey shows gains in team training. 2013. Available at: <http://www.aamc.org/newsroom/newsreleases/351120/080213.html>.
 45. Salas EP, Baker D, King H, Battles J, Barach P. On teams, organizations and safety. *Jt Comm J Qual Saf* 2006;32:112–3.
 46. Weaver SJ, Dy SM, Rosen MA. Team-training in healthcare: a narrative synthesis of the literature. *BMJ Qual Saf* 2014;23:359–72.
 47. Graber ML, Franklin N, Gordon R. Diagnostic error in internal medicine. *Arch Intern Med*. 2005;165:1493–9.
 48. Payne VL, Singh H, Meyer AN, Levey L, Harrison D, Graber ML. Patient-initiated second opinions: systematic review of characteristics and impact on diagnosis, treatment, and satisfaction. *Mayo Clin Proc* 2014;89:687–96.
 49. Patterson MD, Geis GL, LeMaster T, Wears RL. Impact of multidisciplinary simulation-based training on patient

- safety in a pediatric emergency department. *BMJ Qual Saf* 2012;22:3813–9.
50. Pannick S, Davis R, Ashrafian H, Byrne BE, Beveridge J, Athanasiou T, et al. Effects of interdisciplinary team care interventions on general medical wards: a systematic review. *JAMA Internal Med* 2015;175:1288–98.
51. Nabatchi T, Suyeon J. Initial phases of a randomized study of public deliberation about diagnostic error: a preliminary analysis of three healthcare consumer events in 2015. Syracuse, NY. Available at: tnabatch@syr.edu; see also <https://jefferson-center.org/patient-dx/>.
52. Newman-Toker D, Austin J, Derk J, Danforth M, Graber M. Are health care provider organizations ready to tackle diagnostic error? a survey of Leapfrog-participating hospitals. *Diagnosis* 2017;4:73–8.
53. Graber M, Wachter R, Cassel C. Bringing diagnosis into the quality and safety equations. *J Am Med Assoc* 2012;308:1211–2.
54. Berner ES, Graber ML. Overconfidence as a cause of diagnostic error in medicine. *Am J Med* 2008;121:S2–9.
55. Levtzion-Korach O, Frankel A, Alcalai H, Keohane C, Orav J, Graydon-Baker E, et al. Integrating incident data from five reporting systems to assess patient safety: making sense of the elephant. *Jt Comm J Qual Improv* 2010;36:402–10.
56. Sittig DF, Krall MA, Dykstra RH, Russell A, Chin HL. A survey of factors affecting clinician acceptance of clinical decision support. *BMC Med Inform Decis Mak* 2006;6:1–20.
57. Friedman CP, Gatti GG, Franz TM, Murphy GC, Wolf FM, Heckerling PS, et al. Do physicians know when their diagnoses are correct? Implications for decision support and error reduction. *J Gen Intern Med* 2005;20:334–9.
58. Fisher E, Shortell S, Savitz L. Implementation science: a potential catalyst for delivery system reform. *J Am Med Assoc* 2016;315:339–40.