automated technologies can use whole blood that has been stored at room temperature for as long as 24 hours after collection; that ability, along with automation, leads to efficiency in laboratory processing.[5] Fourth, the vast amount of whole blood collected in the United States makes it possible to produce large numbers of platelet units without requiring increased donation.

Potential disadvantages of these automated methods include a slight loss of red cells from the whole-blood unit and a possible need to shorten the red-cell storage period from 42 to 35 days because of room-temperature storage during the 24-hour preprocessing stage. Recipients' potential exposures are increased, since 4 to 5 units of whole-blood–derived platelets are equivalent to 1 unit of apheresis platelets, which are derived from a single donor. However, with current donor screening and testing standards, no evidence suggests that these platelets confer a greater risk of infection than apheresis platelets do. Yet if desired, pathogen reduction can be used to lower the risk of transfusion-transmitted infections. Overall, these disadvantages are negligible. And though the cost of bringing these technologies to the United States would be substantial, the advantages of a robust platelet supply far outweigh the disadvantages and up-front costs of these changes.

An audio interview with William Riley is available at NEJM.org

We believe that platelet technologies used successfully worldwide must be implemented in the United States to address ongoing platelet shortages, accommodate surge requirements, and improve capacity for responding to public health emergencies. The introduction of semiautomated and fully automated whole-blood technologies and the expanded use of the current manual PRP method would achieve this goal. The former can be best accomplished using an industry-wide approach that involves working with the FDA to obtain regulatory approval, with blood suppliers to establish production, and with transfusion services and clinicians to implement use of these platelets.

We recommend establishment of a public–private partnership that could develop an industry-wide solution to the increased need for platelets. The semiautomated and fully automated methods have not been submitted for FDA consideration. An alliance of public and private stakeholders working collaboratively could identify a clear pathway for obtaining FDA approval, followed by production and widespread clinical use of much-needed platelets.

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Supporting Robust Teamwork — Bridging Technology and Organizational Science

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Health care organizations are meeting the demands associated with caring for patient populations with increasingly complex needs by leveraging larger teams that include clinicians with diverse and specialized expertise. Simultaneously, high turnover and labor shortages mean that facilities are often employing a more temporary and mobile workforce than in past eras. The result is that the structure of health care teams often defies decades of wisdom from team-design research about the conditions that support the best possible performance.

Rather than facilities having well-defined teams with clear boundaries dictating who is in-

cluded, team boundaries are blurred, with individual clinicians having roles on multiple care teams whose compositions may evolve over time because of shift changes, the timing of rotations, and changing patient needs. Furthermore, instead of being part of stable teams with a history of working together, clinicians who share a patient often have limited, if any, history of collaboration. These features constrain coordination and communication within and across teams, hamper collective learning processes, and can result in suboptimal — and at times devastating — patient outcomes.[1]

Recognizing the challenges posed by these conditions, many organizations have implemented costly technology to support collective work. Clinicians formerly communicated directly, but in recent years, the complexity of clinical work has increased concurrently with the adoption of various communication tools — from messaging applications to electronic medical record systems. Although these technological solutions hold potential for facilitating communication, they often don't address the fundamental human challenges involved in fostering effective teamwork, such as managing attention and relationships.

Implementing effective solutions for modern health care teams requires a deep understanding of human behavior, not just more advanced technologies. But the findings from decades of research in the organizational sciences and related fields (e.g., human-factors engineering and psychology), which has included rigorous studies of human behavior in health care settings, haven't been incorporated into most health care research.[1,2] We believe there are promising opportunities for integration across these fields. Recent findings from organizational science shed light on coordination and collective-learning constraints in health care. Integrating these findings with technology development could create powerful levers to support robust teamwork.

There are numerous challenges associated with promoting effective teamwork in health care. The shift toward communicating mostly asynchronously by means of notes and messaging platforms, with the occasional phone call or in-person conversation, was intended to facilitate communication among dispersed clinicians. But when someone is out of sight, they are often out of mind.

In keeping with substantial research on cross-boundary collaboration in organizations, one of us found in a recent study of medical inpatient teams at an academic medical center that teams tended to turn inward when conducting their work, excluding other clinicians who could play a critical role in delivering high-quality care, such as nurses, specialists, and pharmacists, as well as patients and their families.[3] Even when information was gathered from outside the team (e.g., a consult occurred and a note was sent back), the team may not have provided other clinicians with all the relevant patient-level information, which limited the usefulness of their input. Moreover, inward-focused teams often failed to take the critical step of synthesizing the input they received from these out-of-sight people. This pattern of isolated work resulted in backtracking and delays when previously missing input from people outside the team came to light and necessitated reworking plans or when clinicians found that they had been oblivious to important decisions (e.g., when nurses were delayed in seeing electronic notices of "STAT" orders, thereby slowing medication delivery).

In the same study, however, about 25% of inpatient teams were found to dynamically integrate people with other roles into team processes as needed. To facilitate this integration, teams essentially shifted their boundaries over time: the boundary surrounding the core medical team expanded as its members gathered input from other clinicians, as well as patients and families, and met with them in real time, often in person, to collectively synthesize information and conduct complex decision making during rounds; the team boundary then contracted again when the core medical team huddled to delegate tasks internally and move on to its next patient. On the surface, these teams engaged in more time-consuming coordination-related work, but they capitalized on available expertise for each patient, and they backtracked less often and completed daily rounds faster than teams that didn't consistently integrate people with other roles in real time. The patients assigned to these teams also had shorter lengths of stay than patients assigned to other teams.[3]

The increasingly fluid structure of health care teams and the reliance on technology-mediated communication do not only affect the care of current patients; they can also erode opportunities for learning from others, which is a critical component of teamwork in health care and is necessary for improving care for future

patients. For instance, the evolution of clinical technologies and their uses (e.g., the integration of robots in surgery) has altered trainees' roles and professional routines, thereby reducing opportunities for trainees to learn by working with experts.[1] Posttraining learning opportunities are also being constrained by the increasingly mobile nature of the health care workforce, which undercuts the formation of key relationships that could otherwise be important sources of knowledge transfer.[4,5]

Research on learning in organizations reveals the power of creating spaces for informal conversation or observing others and learning on the job, which could promote the knowledge sharing and learning necessary for collective work. For example, the constant reconfiguration of air medical transport crews restricts collaboration and interferes with traditional learning mechanisms, yet research by one of us has found that crew members use storytelling routines during downtime to learn from other crews' experiences.[4] This finding, along with a robust body of work on organizational learning, highlights that although didactic teaching is often emphasized in health care (particularly in academic medical centers), learning is a social process. Learning vicariously and learning by doing (together) are critical practices that organizations can support by means of dedicated efforts to bring professionals together to share experience and expertise.

Better understanding the human-focused constraints on — and opportunities for — teamwork in health care can help guide more effective technology-based interventions to track and increase coordination and learning. For instance, artificial intelligence that processes conversations in real time could support information management during team decision making, including by inviting input from people (e.g., nurses, specialists, or patients) who haven't contributed to a discussion but probably should. Identifying patterns of clinician interactions (i.e., who is involved and when) that are associated with critical outcomes could also inform the development of better teamwork-related metrics and tools to encourage collaboration. Such tools could include algorithms that provide recommendations about interactions — prompting, for example, a primary care team to connect with a particular consultant. Similarly, scheduling technologies could draw on interaction and outcome data to create ideal care-team assignments, balancing the inclusion of members who are more familiar with each other (which could improve communication and collaboration) with those who are less familiar with each other and might provide new perspectives or stories related to their own disparate experiences (which would be in keeping with research on the potential value of working with multiple people in the same role — for example, residents working with a greater number of nurses — to enhance learning).[5]

Of course, there are risks associated with deploying new technologies. Algorithms used to support human decision making can lack transparency, which, along with concerns about data security, can create distrust. They can also perpetuate bias, which is especially a risk when high-quality data aren't available. These shortcomings could hamper innovation. Moreover, scaling solutions and integrating them across heterogeneous sites can be challenging. Here, too, research from organizational science and related fields could help organizations collect the right data and use meaningful metrics to identify important contextual factors that could inform modification and integration across sites and to better manage change and implement new solutions.[1,2]

Calls to improve teamwork-related practices in health care aren't new. Yet in today's dynamic health care landscape, where team design often conflicts with best practices, we believe it's critical that researchers, developers, and practitioners integrate insights from research in the organizational sciences with technology development to cultivate more robust teamwork.

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