EXPERT INSIGHT

# Better Computing Devices Are on the Way

By Edward P. Ambinder, MD

TODAY, ONCOLOGISTS AND THEIR patients face disruptive changes in healthcare practice, medical research, governmental oversight and regulation, business practices, and physician -patient communication—changes brought on by the growth and merging of the fields of information technology, medical technology, medical practice, biology, and physics. We now practice in large hospital systems or accountable care organizations rather than in small group practice silos, deal with changing reimbursement methods as we transition from fee-for-service to bundling payments and defined encounters of care, have novel apps like Apple's ResearchKit that have revolutionized patient accrual, document our patient care using electronic media rather than paper, and have a government that has persuaded over 90% of us to adopt certified electronic health records (EHR), which we use to capture, aggregate, organize, summarize, synthesize, store, report, and analyze data.

Edward P. Ambinder, MD

To better cope with today's digital universe, it is important to understand how the modern Information Age, which began in the early 1960s just as the practice of medicine radically changed with the onset of Medicare and Medicaid, enabled information technology to have a logarithmic effect on improving computer hardware, monitors, data storage, software, services, interactive communication, and data transmission tools. Two individuals stand out: first, Douglas Engelbart of SRI International, creator of the first workstation with a mouse, separate keyboard, and computer display. He theorized in 1960 that as electronic circuits became smaller, their components would operate faster, require less power, and become cheaper to produce—all at an accelerating pace. This introduced the electronics industry to the remarkably simple but groundbreaking concept of scaling. Second, Gordon E. Moore, co-founder of Intel Corp, quantified the scaling principle in 1965 and posited what has become known as Moore's Law—that the number of transistors that can be placed on an integrated circuit of a given size would increase exponentially. Moore's Law was accurate because computer dimensions began to shrink dramatically, data storage increased, data transmission rates over wire and cellular modes sped up, and screen resolution improved. This exponential scaling of electronic circuits facilitated the creation of the Internet, mobile computing, mobile medical devices as part of the Internet of Things, the cloud, cognitive computing, and rapid learning systems such as ASCO's CancerLinQ, which uses big data analytics and artificial intelligence to improve outcomes.

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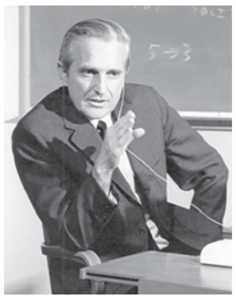
—Edward P Ambinder, MD

However, we remain frustrated with the data processing inefficiencies of our electronic devices and EHRs because they still require typing or dictation for data entry. Because of the absence of seamless data interoperability, we still cannot easily reuse electronic data from a primary care referral or even from a new patient to save time in getting this information into our computer. Additionally, in the future, astronomical amounts of patient data outside the hospital and physician's office will need to be monitored, collected, analyzed, and reported, given the advances in bioinformatics capturing "omics" data (genomics, transcriptomics, proteomics, metabolomics, microbiomics, viromics, epigenomics, and environmental exposure [exposomics] data) and biosensors on wearable medical devices providing personomic data such as vital signs, glucose, blood oxygen, 12 lead-electrocardiogram readings, patient exercise and wellness, mindfulness, nutrition, and sleep.



Douglas Engelbart

Currently, EHR vendors and other health entities continue to engage in information blocking for proprietary purposes. These activities prevent the seamless sharing of patient data and make oncologists and patients' involvement with the healthcare system unnecessarily burdensome. Most EHRs are designed for primary care clinical activities with specialty care such as oncology added on. These handle reimbursement and billing and provide documentation for administrative, legal, and some research efforts. A recent ASCO survey conducted by its Health Information Technology Work Group revealed that the majority of oncologists are disappointed with their EHR's efficiency, navigation, timeliness, interoperability, and workflow. Of importance to oncology, the survey found that EHRs lack many up-to-date cancer-specific tools, intelligent clinical decision support, easy customization, and the ability to create auto-populated reports needed for patients, quality and outcome measurements, cancer registry reporting, and rapid learning systems.

Gordon E. Moore

Other surveys consistently show that EHRs significantly reduce face-to-face time between patients and doctors. Most critically, EHRs fail to provide actionable, interoperable medical data. They should coordinate all sources of care—from medical devices to our formal places of care, including offices, hospitals, labs, and imaging centers and their individual EHRs and health apps. This capability will become mandatory for supporting a value-based, data-rich, coordinated, and cost-effective cancer economy for increasingly engaged, mobile patients struggling with multiple overloaded patient portals, crowdsourcing their research participation, and trying to take more control of their medical decisions and electronic medical media. This will happen as patient-reported outcomes, patient-generated health data, patient values, and wellness and vital signs monitoring are taken outside the hospital and physician offices with portable and wearable medical devices. We are increasingly communicating electronically with all healthcare stakeholders, including our patients, who expect to be able to obtain complete electronic, reconcilable versions of their medical records on request from their providers and even donate their records to research projects.

However, creating the engaged patient who deserves easy access to a reconcilable and complete medical record summary, having oncologists who practice precision oncology in an omics world, providing a value-based and coordinated care health system, and being able to correct the EHR deficiencies discussed will require a novel interoperable and digital ecosystem that transmits both humanand machine-readable medical reports. Health Level Seven International (HL7) has created the architecture for defining almost every type of medical report. This is evident in its Consolidated-Clinical Document Architecture (C-CDA) for handling large documents. HL7 has developed a more nimble, less expensive, more-Internet-resource-friendly, and granular architecture that can handle individual data elements, making data more available for research and discovery. It works with existing C-CDA documents and is much easier for the technologically shy to work with. It is known as Fast Healthcare Interoperability Resources (FHIR) and has rapidly become the leading data standard and interoperability enabler. FHIR—Substitutable Medical Apps, Reusable Technologies, working with application programming interface (API)-enabled EHRs, will enhance our electronic workflows and provide constantly updated specialty-specific information, practical clinical decision support and electronic functionalities that are "written once and able to be run anywhere" on any API-enabled EHR using these modular APIs. APIs are programming routines or protocols that allow software applications to share data. These benefit our overworked oncologists' and their engaged patients' data workflow and electronic information handling, while maximizing actionable medical data creation for reporting and rapid-learning systems.

EHRs must also provide a standardized set of common data elements and value sets for defining the basic family and internal medicine patient. For the medical specialties like oncology, additional data elements, value fields and software tools are also needed for each medical specialty. These should be defined by the respective medical specialty associations as suggested by the American Medical Association.

Today, by providing these existing and rapidly advancing standards, a complete medical record summary of the patient known as a HL-7 Continuity of Care Document, an example of a C-CDA, should be able to be electronically sent by most EHRs today to the oncologist by the primary care physician, who could automatically incorporate it into an EHR with correct data field placement. Similarly, patient-generated data could be added and the oncologist could begin to add their oncology diagnostic workup, cancer staging, cancer treatment plan, cancer treatment summary, and survivorship care plan, completing a report documenting the patient's cancer treatment journey.

**TABLE:** NEXT-GENERATION INFORMATION TECHNOLOGIES

- **Conversational interfaces:** Amazon Alexa, Google Assistant, Apple's SIRI, Microsoft's Cortana
- **Blockchain for healthcare:** The concept is to use blockchain as a tamperproof ledger in which medical records are electronically available and able to be retrieved when appropriate consent is given to an individual.
- No centralized database or government involvement
- Internet of Things devices
- **Mobile apps:** tied to our API-enabled EHR for simple clinical functions and clinical decision support
- **Chatbots:** automated conversations for simple tasks
- Artificial intelligence with neural networks for image, pattern, and video recognition: technology to recognize people and objects in images and videos; identify patients, staff, etc; skin photos dx (dermatology), microscope slide interpretation (pathology); identify radiological images and scans (radiology)
- **Big data (machine learning):** Provide computers the ability to learn without being explicitly programmed (facial recognition, detect emotions, cognitive computing, IBM Watson).
- **Dashboards and analytics:** Leverage innovative technology that can visualize large amount of live data for useful analysis.
- **Augmented reality:** a technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view.
- **Virtual reality:** a computer technology that uses virtual reality headsets, sometimes in combination with physical spaces or multi-projected environments, to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual or imaginary environment.
- **Omics data:** The English-language neologism omics informally refers to a field of study in biology ending in omics, such as genomics, proteomics, and metabolomics.
- **Care plan navigator:** An up-to-date, mobile, cloud-based, and multidisciplinary care plan management and data aggregator and reconciliation tool for cancer patients and oncologists to create and track action plans with identification of the patient's values and provision of adequate longitudinal, clinical, genomic, personomic, and financial data linking facilitating communication between patients and their families, caregivers, active providers, and ultimately, in a real world, payers and health information technology companies

API indicates application programming interface; dx, TK; EHR, electronic health record.

Because FHIR uses standard Internet resources for sending data between apps or any participating application such as an EHR, consensus is rapidly building among all participants in healthcare for having third party public API and API-enabled EHRs work together for healthcare just like the applications on our smartphones or web services on the Internet. For oncology, this will permit us to provide tools for having access to real-time precision medicine data, evidence-based and evidence-generated medicine guidelines, and links to up-to-date cancer treatment information and prognoses from web-based knowledge bases. Providers would be empowered by innovative user interfaces and analytic platforms that could support their clinical decision making and measurable quality reporting. Investigators could have easier access to detailed clinical and cost claims data to create hypotheses and identify trends—and create a better experience for individuals donating their data for science. We could have value-based care for our healthcare system and a care-coordinated, modular and up-to-date care plan using a care plan manager/navigator-type app for patients, caregivers, and any of their involved providers.

Use of the above tools could help coordinate care among many clinicians from multiple provider organizations and assist our oncologists with the upcoming Medicare Access and CHIP Reauthorization Act and Merit-based Incentive Payment System (MIPS) requirements for better care coordination needed for healthcare reimbursement. The improvement would drastically reduce faxes, phone calls, the need to carry bags of paper between clinics, record duplication, and unnecessary retesting. This is especially important to cancer patients, as their care is usually a collaboration of providers and caregivers who may be spread across healthcare systems, time zones, and geographies. APIs would not only enable EHR systems to share data with patients but would also help to create system-wide interoperability among patients, different providers, and their EHR systems. If needed, these could bring caregivers into the discussion, providing them with up-to-date medical information and the ability to communicate with the care team. Patients could have a modular, up-to-date, multi-provider interactive care plan summary that captures, aggregates, and displays medical data in a standards-compliant longitudinal view, while transmitting and reconciling all their health information.

To promote the adoption of healthcare APIs, there are financial incentives for providers and EHR certification requirements for incorporating API technology in MIPS as well as new incentives for professionals participating in alternative payment models going into effect starting in 2019. The concerns of both provider and patient regarding requirements for privacy and security have been addressed standards for the secure exchange of sensitive data using OAuth 2.0 and Open ID Connect to facilitate authentication and authorization using APIs. Most vendors are implementing open, standardized APIs with transparent terms of use, policies, and developer fees as part of the Argonaut Project. Some cultural and workflow issues remain, but I am optimistic they will be resolved.

In coming years, oncologists will be kept very busy and must have software tools that are more productive, workflow efficient, up-to-date, clinical specialty specific, and user friendly as we face new reimbursement and practicing models. I am convinced that our future oncologists and their engaged cancer patients will have computers that work for us, unlike today, where we are working for the computer. (**Table**)