Evidence-Based Care
How the Right Software Tools Can Help Support Clinical Decisions

Standard of Care
RapidPlan Tackles Variability in Treatment Plans

Implementing ARIA 11
Early Adopters Share Tips

Change Agent
PremierAssurance Advantage Services Help Build Operational Excellence
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UNLOCK A WEALTH OF POSSIBILITIES.

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## Safety Information
Radiation treatments may cause side effects that can vary depending on the part of the body being treated. The most frequent ones are typically temporary and may include, but are not limited to, irritation to the respiratory, digestive, urinary or reproductive systems, fatigue, nausea, skin irritation, and hair loss. In some patients, they can be severe. Treatment sessions may vary in complexity and time. Radiation treatment is not appropriate for all cancers.
Helping You Help Patients: Varian Oncology Solutions from Diagnosis to Survival
By Kolleen Kennedy, president of Varian’s Oncology Systems business

We know that the cancer care landscape is changing at a fast pace. With pressures that include the development of accountable care models in the United States and similar initiatives around the world that seek to control healthcare costs while improving coordination and quality outcomes, having access to the right information at the right time has never been more essential. Consequently, we have launched an initiative that focuses on how we can leverage informatics, big data, and software development to help you deliver high-quality, evidence-based care, coordinate with colleagues, and manage the patient journey from diagnosis through survivorship.

We’re working to develop solutions that help cancer care providers deliver high-quality, cost-effective, coordinated care. Our aim is to bring you software solutions that tap the knowledge and experience of the world’s leading oncology practitioners and unlock the vast amounts of clinical data that are currently housed in disparate databases around the globe. We will do this by leveraging advances in information technology to assemble a collective knowledge base that transcends the clinical skill set at any one institution. We are cultivating an electronic environment that aggregates images, treatment plans, and patient records within a powerful software architecture that makes information accessible and usable in managing and streamlining complex patient care regimens.

Several of the articles in this issue of Centerline highlight activities related to this ongoing initiative. In a feature about Varian’s new RapidPlan™ knowledge-based treatment planning software, two distinguished professors of medical physics share their thoughts about how this system can help clinics reduce variability in treatment planning and achieve greater consistency and quality in patient care (see story on page 12).

In another article, clinical teams from Dartmouth-Hitchcock Medical Center, the University of Pennsylvania Health System, and Central Georgia Radiation Oncology describe how they prepared for the deployment of version 11 of the ARIA® oncology information system in order to take maximum advantage of new workflow management features. All three sites report improvements in operational areas such as documentation, workflow, compliance, and resource management (see story on page 18).

“Having access to the right information at the right time has never been more essential.”

PremierAssurance™ Advantage, a new professional services plan that Varian has developed to help customers manage, change, and create operational excellence, is the topic of yet another feature. The PremierAssurance plan helps customers identify technology gaps, address workflow challenges, and find ways to increase clinical efficiency and cost-effectiveness (see story on page 15).

Finally, we shine the spotlight on members of our new Oncology Continuum Solutions (OCS) team, a dedicated group of some 200 people in five countries who are working to deliver the software solutions of tomorrow (see story on page 9). This unique team includes people with a wealth of informatics, software development, and clinical experience, as well as experts in software as a service (SaaS), big data, cloud computing, and information technology. They are working alongside experts outside the company to develop an ecosystem of collaboration platforms that will transform individual silos of data into readily accessible, knowledge-based solutions. That’s our vision of the future, and we hope you find it as compelling as we do.

Kolleen Kennedy, MS, is president of Varian’s Oncology Systems business. She has served Varian for more than 15 years in a variety of management roles.
Doctors at the Scripps Proton Therapy Center in La Jolla, California, have begun treating patients using Varian’s ProBeam™ proton therapy system. Carl Rossi, MD, medical director at the facility, delivered the first treatment to a prostate cancer patient in February 2014.

The Scripps Proton Therapy Center encompasses five treatment rooms, three of which include gantries. The center’s two other rooms are designed for fixed-beam treatment delivery. Two of the facility’s gantry treatment rooms are operating. The additional treatment rooms are projected to be commissioned and put into clinical use by the end of this year.

“The Scripps Proton Therapy Center brings to patients in this region and beyond one of the most advanced, accurate treatments available for cancer care,” says Chris Van Gorder, Scripps president and CEO. “The center exemplifies innovation and collaboration, and we are proud to bring this life-saving technology to our region with our affiliates.”

The ProBeam system utilizes pencil-beam scanning to deliver intensity-modulated proton therapy (IMPT). The technology modulates dose levels on a spot-by-spot basis throughout the treatment area. Irradiation from multiple angles is combined in an optimal manner to improve the control of dose distributions. Scanning beam technology also eliminates the time-consuming need to manually insert physical beam-shaping devices. The beam is shaped via sophisticated electromagnetic technology.

“Pencil-beam scanning allows doctors to treat larger and more complex tumors, while sparing more normal tissue and producing about one-tenth as many carcinogenic neutrons,” says Rossi. “We’re essentially breaking down each tumor into thousands of tiny cubes, and then ‘painting’ each individual cube with radiation, layer by layer.”

“The ProBeam user interface was designed to be consistent with what clinicians see when they use a Varian TrueBeam® machine,” says Moataz Karmalawy, vice president and general manager of Varian’s Particle Therapy group. “Clinicians who know the TrueBeam system should have a relatively easy time learning how to work with the ProBeam system. We’re excited to reach this milestone in the Scripps Proton Therapy Center project, and look forward to working closely with them over the coming months to get the rest of the treatment rooms up and running.”

Varian’s scanning beam IMPT technology is also being utilized at the Rinecker Proton Therapy Center in Germany, which has now treated more than 1,500 patients. Varian also has contracts to install ProBeam systems at five more sites in addition to Scripps: three in the United States, one in Saudi Arabia, and one in Russia. ■
**First Edge radiosurgery treatments take place in Portugal**

Clinicians at the Champalimaud Centre for the Unknown in Lisbon, Portugal, have performed the world’s first cancer treatments using Varian’s new Edge™ radiosurgery system. In February, doctors at the center used the new system to deliver radiosurgery treatments for patients with lung, prostate, and brain cancer.

The first patient treated was a 63-year-old female with borderline operable stage I non–small cell lung cancer. Her treatment was completed using implanted Calypso® anchored Beacon® transponders to track lung tumor motion in real time.1 Carlo Greco, MD, of the Champalimaud Foundation, noted the Edge system’s ability to apply subtle rotational pitch-and-roll corrections during fast patient setup and alignment, using the system’s PerfectPitch™ six-degrees-of-freedom couch.

In addition to the lung cancer patient, clinicians treated a 67-year-old male with two brain metastases resulting from a primary lung tumor. The patient received a single radiosurgery fraction of 24 Gy and spent less than 10 minutes in the treatment room.

Two hypofractionated treatments for prostate cancer, designed for urethral sparing under Calypso Beacon transponder guidance, also took place. According to the clinical team at Champalimaud, preliminary data indicates that hypofractionation holds great promise in achieving biochemical relapse-free outcomes in properly selected prostate cancer patients.2

“We believe the Edge radiosurgery system offers more options for clinicians and will prove to be an effective tool for offering fast, ablative, and precise hypofractionated treatments,” says Rolf Staehelin, head of international marketing for Varian.

Other leading cancer centers around the world—including the Henry Ford Clinic in Detroit, Michigan, and the Humanitas Clinic in Milan, Italy—are scheduled to commence treatments using the Edge radiosurgery system in the near future. ■

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1. Anchored Beacon transponders for lung have the CE mark, but are not available for sale in all markets. They are investigational devices limited by federal law to investigational use only in the U.S.

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**Edge Radiosurgery Symposium held**

Leading oncology centers were on hand to report on advances in stereotactic radiosurgery (SRS) and stereotactic ablative radiotherapy (SABR) treatments at the first Edge™ Radiosurgery Symposium, held at the Champalimaud Centre for the Unknown in Lisbon, Portugal, in November 2013. Experts from around the world presented details of the latest in advanced treatment techniques to an audience of more than 110 industry professionals.

Clinicians from Memorial Sloan Kettering Cancer Center (New York), Barnes Jewish Hospital (St. Louis, Missouri), Henry Ford Health System (Detroit, Michigan), Humanitas Cancer Center (Milan, Italy), VU University Medical Center (Amsterdam, Netherlands), and the Champalimaud Foundation shared advances in biology, targeting, speed, and motion management involved in radiosurgery treatments.

“A growing body of clinical evidence demonstrates the benefits of delivering high doses in a small number of fractions, and radiosurgery can currently treat targets previously not considered candidates for high-dose hypofractionation,” according to the Champalimaud Foundation’s Carlo Greco, MD. “In order to support this clinical trend and paradigm shift, we are introducing a comprehensive radiosurgery system designed to shape the future of cancer care, and we were delighted to be able to share our experiences with other centers from around the world.”

“This symposium enabled the sharing of best practices in SRS and SABR as well as further defining and expanding the role of Edge radiosurgery in the treatment of intracranial and extracranial lesions,” says Rolf Staehelin, Varian’s senior director of international marketing. “Sharing knowledge and experience in these areas is vital to further developing noninvasive surgical techniques in the brain, spine, lung, liver, prostate, and other indications.” ■
Varian Education Center goes green

In February of this year, the Varian Education Center in Las Vegas, Nevada, launched a “go green” initiative that eliminates the use of paper in the classroom. Students attending classes now access manuals and other educational material using an iPad reserved for their temporary use while at the education center. On the iPad they can annotate the materials, take notes, draw pictures, save materials to a Dropbox location, and upload materials to their own networks for sharing with colleagues.

The “go green” initiative will save in excess of 3 million sheets of paper annually, not to mention the cost—and environmental impact—of using copiers, toner, and binding materials such as glue. The initiative will soon be rolled out across Varian’s other education centers in Cham, Switzerland; Beijing, China; Tokyo, Japan; and Mumbai, India.

“Customers who participated in the pilot program were pleased with the ease of use of the iPad,” says Sue Merritt, Varian’s education director for the Americas. “They liked being able to share the materials easily with others at their sites. This way, they won’t take the materials with them if they leave a site to take a job elsewhere, which is what often happens with paper manuals.”

According to Alex Salima, RT(R)(T), an instructor on Varian’s strategic internal training team and one of the leaders of the “go green” initiative, students have reacted positively to the change. Comments on student surveys have focused on the convenience of taking notes, zooming in, and finding relevant materials on the iPad, as well as the portability of the materials. “I’ll always have my notes and manuals when traveling or training on site,” wrote one student.

“Overall, the change has been well received,” Salima says. “I believe our customers expect us, as an innovative company, to always look for ways to effectively use technology and integrate it into our teaching and learning environments.”

Varian acquires Velocity software platform for data-driven clinical decision-making

Varian Medical Systems has acquired specific assets of Velocity Medical Solutions, LLC, an Atlanta-based developer of specialized software for cancer clinics. The acquisition includes software designed to access and aggregate unstructured treatment and imaging data from diverse systems to show a comprehensive view of a patient’s diagnostic imaging and treatment history, regardless of where the patient was treated or what technology was used.

Velocity Medical Solutions was founded by leading clinicians who have developed innovative and powerful tools that transform unstructured data into useful clinical knowledge. The Velocity software enables clinicians to collect, integrate, and share data from CT, PET, and MR images and diverse treatment systems for close collaboration with referring physicians, oncologists, medical physicists, and others on the care team.

The Velocity software is already in use at more than 200 cancer treatment centers worldwide.

“This acquisition supports our commitment to providing clinicians with tools for data-driven clinical decision-making,” says Kolleen Kennedy, president of Varian’s Oncology Systems business. “The software enables healthcare professionals to use oncology patient images and data to plan and assess treatments, collaborate with colleagues, and share clinical knowledge—all important capabilities in an era of evidence-based medicine. We envision clinicians using this software to fully understand a patient’s clinical history in order to make informed decisions about the path forward.”

“Customers tell us that they are using the Velocity software for many of their image-related processes, from image fusion to monitoring dose accumulations,” says Corey Zankowski, Varian’s vice president of product management. “They also use it to access images remotely. For those working in mixed-vendor environments, it is important to have software that can aggregate data from diverse systems.”

1. Velocity products are not for sale in all markets.
Linking ARIA systems with Siemens accelerators

In January of this year, clinicians at Radiologische Allianz GbR in Hamburg, Germany, became the first in the world to utilize Varian Exchange, an interface that connects the ARIA® oncology information system with Siemens’ ONCOR®, PRIMUS®, and ARTISTE® accelerators. The interface was successfully deployed and used clinically for the first time with an ONCOR machine.

According to Joachim Brazerol, software sales manager for Varian’s Oncology Systems business, the ONCOR treatments using ARIA and Varian Exchange were completed as quickly as treatments done previously using Siemens software exclusively. “With Varian Exchange, ONCOR treatments are fully integrated in the workflow management, and in this case, planned using Varian’s Eclipse™ system,” he says.

At the same time that Varian Exchange was installed, Siemens also upgraded its Syngo software, which connects to the linac and handles record-and-verify functions, image acquisition, and patient position verification. “ARIA interfaces with Syngo via DICOM connectivity to provide the patient plan, the reference images, and the daily worklist, and then receives the dose history and acquired images for saving back into the database,” says Brazerol. “From a workflow perspective, it’s very similar to what is done in a Varian-only environment. The head physicist at the site, Matthias Kretschmer, reported that the upgraded Syngo software enhanced the image quality—an additional benefit that hadn’t been anticipated.”

The sales and implementation processes were handled directly by Varian to give the customer a single point of contact. Varian and Siemens worked together to install the software and provide training. “Our goal was to make the transition to Varian Exchange as easy as possible for the customer,” says Adam Earwicker, manager of strategic alliances for Varian.

TrueBeam system orders reach 1,000 units

The TrueBeam® system for image-guided radiotherapy and radiosurgery has been the most successful technology platform in Varian’s history, in terms of how quickly and widely it has been adopted. Since its introduction in April 2010, some 1,000 TrueBeam machines have been ordered, and more than 600 are either installed or in the process of being installed at cancer centers around the world. During the last year, TrueBeam machines have been deployed at cancer centers in Bangladesh, Belarus, Brazil, Colombia, India, Mexico, Panama, the Philippines, Puerto Rico, Romania, Russia, Saudi Arabia, South Africa, and Turkey. Over the same time period, 10 TrueBeam machines were installed in Japan; 4 each in India, Poland, South Korea, and China; and 15 TrueBeam machines were installed at 13 centers across Canada.

“We have been gratified by the clinical community’s widespread acceptance of the TrueBeam system,” says Chris Toth, vice president of global marketing for Varian’s Oncology Systems business.

TrueBeam 2.0 system expands usability and performance

The TrueBeam® 2.0 system, which is now available to customers, provides increased treatment automation, enhanced user interactions, and a dynamic QA workspace. This infrastructure enables integration and control of Varian’s PerfectPitch™ six-degrees-of-freedom couch, use of advanced IGRT and motion management capabilities, connectivity for real-time tracking solutions such as those available with Edge™ radiosurgery packages, and a new low-energy and low-dose imaging beam.

“The new software allows us to deliver the optimal radiotherapy treatments for our patients due to two pioneering additions: the new PerfectPitch treatment couch that integrates with the existing machine to offer even more accuracy in patient positioning, and developments to the integrated imager that allow the movement of a patient’s tumor to be assessed before and during treatment,” says Philip Mayles, PhD, head of physics at the Clatterbridge Cancer Centre near Liverpool, England.
Varian has acquired a new software tool from the United Kingdom’s National Health Service. The R-PORT™ radiation oncology planning resource tool enables hospital administrators to benchmark workflow, do forward predictive planning of resources, and budget for patient treatment capacity, allowing for more informed resource management decisions.

An oncology-specific capacity planning and management software tool, R-PORT was designed in response to the demands of patients and their advocates for better and timelier cancer care. “It has been very helpful in improving efficiencies and controlling costs,” according to Jane Whittome, who heads the NHS Improving Quality program on patient experience.

Whittome was responsible for commissioning the original development of R-PORT. The software was subsequently tested outside of the United Kingdom and found to be useful in reducing the impact on patient waiting times through its simulation and resource scenario planning features.

Steve Laws, Varian’s regional director of software sales for Europe, the Middle East, and Africa, was inspired by the technology and its potential. “R-PORT is highly synergistic with Varian’s existing software portfolio,” says Laws. “It builds on Varian’s mission to be a partner for life—supporting our customers to deliver world-class cancer care.”

“Healthcare providers worldwide are seeking solutions to help them deliver better patient care, reduce patient wait times, increase physician and staff productivity, reduce costs of operations, and basically do more with less,” says Scott Brouse, Varian’s vice president of worldwide site solutions. “This is a tool that can help Varian support customers in the fight against cancer.”

Varian acquires R-PORT oncology planning tool

TrueBeam Developer Mode workshop held

Last August, Varian held its first TrueBeam® Developer Mode workshop for members of the research community who use this unique nonclinical research tool. “We designed this event for our research community to pool knowledge and help each other become more productive in what we call the Varian Nonclinical Environment to Empower Research (NEER),” says Michelle Svatos, senior manager of translational research. “The goal was to get people inspired, help them take an existing research project to a new level, and facilitate alliances between researchers interested in similar projects. And to have fun!”

The event offered two tracks: one for experienced users to share their ongoing research projects, and one for people who wanted to see what’s possible and gain inspiration for launching their own projects.

Developer Mode turns the TrueBeam machine into a big robotic laboratory for pioneering and prototyping new techniques in a nonclinical setting. In Developer Mode, the TrueBeam researcher can control many aspects of the machine’s functioning, including the kV photons, MV photons, imaging arms, gantry, and table rotation. Because the work takes place in a protected, nonclinical environment, researchers have great experimental freedom. The processes and techniques being worked out in Developer Mode are by definition not FDA cleared and cannot be used clinically.

“This is really about doing translational research in an ‘open source’ environment,”
says Svatos. “It’s a little like crowdsourcing. When users of Developer Mode figure out how to do something new with our technology and show us, we all learn.”

The use of TrueBeam Developer Mode can also potentially facilitate a compressed timeline for taking a good idea from prototype to product cleared for clinical use. “If a Developer Mode project really opens up a new horizon, we are in a position to move something quickly into the product development pipeline toward regulatory clearance,” Svatos explains. “Because the research was carried out using Varian technology, we’re already part of the way there.”

Varian has also set up online resources to support researchers. Radiotherapy Research Tools (radiotherapyresearchtools.com/) provides technical resources for performing research with Varian equipment, and the Varian Developers Forum (variandeveloper.codeplex.com/) is an online repository that supports code sharing among collaborators in their work with Varian public application programming interfaces (APIs).

“The next revolution in radiotherapy treatment might come from any one of our collaborators,” Svatos says. “We hope that, by facilitating collaboration, we are helping to advance the science of radiation oncology, to everyone’s mutual benefit.”

Siemens receives FDA 510(k) clearance for SOMATOM Definition AS Open RT Pro

Varian’s strategic partner, Siemens, recently received 510(k) clearance from the U.S. FDA for a new solution especially designed for use in radiation therapy. The SOMATOM® Definition AS Open RT Pro edition is a package of software features that further optimizes Siemens’ SOMATOM Definition AS Open CT simulator for radiation oncology workflow.

According to Siemens, the RT Pro edition of the SOMATOM Definition AS Open was designed to deliver excellent image quality for radiation oncology, even for large patients and for patients with metal implants. Innovations in the package include:

- Metal Artifact Reduction in Image Space (MARIS), which helps provide accurate CT data for treatment planning by reducing image-distorting, beam-hardening artifacts caused by a patient’s metal implants.
- Motion Management Pro, a comprehensive solution for respiratory gating with full compatibility with Varian’s Real-Time Position Management™ (RPM) system that includes enhanced tools such as Average CT and temporal MIP to help evaluate tumor motion and enable reliable contouring in a single image.
- HD FoV Pro, an intelligent image reconstruction feature that provides sufficient HU accuracy and visualization of the body outline outside the scan field-of-view.

For more information about this and other Siemens imaging technologies, contact your local Varian representative.

Varian publishes annual sustainability report

Varian has published its 2013 corporate social responsibility report, detailing the company’s policies and achievements in extending care, protecting resources, and helping to save lives. The report has been produced as part of a wider company investment to continually improve sustainability performance and transparency. “Companies such as ours have a responsibility to achieve our business goals in a socially and environmentally responsible manner,” says Dow Wilson, Varian’s chief executive officer.

The Varian Sustainability Report 2013, which covers environment, health access and outcomes, safety and responsibility, and colleagues and communities, can be accessed online at varian.com/sustainability.
Varian has a new organization that we’d like you to meet: Oncology Continuum Solutions. Whether or not you ever see a member of the OCS team face to face, you’ll soon experience the impact of the organization as you use Varian software to deliver increasingly more patient-centered and outcome-driven care all along the care continuum.

“We are seeing a global trend toward comprehensive cancer care that combines all aspects of oncology care, including diagnosis, medical oncology, surgery, radiation therapy, care coordination, and survivorship,” says Dow Wilson, CEO of Varian Medical Systems. “At Varian, we’re focusing our software vision and strategy on the needs of the entire oncology domain.” The focal point for turning the vision into solutions is the aptly named Oncology Continuum Solutions organization, a dedicated group of more than 220 people in five countries, pulling together with a shared purpose.

Harnessing informatics
The people of OCS have been recruited from a variety of fields to create synergy and drive innovation. Some are physicians, physicists, and nurses who know the clinical landscape. Others bring expertise in a variety of key technologies—from rapid software development and user-experience architecture to cloud technology and software as a service (SaaS) to health informatics. Health informatics, which encompasses the collection, organization, management, and dissemination of recorded knowledge, involves the interworking of many systems required for clinical practice and medical research, including electronic medical records, health information exchange standards, and portable devices that collect data.

“We are keenly interested in developing solutions that capitalize on health informatics to streamline clinical workflow, improve care coordination throughout the patient journey, and advance care for individuals—and ultimately for populations,” says Kolleen Kennedy, president of Varian’s Oncology Systems business.
Co-innovation with customers

Co-innovation with customers is a cornerstone of OCS, says Sukhveer Singh, general manager. “OCS enables customers to be an integral part of solution development. Working closely with us, customers help us understand their needs and build a consensus about future directions.”

OCS will continue to involve customers in a variety of ways: in brainstorming workshops and on advisory boards, as test drivers of solutions throughout the development process, and as development partners through research grants.

For example, clinicians at the University of Pittsburgh Medical Center (UPMC) worked closely with Varian on the first large-scale deployment of version 11 of the ARIA® oncology information system. UPMC clinicians provided feedback while embedded Varian engineers and IT professionals from UPMC collaborated to enhance the software. UPMC continues to facilitate the ARIA advisory board.

A similar process was used successfully during the recent development of Varian’s RapidPlan™ knowledge-based treatment planning software. Varian personnel worked closely with researchers at the Washington University School of Medicine in St. Louis, Missouri, throughout the RapidPlan product evolution. This collaborative model is another good example of the product development process that the OCS team will continue to follow. (For further information about RapidPlan, see the article on page 12.)

The people of OCS

The lifeblood of the OCS organization is the more than 220 men and women who are working to elevate your experience with Varian software and create innovative solutions along the care continuum. We’d like you to meet three of them right now.

Gunther Lenz, director of the OCS technology office in Palo Alto, California

Gunther Lenz came to Varian with more than 15 years of experience at Siemens, Wipro, and Microsoft. He received his MS degree in electrical engineering from the Technical University of Munich and an MBA from New York University. Lenz observes that, traditionally, healthcare has lagged behind other industries in embracing new technology, but he joined the OCS team to help break that tradition. When he is not working to help close the technology gap, Lenz is involved with gadgets and sports, and is trying to adapt to California life by driving his first electric vehicle.

As director of the OCS technology office in Palo Alto, Lenz is charged with bringing innovation to the next-generation Varian solutions, leveraging state-of-the-art technologies, and implementing proven new software development paradigms and best practices. Healthcare systems, he explains, are silos that, despite advances in technology, still don’t talk to each other well enough.

“We need to learn from other industries that are solving the problems of isolated systems and stove-piped data by applying new architecture paradigms and proven technology,” says Lenz. “For example, more centralized cloud-based solutions would enable data sharing across departments, across...
The hospitals of a single provider, and across all providers. Furthermore, adding a coordinated-care layer and analytics could lead to evidence-based treatment decisions and support rapid learning solutions to provide more efficient and better quality care delivery.”

Cloud computing also provides the means to deliver efficient solutions more quickly and without disrupting clinic operation. “It’s an exciting time in healthcare,” says Lenz. “With thousands of installations, the experience to know what the market needs, and the investment to make in innovation, Varian is in a great position to solve the challenges and elevate oncology care to the next level.”

Ashish Kadam, software architect in Pune, India
Ashish Kadam grew up in Mumbai, where he studied engineering at the Vivekanand Education Society’s Institute of Technology (VESIT). Outside of work, he enjoys spending time with his family and working on hobby projects.

Kadam joined Varian in 2009, bringing with him a passion for software engineering and execution. At first, he saw unsolved challenges as learning opportunities that could sharpen his skills. Now he appreciates the impact that Varian products have. Kadam is currently working on several projects:

- Integrating business intelligence into Varian software offerings to help customers explore and use data to aid business decision-making
- Developing an event-driven framework, enabling users to observe system changes and configure actions “on the fly”
- Expanding integration and interoperability through web application programming interfaces (APIs) for access to Varian data

“We are engaging with our customers and focusing on how we can make their lives smoother and simpler with our applications,” says Kadam. “We want them to be able to focus on their patients while we abstract the complexities for them.”

David McConnell, team lead for OCS software development in Winnipeg, Canada
David McConnell’s software development team codes product improvements. Born and raised in Winnipeg, Canada, McConnell says that, when he is not working, he is mostly involved in being a father to his three children, which often includes cheering them on at hockey games.

McConnell explains his role in OCS this way: “We provide new functionality that makes it easier for people treating cancer to do their jobs and provide better patient care.” It’s personally rewarding, he says, to work on something that is so important to so many people, especially given that software development work often takes place far removed from a company’s customers.

Immediate tasks for McConnell’s team are to get the ARIA oncology information system certified for stage 2 of the U.S. Health Information Technology for Economic and Clinical Health (HITECH) Act and to deliver functionality to support ICD-10 codes, which the U.S. Centers for Medicare and Medicaid Services (CMS) use to identify medical diagnoses and procedures. He builds Varian solutions “brick by brick,” but never takes his eye off the long-term implications of his work. “Our job,” says McConnell, “is to enable the people who treat cancer and save lives.”

“OCS enables customers to be an integral part of solution development. Customers help us understand their needs and build a consensus about future directions.”

—Sukhveer Singh, Varian Oncology Continuum Solutions
Varian is now taking orders for the RapidPlan™ knowledge-based planning tool, an option for the Eclipse™ treatment planning system. RapidPlan tackles a significant clinical issue—the considerable variability in radiotherapy treatment plans across clinicians and treatment centers.

Toward a **higher standard** of care for all
Inconsistencies between plans can arise when clinicians manually create multiple plan versions. “Treatment planning has long been more art than precise science, relying as it does on the experience of the planner,” says Sasa Mutic, medical physicist and professor at Washington University School of Medicine in St. Louis, Missouri. Planners start with a blank page or perhaps a static template and plug in values based on their experience. “Starting the planning process has always involved some educated guesswork followed by multiple trial-and-error iterations,” says Yves Archambault, clinical solutions manager at Varian.

The “trial-and-error” approach to planning
That “trial-and-error” approach is the crux of a significant challenge. While planning this way can be time-consuming, the greatest concern is the quality of the resulting plan. Mutic explains the problem this way: “When you’re looking at the individual patient’s anatomy, you can’t quite tell what is possible to be done for the patient. You know roughly what can be done, but it’s very difficult to tell exactly what the optimal solution is for that patient.”

Kevin Moore, PhD, of the University of California, San Diego, agrees. “Because there has been a strong human element to treatment plan design at all stages, from physician to physicist to dosimetrist, all along the line, it falls victim to the pitfalls of human error, whereby plans can be presented, approved, and treated that are not as good as they could be with the technology we already have,” says Moore, an assistant professor in the Moores Cancer Center Department of Radiation Oncology. “It’s been an open question as to how much substandard treatment plans affect the quality of clinical care, but the handful of studies that have examined the issue indicate that the problem of suboptimal treatment plans is underappreciated.”

“The idea behind the technology in RapidPlan is to make the art and the experience of the planner less important as a factor, and help level the playing field when it comes to quality.”
—Sasa Mutic, PhD, Washington University School of Medicine

Varian is addressing this challenge with RapidPlan. “Varian makes treatment systems capable of delivering radiation doses with pinpoint precision, and we want to help clinicians use the technology to its highest potential,” says Archambault. That, he says, is the raison d’être for RapidPlan.

Advancing consistency and quality in patient care
“The idea behind the technology in RapidPlan is to make the art and the experience of the planner less important as a factor, and help level the playing field when it comes to quality,” says Mutic.

To accomplish this objective, RapidPlan provides clinicians with standard-of-care models to use as a baseline for developing high-quality personalized treatment plans for virtually every type of external beam radiotherapy, including intensity-modulated radiation therapy (IMRT) and volumetric modulated arc therapy (VMAT). RapidPlan provides estimated dose volume histograms (DVHs) that may be used as guidelines and starting points. RapidPlan uses the dose and patient anatomy information from existing plans to estimate the dose distribution in new patients based on their contoured anatomy. Using pre-configured plan models in RapidPlan, clinics may reduce variability in treatment planning to achieve greater consistency and quality in patient care. And with greater efficiency, too.
Putting the “rapid” in RapidPlan

“RapidPlan is designed to help users produce a near-ideal plan the first time, reducing or even eliminating the need for multiple time-consuming iterations before plan approval,” says Chris Toth, Varian’s vice president of marketing. RapidPlan streamlines the process by enabling users to tap into knowledge derived from historical treatment plans.

“When you know the answer that you’re looking for,” says Moore, “it tends to be faster to find than if you don’t know the answer and you keep trying variations until you think that you have a solution.”

RapidPlan fits seamlessly into the usual planning workflow because of the way it’s integrated into the Eclipse treatment planning system. “RapidPlan is tied directly into the IMRT optimization and makes use of knowledge-based predictions for automated planning,” explains Archambault. After the physician contours the structures and prescribes the radiation doses, the planner selects a model within RapidPlan. Using data extracted from its knowledge base of historical plans, RapidPlan estimates what the new plan should look like. “The prediction usually takes less than a minute to process,” says Archambault.

The vision: continuously improve standard of care for all

While RapidPlan may lead to faster planning, that’s really a byproduct of the greater advantage, which is higher confidence in the quality of each plan, asserts Mutic. But there is an even bigger picture. “RapidPlan will facilitate the transparency between how different clinics use the treatment planning software and use the linear accelerators, and people can basically learn from each other in a way that hasn’t been possible before,” says Moore. In its initial release, RapidPlan comes with derived models for prostate and head and neck treatment that have been developed and contributed to by academic treatment centers in partnership with Varian. In addition, clinics everywhere can add their own history of cases to RapidPlan’s bank of models for their own use and also to share with the greater radiation oncology community.

“RapidPlan enables institutions to create their own models, and these models could become available for sharing in the public domain,” says Mutic. “Institutions in parts of the world without major physics or dosimetry resources could benefit from the experience amassed at centers with more of these resources. There are very smart people around the world expending time and energy solving problems, and I look forward to having tools that make their experience available to me and to others.”

“That’s really the power of RapidPlan,” says Mutic. “You enable the playing field and the exchange of information in a way that we’ve never been able to do before. We generally don’t have the ability to benchmark in relation to one another, and RapidPlan helps to break down those barriers.”

The vision behind RapidPlan is to enable the creation of high-quality, world-class treatment plans anywhere, in a fraction of the time required for standard treatment planning. “I have every confidence that RapidPlan will change clinical practice for the better,” says Moore.

Nancy Heifferon is a freelance healthcare writer.

Note: RapidPlan knowledge-based planning and its models are not intended to replace clinical decisions, provide medical advice, or endorse any particular radiation plan or treatment procedure. The patient’s medical professionals are solely responsible for and must rely on their professional clinical judgment when deciding how to plan and provide radiation therapy.
Varian’s PremierAssurance™ Advantage professional services plan supports the adoption, utilization, and optimization of new technologies, giving clinics a competitive edge.  

By Kerri Reeves

Today’s clinical environments are constantly in flux. The healthcare winds of change are blowing through information technology, organizational mergers and restructuring, changes in reimbursement plans, and numerous other challenges. Nevertheless, cancer care professionals must continually find new ways of optimizing patient care, finding cost-efficiencies, and staying current.

To help customers meet these challenges, Varian has expanded its service offerings to include PremierAssurance Advantage, a professional services plan that helps clinics manage change and build operational excellence. PremierAssurance Advantage plans leverage Varian’s long-standing, global, end-to-end radiation oncology experience to help customers identify technology gaps and address workflow challenges. Each plan is customized to address the clinic’s particular challenges, and a dedicated customer service advocate is assigned to marshal all of the appropriate Varian resources required to meet the clinic’s needs. Together, the clinic staff and the Varian advocate find ways of increasing clinical efficiency and cost-effectiveness.

“We thought the program was a great fit because it was set up to enable the center to bring up a large amount of technology very quickly, despite limited in-house staff and resources. We are very fast paced, and it’s important to us to bring on new technology quickly, safely, and efficiently.”

—B.J. Sintay, PhD, DABR, Cone Health Cancer Center

B.J. Sintay, PhD, DABR, chief physicist at the Cone Health Cancer Center in Greensboro, North Carolina, utilized PremierAssurance Advantage services to commission both Eclipse™ treatment planning software and a new TrueBeam® linear accelerator. “We thought the program was a great fit because it was set up to enable the center to bring up a large amount of technology very quickly, despite limited in-house staff and resources,” he says. “We are very fast paced, and it’s important to us to bring on new technology quickly, safely, and efficiently.”
Sintay discussed with Varian the commissioning and validation methods to be used, the measurements to be taken, and his expectations in terms of general quality parameters. Saving time and money during the validation process was of paramount importance, he says. He was pleased with the documentation Varian provided, the plans for communicating with staff members, and the quality standards that were applied throughout the project.

According to Sintay, the commissioning would have taken six to eight weeks if it had been completed by a typical physics group. Varian’s team completed the job in six days.

“Typically, commissioning takes many weeks or even months for more advanced features,” Sintay says. “When you bring in a group that really understands the technology and has worked with it many times before, the project isn’t impacted by a steep learning curve. That allows the hospital to commission the linear accelerator in a short timeframe. Varian’s extensive experience took the pressure off our team so they could really focus on patient care. Knowing that the commissioning of the new linear accelerator was being handled professionally and quickly by a team with a solid reputation was invaluable.”

Adding new software can be particularly challenging (see page 18 for case studies from sites that deployed a new version of Varian’s ARIA® oncology information system). While the initial setup and training can be tailored to ensure that the clinical staff is able to manage its current roster of patients, there’s often still more to do in order to maximize use of the new tools and fully realize its workflow enhancements. Varian’s support through the PremierAssurance Advantage program is designed to help clients fully realize the potential of sophisticated new tools.

“Assessing a department’s needs, identifying features that are not currently in use, showing the value of implementing additional features, and developing an implementation roadmap are key facets of our professional services program,” says Rob Thibault, RT(T), manager of clinical implementation consulting for Varian and a PremierAssurance Advantage program advocate.

Michael Bligh, MS, DABR, lead medical physicist at Sutter Health’s Memorial Medical Center in Modesto, California, saw firsthand how the support provided by PremierAssurance Advantage services could benefit his clinical and information technology staff. After the installation of ARIA and Eclipse software, the clinic was experiencing suboptimal clinical workflow. Because the center was not using the software in a traditional way, they had developed some stopgap measures that were hindering flow and performance.
Through a targeted PremierAssurance Advantage engagement, the Modesto team gained a clearer understanding of how the technology could work for their staff and patients.

“Rob Thibault, our advocate, helped us determine how we could configure the Varian system to be more closely aligned with the way we were used to doing things, so we wouldn’t have to adapt to a forced template that Varian provided,” says Bligh.

Through the collaboration with Varian, the Modesto team identified their technology consumption gap, created a long-term plan, and determined how best to coordinate resources. Thibault, the team’s Varian advocate, uncovered areas of nonoptimal workflow and improper role assignments that were causing some staff members to feel “burned out.” For example, physicists and dosimetrists had been completing tasks that were better suited for other members of the department, according to Bligh. “We’ve now migrated much of that work to the unit assistants and scheduling therapists,” he says.

Once Varian helped put these efficiencies into place, the Modesto site was able to consider additional opportunities. The physicists had the capacity to consider new technology implementations that required more comprehensive quality assurance practices, an option that was not feasible before the workflow improvements were undertaken.

“Our advocate helped us determine how we could configure the system to be more closely aligned with the way we were used to doing things.”

—Michael Bligh, MS, DABR, Sutter Health Memorial Medical Center

Through the collaboration with Varian, the Modesto team identified their technology consumption gap, created a long-term plan, and determined how best to coordinate resources.

The biggest benefit of PremierAssurance Advantage, however, was that it allowed the Modesto team direct access to the deep knowledge and experience that Varian’s service team can bring to bear, according to Bligh. Varian has amassed experience from nearly 7,000 installations of its technology, as well as through its significant research and development investments. “We want to ensure that customers are able to maximize their own investment by leveraging the best practices that we have learned from working with customers in the field,” says Akhilesh Prasad, Varian service marketing manager. “It’s not just about using the technology in the clinic. It’s about realizing the benefits that accrue when the clinic is running at its highest, most efficient level.”

Kerri Reeves is a freelance healthcare writer.
Implementing ARIA 11
Tips from Successful Sites

The ARIA® oncology information system has long provided cancer treatment centers with powerful tools for managing the full spectrum of clinical, administrative, and financial activities in multidisciplinary settings. With version 11, ARIA has been significantly redesigned to enable more personalization to the user, expedited workflow, and greater automation. New workflow management features make the system more role specific and more integrated with Eclipse™ treatment planning software.

In this article, Centerline highlights the experiences of several successful early adopters of ARIA version 11. We asked how they prepared for the deployment, what changes they made to their work practices to enable a robust use of the system, and what benefits they have realized.
Dartmouth-Hitchcock Medical Center

For Alan Hartford, MD, interim section chief of radiation oncology at Dartmouth-Hitchcock Medical Center in New Hampshire, deployment of ARIA 11 has significantly improved radiation oncology operations in two areas: documentation and workflow. His colleague, David Gladstone, PhD, chief of clinical physics, adds a third area: compliance.

“Long before we ever heard of ARIA 11, we were working to upgrade our electronic documentation,” Hartford says. “Our documentation processes up to that point were all done by hand on paper. We relied on people remembering to file things, so it was too easy for tasks to be left aside or for human error to creep in, like dates not matching, or procedure codes not being entered correctly. We had started working with a consultant to set up electronic documentation using the Dynamic Documents feature in ARIA 10, and this turned out to be excellent preparation for taking advantage of the features in ARIA 11.”

Separately, Hartford adds, Dartmouth had begun to promote performance improvement, so the staff was already looking at how to improve workflow. “After the advent of 3D, IMRT, VMAT, and gating, our workflows, which had been simple, became very complex,” he recalls. “Dosimetrists and physicians were being asked to do more and more; QA became more complicated; final time checks were more time-consuming. Everyone was feeling pushed, and we were asking ourselves, ‘Why does our process feel like it is full of bottlenecks and inefficiencies?’ It was frustrating.”

So, says Hartford, “We launched a project to look at workflow across all steps, from treatment planning to simulation, from dosimetry to treatment. It is a multilayered, multilevel set of interdependent processes that is different for different types of cases.” Once a decision was made to adopt ARIA 11, the department launched a new project to prepare for deployment by building on the workflow analysis that had already been done. The new project proceeded along parallel tracks over a six-month period, in the areas of workflow analysis, interface testing, and user education.

The project team set up ARIA 11 in a test environment so they could test electronic interfaces to other systems, including the enterprise-wide electronic medical record in use across the Dartmouth-Hitchcock system. The team also attended Varian educational programs, including onsite sessions and webinars. All staff members received electronic and printed manuals, plus a list of features to study and practice.

Varian clinical applications specialist Ryan Kelley assisted the team in mapping out work processes in a way that would dovetail with ARIA configuration efforts. “You have to stand up in front of a whiteboard and really map it out,” says David Gladstone, PhD, Dartmouth’s chief of clinical physics. “We worked with Ryan to create flowcharts for each different process, by every disease and treatment type.”

Colleen Fox, PhD, assistant chief of physics, and Lesley Jarvis, MD, radiation oncologist, co-led the effort to develop care paths based on departmental practices. “We saw this as an opportunity to organize our whole department,” says Fox. “We mapped out all our processes, defining what each person does at every step. In some cases, we worked with people to change some of their processes so that they were more standardized and utilized the new ARIA framework.”

Map your workflow. “You have to stand up in front of a whiteboard and really map it out. We... create[d] flowcharts for each different process, by every disease and treatment type.”

—David Gladstone, PhD, Dartmouth-Hitchcock Medical Center
At Dartmouth, the creation of care paths occurred after ARIA 11 was deployed over a weekend. “On Monday morning, everyone came in, logged on, and set up their personalized home pages,” says Gladstone. “We then set about building our care paths.”

“We started with three basic care paths, for 2D, 3D, and IMRT workflows, and then quickly had to add a workflow with a boost,” Jarvis says. “We used those to get people used to the task lists, and to working in a system with built-in dependencies—my step B can’t happen until someone else has completed step A. It took about a month for people to really get used to it. And we found that, for situations where we didn’t have a care path, people were asking for it. You start relying on them because it organizes your life. You go to your task list and see what you need to do that day.”

“It has been invaluable for getting people on schedule, knowing when something is late, getting messages to people so they know where they need to be,” says Gladstone. “We’ve eliminated ‘just-in-time’ treatments, where you get the last piece of information minutes before the patient arrives. If a plan is delivered to the machine with no opportunity to really review it, it might be missing something and everything comes to a halt while the problem is solved. We now know the day before if something is sitting out there unfinished. We can track it down with half a day to spare, when we still have time to work on it. We decided that was the structure we wanted to use. We made it nonoptional, and it’s a decision that is paying off. It’s universally described as indispensable.”

“Before we started using tasks in ARIA 11, we didn’t have transparency, and so if something was missing when you went to treat, it was hard to find out where things had stalled,” says Craig Hansen, chief therapist. “You might have to check with five different people. Now we can see where in the process we are and contact the right person. Usually they know and can say: ‘I’ll get that to you in 10 minutes.’”

Fox is able to use the dosimetry task list to see the workload on any given day. “I never had that visibility before,” she says. “I could see the machine load, but not dosimetry or physician load. This is something the industry struggles with—determining just how many people in a given role are needed for optimal operation. We can start by looking at how many plans are at a particular point in the process at one time.”

The Dartmouth team is using ARIA 11 care paths to manage chart rounds. “You can run the list of people who have new plans that week,” Fox explains. “The list includes anyone for whom a planning charge was submitted. We used to have to go and assemble a paper list of everyone approved to start that week, and we ran the risk of missing someone.”

“As we proceed with a patient’s care path, each element in the care path is linked to the necessary documentation,” Hartford says. “For example, if we’re doing a 3D lung or IMRT pelvis treatment, the system presents us with the correct documentation for that situation. We’re not confronted with all possible documents and having to choose the right ones. ARIA 11 has helped us deal with the twin issues of documentation and workflow and has enabled a true integration between the two. I don’t dread documentation the way I used to.”
University of Pennsylvania Health System

When the team at the University of Pennsylvania Health System was introduced to ARIA 11, a quality-oriented workflow project was already under way. “We were working to outline our workflow from simulation and planning to QA,” says Marc Bellerive, MSc, DABR, chief of clinical physics for photon therapy. “We looked at all the classes of cases we treat and aggregated them into categories to create treatment schedules based on complexity level, and worked toward a class solution for each type. This is what we call our ‘tiered planning’ process. We identified all the activities and the associated roles and responsibilities for each tier. Physicians, dosimetrists, physicists, and therapists defined how much time was required to perform each of their tasks within any given tier. We started with a high-level process overview, and then filled in details, mapping the steps and tiers to relevant policies and procedures.”

Consequently, when Bellerive and some of his UPenn colleagues visited Varian in California, they were excited to see the direction that ARIA development had taken. “The visual care paths were going to help us implement our new workflow management process, because they mirrored the way we were mapping the tiered planning project we’d been working on for the better part of 18 months,” he says. “The physician on our team also liked the idea of being able to launch tasks right from the care path and have the system put you directly into the correct application.”

Train a group of superusers. “We set aside time for our empowered users to define the workflow, play around with the system, go through onsite training, and work on training materials for their peers.”

—Edna Volz, University of Pennsylvania Health System

Over the next six months, the UPenn clinical team prepared to upgrade from ARIA 10 to 11 using the tiered planning process to create care paths that matched their workflow. Because of the complexity and scale of the UPenn operation, which includes multiple sites, a proton therapy treatment center, and Gamma Knife® and CyberKnife® technology, the UPenn team created several separate cross-functional workflow teams with membership based on process rather than clinical roles. One team worked to define the workflow for the intake process from initial consultation to simulation. Another team worked on simulation, treatment planning, plan check, and QA to treatment. The ARIA workgroup had oversight and put all the pieces together to map the patient’s journey from initial consultation to final treatment. These same team members later served as a group of “empowered users” who could train others.
“In our resource plan for the upgrade, we set aside time for our empowered users to define the workflow, play around with the system, go through onsite training, and work on training materials for their peers,” says Edna Volz, manager of clinical outcomes and quality improvement. “We did this up front so that team members fully understood the magnitude of the commitment they were making.”

The cross-functional teams each worked on different parts of the process. They evaluated the current state of affairs, and then looked at ARIA 11 enhancements to determine how they might change their workflow to take advantage of new functionality. “We took advantage of as many features as we could to support and enhance our workflow,” says Volz.

“We focused on how to build in quality and safety,” adds Bellerive. “We made judicious use of gates and checklists; we created mini care paths for replanning, special add-on procedures such as evaluation scans for proton cases, and other special procedures or processes. You are essentially taking a nonlinear process with multiple decision nodes, and converting it into a linear sequence of steps.”

During this time, a Varian-UPenn team took advantage of ARIA’s open architecture to successfully complete Varian–third-party connectivity. The team ensured that ARIA interfaces were functioning effectively with the proton therapy, Gamma Knife, and CyberKnife technologies in use within the University of Pennsylvania system.

According to Kwon Lee, IS technology director, the next step was to set up an ARIA 11 test environment so that power users could get familiar with the system and its new graphical user interface (GUI). The first care paths were created in this test environment.

“We started out working with just one care path,” says Bellerive. “We could see that if we created multiple care paths in parallel, and then wanted to change something, we’d have to go back and propagate that change across all the care paths. It would mean a lot of rework. So we developed one care path and had users take it for a dry run. Then we made modifications based on how the system really functioned. It was an iterative process.”

Create care paths. “We developed one care path and had users take it for a dry run. Then we made modifications based on how the system really functioned. It was an iterative process.”

—Marc Bellerive, MSc, DABR, University of Pennsylvania Health System

Among the challenges was setting up appropriate proton therapy workflows in the system. “We’re one of just a few ARIA 11 centers that offers both photon and proton radiotherapy treatments, and so there were some unique requirements when we were configuring ARIA to support us across all modalities,” says Bellerive. The UPenn proton therapy center, run by the Ion Beam Application (IBA) company, has five treatment rooms, four gantries, and one static beam. The center also has the only Varian multileaf collimator for proton therapy and is using pencil-beam scanning for treatment. “This created many unique challenges for the UPenn, Varian, and IBA teams,” notes Bellerive. “We worked together to make sure that ARIA and the IBA proton treatment interface were compatible.”
Prior to “activation weekend,” users across the five networked UPenn Medicine radiation oncology sites logged into the test system and configured their home pages. Those modifications were then put into production, and the system was deployed. “Varian personnel did the migration, and we had a team working to test and validate the system before we went live on Monday,” says Bellerive.

“As we gain more experience with ARIA 11,” he adds, “we have been working on refining our care paths and QA tools within the system to make it even more efficient and further enhance the quality and safety processes for our patients.”

Central Georgia Radiation Oncology

A single person was largely responsible for the up-front work that led to a successful launch of ARIA 11 at Central Georgia Radiation Oncology, a facility with sites in Macon and Warner Robins, Georgia.

“They took my advice to heart when I told them it would work best if one person could spearhead the creation of the workflow,” says Nan Newman, Varian clinical support specialist. “They assigned the job to Kelli Suddeth, one of the radiation therapists, and let her live it, sleep it, eat it, breathe it. She interviewed every person in the department—sometimes more than once, because people don’t always remember every detail the first time.”

“I’m a therapist first, so at best I could devote about half my time to this,” says Suddeth, who was named systems administrator on top of her therapist’s role. She started by devouring all the training materials she could get her hands on.

“I listened to all of the tutorials Varian provided. One that was specific to ARIA version 11 became my most important resource—I did absolutely everything it told me to do.”

—Kelli Suddeth, Central Georgia Radiation Oncology

Suddeth asked everyone in the department to write down what they did, down to the minutest detail. “I asked for every detail, like ‘made a copy of the insurance card.’ I wanted to be sure that nothing was left out when we built our care paths. Then I grouped things together, created highlights, and reflected the information back to the team in little minidiscussions, grabbing 20 minutes here, half an hour there. People are busy, but they made the time.”

At first, Suddeth says, not everyone was on board with using “tasks.” The dosimetry department was the most enthusiastic. “We had to help people understand that it was the only way we were going to be able to build our care paths to properly reflect our processes.”

Team members were also given a few months to complete the ARIA 11 tutorials. “We’re not an overstuffed department, but we were able to give people enough time to do their jobs and get through new learning,” says Stacy Byrd, who serves as chief radiation therapist, dosimetrist, and department manager. “We had to work with people on that. Sometimes people would say that they couldn’t find time to do tutorials because they had too much work to do. So we’d take a look and find ways of transferring tasks to other people so they could complete the tutorials.”
When the time came to actually build the care paths, Suddeth involved the rest of the clinical team in making decisions about when and where to use checklists, and what tasks could be grouped together. “You don’t want 900 million tasks, like: ‘Take photo. Obtain consent.’ We grouped these types of small steps together.”

The care paths were built over a period of several weeks. The process, according to Suddeth, was like building a big puzzle by working backwards. “What we did initially is not necessarily what we have now,” she says. “We asked people to keep an open mind, and realize that it can evolve as we use it. We started by making the puzzle pieces. Then we put them together. We promised people that, once we got through it, it would make our lives easier.”

And it has. “For the most part, I can pull up a patient and know exactly where that person is in the pipeline,” says Suddeth. “Radiotherapy is a matter of running a race and passing the baton. Until the front desk staffers get through their piece, they can’t pass the baton to nursing, or to intake, or to the doctors for the next step. And I’m no longer keeping 50 sticky notes at my desk. I can use my home page as my task prompter, and everything is in one place.”

“If you set up your care paths correctly, they reflect how your office works,” adds Byrd. “Using them allows us to know that everything is getting done, because nothing moves on unless it is. I don’t have to get up from my chair and go find a doctor to find out where a patient is in the process. The documentation is there, and communication is easier. I think it makes us more efficient.”

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**Key Success Factors for Deploying ARIA 11**

As these early adopter profiles illustrate, there are key success factors to ensure a smooth deployment of ARIA 11:

- Identify an internal project owner—either a motivated individual or a steering committee.
- Create as much buy-in or joint ownership of the project as possible by explaining benefits that will accrue over time.
- Train a group of superusers who can serve as departmental resources.
- Allow people time to utilize Varian-provided tutorials and manuals, classroom training, onsite training, and webinars. Then, as early as possible, set up a test environment to enable practice.
- Map departmental workflows using cross-functional work teams.
- Begin the creation of care paths that reflect departmental workflows by starting with one workflow or a few basic, common ones, and expanding from there.
- Work with the Varian applications team to deal with any custom interfaces needed to connect with third-party technologies.
- At “go live,” have all users log in to the system and configure their home pages.
- Refine care paths over time based on experience.
At the University of Virginia (UVA), they call it “CT-on-rails.” Since the brachytherapy suite was established in 2011, clinicians at UVA have been able to reduce the risk of inaccuracies caused by moving patients between the treatment room and the radiology department by imaging in the treatment room.

Challenges of image-guided brachytherapy

“Image-guided brachytherapy is used increasingly for applicator placement, target volume definition, and treatment planning, and CT simulators are now widely available,” says Timothy Showalter, MD, assistant professor in the UVA Department of Radiation Oncology. “But there are some challenges with image guidance because it adds steps. Applicator placement, CT imaging, and treatment delivery could all take place in different rooms and/or locations, and additional imaging such as MRI or PET/CT can add even more steps. These extra steps add time, and each transfer introduces the possibility of error related to either applicator movement or patient movement.

One of the many benefits of the collaboration between Varian and Siemens is the successful pairing of imaging and treatment technologies to facilitate in-room brachytherapy procedures without needing to transport the patient elsewhere for imaging. By combining a Siemens CT sliding gantry with a Varian afterloader, Timothy Showalter, MD, and his team at the University of Virginia are able to reduce the steps needed during treatment and speed up workflow.
In the integrated brachytherapy suite at UVA, we try to avoid the potential problems that may be caused by having to move patients with the applicators in place by bringing the scanner to the patient,” says Showalter. “This allows us to place the applicator and then scan, plan, perform safety and quality checks, and treat, without needing to transport patients for imaging.”

Utilizing the Siemens SOMATOM® CT sliding gantry with any Varian afterloader to enable 3D, image-guided, high-dose-rate (HDR) brachytherapy procedures within a single treatment room can offer time-savings while eliminating the problems potentially associated with patient transport between imaging and treatment.

“HDR brachytherapy treatments are planned using anatomical images of the targeted area taken after applicators have been put in place,” says Hosea Mitchell, head of Varian’s BrachyTherapy division. “The Siemens sliding gantry CT is ideal for use right in the brachytherapy treatment room, so the patient doesn’t have to be moved to another room for scanning. This helps minimize the amount the patient is moved and avoid possible applicator motion, which could compromise accuracy.”

Compared to conventional x-ray and ultrasound imaging, CT shows excellent image quality while providing 3D information. In addition, the Siemens SOMATOM Sliding Gantry CT solution is built to provide virtually all of the features of a conventional diagnostic CT, including high-resolution imaging and metal artifact reduction, in order to offer outstanding image quality, even for challenging clinical cases.

**UVA’s brachytherapy suite**

The brachytherapy suite at the University of Virginia includes three beds, multiple treatment planning consoles, two shielded rooms, and ultrasound and anesthesia capabilities. With the Varian and Siemens technology combination, UVA patients can benefit from an optimal pairing of in-room imaging and treatment capabilities. “Combining advanced imaging and treatment capabilities is one of the major goals of the Varian-Siemens partnership,” says Adam Earwicker, strategic alliance manager for Varian’s Oncology Systems business. “The brachytherapy suite at UVA is a concrete example of how this vision can help to advance the practice of cancer care.”

At UVA, the sliding gantry approach is currently used mainly during gynecological treatments such as vaginal cylinder and tandem and ovoid brachytherapy. “Many centers prefer to take complementary MRI or PET/CT images of the patient with the applicators in, and in cases such as these, there is inevitably an extra step involved,” says Showalter. “For tandem and ovoid patients, we take complementary MRI images before the day of the procedure, which enables us to carry out the treatment without moving the patient during the treatment itself.”

For vaginal cylinder treatments, where the total treatment time has been reduced to about one hour, the CT plan allows confirmation of the applicator size and placement. Interstitial gynecological HDR treatments typically take less than two hours in the brachytherapy suite.

“Time savings are made possible by the rapid workflow approach we take here,” says Showalter. “From patient registration and medication through applicator insertion, CT imaging for treatment planning, treatment delivery, applicator removal, and patient discharge typically takes just 60 minutes to 90 minutes on average. Complementary MRI imaging the day before can take an additional 90 to 180 minutes’ time for the patients and 10 to 15 minutes for the clinicians.”

Showalter and his team plan to expand the use of the sliding gantry approach for other types of brachytherapy treatments going forward, including for breast intraoperative radiotherapy and prostate HDR, where the entire treatment can be carried out while the patient is under anesthesia.

“There are some real benefits in taking this approach. You achieve high-quality images that integrate well with planning systems, you can use standard brachytherapy tools, you avoid transferring the patient and risking applicator movement, and you can speed up the whole process.”

—Timothy Showalter, MD, University of Virginia
The Role of Radiation Oncology in the Era of Pay-for-Performance and Collaborative Healthcare in the United States

By Andy Whitman, Varian’s vice president of government affairs

An accountable care organization (ACO) is generally described as a group of healthcare providers who form an organization and agree to be accountable for the quality, cost, and overall care of patients enrolled. An ACO employs a payment and care delivery model that seeks to tie provider reimbursements to quality metrics and reductions in the total cost of care for their patients. The ACO is accountable to the patients and to third-party payers for the quality, appropriateness, and efficiency of the healthcare provided.

In the United States, federal ACOs operating under the Medicare Shared Savings Program are accountable to the Centers for Medicare and Medicaid Services, which is the national agency administering the country’s public health insurance programs.

In this article, Varian’s vice president of government relations makes the case that ACOs need look no further than the field of radiation oncology for models of coordinated care that can achieve these objectives on behalf of cancer patients.

It is challenging to pinpoint the centerpiece of the massive U.S. healthcare reform law known as the Affordable Care Act (ACA), but for the medical profession, the accountable care organization (ACO) has to be a top contender: its objective aims to change the approach to delivering quality care as well as how that care is reimbursed.

While this approach isn’t rocket science—the fundamental features of an ACO sound practical—theory and practice are two very different things. Whether medical practices and professionals are greeting this transition with skepticism or a full embrace, ACOs are part of healthcare’s new frontier. So the question to ask is, “How does the radiation oncology community fit in?”

The answer is, with a more targeted approach to creating “specialty” ACOs, radiation oncology can fit in very well.
Radiation oncology and the specialty ACO

The infrastructure of the ACO is designed to streamline patient care, improve the quality of care, and enhance coordination among a patient’s providers to create efficiencies in the process. After achieving all of that, the expectation is better health outcomes and cost savings from an integrated, performance-based healthcare delivery system. This system rewards providers by sharing the savings achieved from coordinating care and meeting quality standards.

While the primary care physician is looked upon as the key provider and manager in a traditional ACO, when a patient has a cancer diagnosis, it is the oncologist who manages care and treatment. It is essential that oncology specialists take the lead in educating ACO participants about the value of their role in providing coordinated care to cancer patients, and further define the place of specialty care in the ACO framework.

Consider the current team approach when utilizing state-of-the-art radiation treatment devices such as Varian’s Edge™ radiosurgery suite. In this scenario, a team consisting of a radiation oncologist, dosimetrist, medical physicist, and radiation therapy technician work together, sharing information, devising a treatment plan, and following treatment protocols. Medical innovation has produced technology that can rapidly deliver treatment in a way that minimizes dose to surrounding tissues. Typically patients undergoing this type of noninvasive treatment are able to continue with their normal activities during the course of treatments. This is the type of cost-effective, high-quality care that is tailor-made for the goals of an ACO. In summary, radiation oncology can serve as the paragon for the specialty ACO.

But with the rise of ACOs, more insurers are understandably requiring a higher level of clinical evidence before approving payment for services. Therefore, it only makes sense that an ACO model highlight the latest medical advances available for cancer patients—advances such as high-precision radiation treatment technologies that are yielding better outcomes, requiring less time for service delivery from the medical team, and subjecting patients to fewer inconveniences, whether emotional or physical.

Further, advancements in radiotherapy technology have made tumor control beyond simple palliation a viable clinical goal in many cases. This fact makes radiation oncology a logical fit within the ACO model, which seeks ways of improving clinical outcomes. Radiation oncology is one field where evidence of improved outcomes has been steadily accruing over the last decade.

Integrating oncology into ACOs

There is movement toward the integration of oncology in the framework of ACOs as pioneering organizations in the cancer space continue to increase in number. A growing list of networks and consolidations is forming in the private oncology marketplace. A 2011 Cancer Center Business Summit survey found that, among those reviewed, 65 percent of the health plans that are forming ACOs were including oncology providers in their plans. Another 30 percent had loose affiliations with oncology providers, showing that the oncology community is taking heed.

It is, however, important to take a deliberative approach to this integration process so key objectives in cancer care are not diluted or lost in the process. A research paper published earlier this year in the Journal of Oncology Practice offers an interesting analogy and a transitional option: “The approach taken by the oncology ACO is similar to the approach taken by the oncology medical home. The oncology ‘medical homes’ provide care for patients by reducing emergency room visits, inpatient admissions….and provide a promising option for oncologists to dip their feet into the ACO movement.”

Radiation oncology has the opportunity to win in the ACO environment because the best clinical treatments for the patient are now increasingly available in standard practice.
Whether a dip or a plunge, it is noteworthy to see the partnerships oncology practices are forming. A year ago, the nationally renowned Moffitt Cancer Center in Tampa, Florida, announced a new agreement with Florida Blue, Florida’s Blue Cross and Blue Shield company, to create an accountable care program specific to the treatment of cancer. Moffitt is the only National Cancer Institute–designated Comprehensive Cancer Center based in Florida, and the Moffitt Medical Group includes 330 cancer practitioners throughout the state who are well equipped to deliver cutting-edge radiotherapy treatments like intensity-modulated radiation therapy (IMRT), image-guided radiation therapy (IGRT), stereotactic ablative radiotherapy (SABR), stereotactic radiosurgery (SRS), RapidArc® radiotherapy and radiosurgery, accelerated partial breast irradiation, and four-dimensional radiation therapy. Together, Moffitt and Florida Blue are developing quality metrics for a multiyear program that began this year, and are working to further enhance patient care by sharing clinical and administrative claims data.

Information sharing is integral to the ACO process and encouraging continuity of care. ACOs are designed to expedite the best standard of care for patients. Varian’s new RapidPlan™ knowledge-based treatment planning software is one example of technology designed to facilitate this type of information sharing. It allows clinicians to enter their best cases in terms of achieving clinical objectives in order to develop a “knowledge library” that can inform subsequent treatment planning activities. Seamless access to this kind of information can help to create a standard of care across an ACO network that puts best practices at the fingertips of the oncologist.

**Evolving along with the healthcare system**

We know that collaborative practice is already inherent in the radiation oncology model and that research and data are plentiful on health outcomes in the treatment of inoperable and even some operable tumors. It is significant to note that the choice of noninvasive cancer-eradicating procedures is becoming increasingly important to cancer patients who are weighing all options. But where does that leave the radiation oncology community on payment methods fitting for an ACO? Again, it leaves them in a favorable position, at least in the United States, given the leadership already taken by radiation oncology practices that had the foresight to build a presence in Washington, DC.

Take the example of bundled reimbursement payments for care. The radiation oncology community has been at the forefront of articulating and advocating before Congress and the Administration for reasonable appropriate bundled payments that accurately reflect all facets of a given procedure. All those who share in the savings yielded by their ACO are striving for the most clinically effective and cost-effective treatments with optimal outcomes. When a patient treated with IMRT or stereotactic body radiotherapy (SBRT) experiences few side effects and therefore doesn’t require a hospital stay, a sea change in standard of care is not far off. Radiation oncology has the opportunity to win in the ACO environment because the best clinical treatments for the patient are now increasingly available in standard practice.

The progressive and innovative field of radiation oncology is evolving with the healthcare system by responding to the remarkable technological innovations that continue to improve cancer treatment while preserving the position of the key decision-maker: the physician.

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Innovations in Radiosurgery: Treating Brain Lesions
Advances in linear accelerator technology, including 3D imaging, high dose delivery rates, and high-definition multileaf collimation, have made it possible to offer patients highly conformal stereotactic radiosurgery (SRS) treatments for brain lesions—even several at a time—quickly and efficiently. Here, *Centerline* looks at how clinicians at four notable cancer centers are pushing the boundaries of the possible. They are reinventing radiosurgery, and finding ways to do more and to do it better for the benefit of cancer patients, many of whom would be without other viable options for treatment.¹

**Multidisciplinary collaboration at Rush Radiosurgery**

Rush Radiosurgery Center was established in 2011 as a joint venture between Rush University Medical Center and US Radiosurgery. Outfitted with Varian’s TrueBeam® STx system, Rush Radiosurgery serves about 150 to 200 patients per year. More than 60 percent of these are CNS cases, with the majority involving brain metastases. Other conditions treated at Rush include trigeminal neuralgia, and spine, paraspinal, lung, and liver lesions.

Multidisciplinary collaboration is at the heart of the Rush Radiosurgery Program, where a clinical team including doctors from neurosurgery and radiation oncology collaborate and use a TrueBeam STx system to handle radiosurgery treatments for Rush University Medical Center in Chicago, Illinois.

Brain metastases are managed through one of three weekly clinics. The other two clinics are for patients with spine tumors and for other neuro-oncology cases that might require a more global look, as well as multimodality treatment including surgery and/or systemic therapy.

“When patients come in or are referred, they are scheduled during the appropriate clinic so they can see all relevant specialists at the same time,” explains Aidnag Diaz, MD, medical director of Rush Radiosurgery.

“Aidnag Diaz, MD (left), consults with Robert Aiken, MD, director of the Section of Neuro-Oncology and the Coleman Foundation Comprehensive Brain Tumor Clinic at Rush University Medical Center. Image courtesy of Rush Radiosurgery.

“SRS has made it possible for us to treat brain metastases very aggressively. Whether the primary cancer was in the lung, the breast, or elsewhere, we’re often able to control brain metastases.”

—Aidnag Diaz, MD, Rush Radiosurgery

The treatment of brain metastases has changed significantly over the last three to four years, Diaz asserts. “SRS has made it possible for us to treat brain metastases very aggressively,” he says. “Whether the primary cancer was in the lung, the breast, or elsewhere, we’re often able to control brain metastases. I tell my oncology colleagues: ‘If you can take care of the body, I can take care of the brain.’”
Diaz points out that a significant number of his patients live a relatively long time, and often eventually deteriorate because of non-CNS conditions. “If they develop a new brain metast, we can often do radiosurgery again; I have patients who have been treated two or three times who are doing well and functioning at a very high level as measured by Karnofsky performance scores. By contrast, as recently as three years ago, a lot of patients were getting large volume, whole-brain radiotherapy, and many were living with serious cognitive impairment as a result. On mental status exams, we used to see scores as low as 20 out of 30 after whole-brain radiotherapy. Today, after SRS, we see patients typically scoring 27, 28, 29 on these exams.”

Patients are considered for single-fraction SRS when certain conditions are met. Lesion size is important. So is V12Gy—the volume of brain tissue that would receive 12 Gy or more during the procedure (see Figures 1 and 2). “If V12Gy is more than 10 cc or so, depending on the location inside the brain, we may conclude that the patient is not amenable to single-fraction radiosurgery. In that case we treat using a multiple-fraction regimen,” says Diaz. “We follow a protocol similar to that published by Ernst-Stecken, et al, and treat large metastases by delivering 30 Gy in five fractions of 6 Gy each. If the patient has never had any brain radiotherapy or radiosurgery, we might try 35 Gy in five fractions. For these fractionated cases, every attempt is made to maintain the V20Gy at or below 23 cc (Figure 3). If that is not possible, we utilize whole-brain radiotherapy; however, that’s quite rare these days. Sometimes, when a lesion is large or symptomatic, we’ll irradiate after surgical resection. In all cases, we’re following established protocols, so we generally agree on the best way to proceed.”

At Rush, clinicians use a frameless mask system for patient immobilization. Diaz maintains that this, plus image guidance—both a room-based kV imager and machine-based cone-beam CT—enable the required level of precision. “In MRI images after SRS for trigeminal neuralgia, we can see the white area where the high dose radiation was right on the targeted nerve,” he says. “At first, frameless immobilization was a little bit scary, because of the high dose being delivered all at once. You worried: ‘Am I going to hit the right spot?’ We are hitting the right spot.”

“I tell my oncology colleagues, ‘If you can take care of the body, I can take care of the brain.’”

—Aidnag Diaz, MD, Rush Radiosurgery
Treatment delivery is accomplished using technologically advanced arc therapy. “We do radiosurgery in one of two ways—either using multiple dynamic conformal arcs, or one to three volumetric modulated therapy arcs (VMAT),” says Diaz. “But dynamic conformal arcs take about 30 to 40 minutes per lesion, including positioning, imaging, and dose delivery, even with High-Intensity Mode on the TrueBeam STx machine. For a patient with three metastases, that’s an hour and a half on the treatment couch. With RapidArc® delivery we can get that down to 15 to 20 minutes, without sacrificing the quality of the dose distribution.”

“Brain metastases have, by definition, started with cancer elsewhere in the body,” Diaz adds. “In recent years, we’ve seen the development of better systemic agents that enable cancer patients to live much longer with their disease. Therefore it really is very important that those of us who concentrate on treating brain metastases be aggressive with it, but in a way that keeps the brain working as optimally as possible for as long as possible. It’s our job to give the medical oncologist time to maximize the use of systemic agents dealing with the cancer elsewhere in the body.”

Radiosurgery at Thomas Jefferson University Hospital

Thomas Jefferson University Hospital of Philadelphia, Pennsylvania, established its linac-based radiosurgery program in 1994 with the deployment of the second Varian 600SR machine, the first having been installed at Brigham and Women’s Hospital in Boston. The 600SR was a single-energy 6-MV linac with a redesigned flattening filter that could deliver dose rates up to 800 MU per minute in clinical mode. Jefferson has since worked with several generations of Novalis technology, and will soon install Varian’s TrueBeam STx.

At Thomas Jefferson University Hospital, clinicians led by David Andrews, MD, were among those who, in the mid-2000s, helped to make whole-brain radiation therapy (WBRT) with a radiosurgery (SRS) boost a standard of care for treating selected patients with brain metastases. Their article in The Lancet (May 2004), which summarized RTOG 9508, evaluated WBRT with or without a stereotactic radiosurgery boost for patients with one to three metastases.
“We’ve seen patients who have had multiple courses of radiosurgery and remain fully functional. **These are low-impact treatments.**”

—Wenyin Shi, MD, PhD, Thomas Jefferson University Hospital

“WBRT, either alone or as adjuvant treatment after surgery, has for some time been the standard of care for patients with brain metastases. But this approach has also been associated with substantial neurocognitive decline and general side effects,” says Wenyin Shi, MD, PhD, codirector of the Brain Tumor Center of the Kimmel Cancer Center at Jefferson. “Currently, we have evolved beyond whole-brain radiation for patients with a limited number of brain metastases. There is now substantial evidence to suggest that, for patients with a limited number of brain metastases, using stereotactic radiosurgery alone and omitting WBRT doesn’t compromise survival, and associated side effects are diminished, particularly in the area of neurocognitive impairment.”

Shi and his colleagues have been accruing data comparing single-isocenter RapidArc radiosurgery plans with Gamma Knife® plans for the treatment of multiple metastases. They choose cases involving very small targets and large prescription doses (up to 24 Gy). Dose prescriptions are set following RTOG 9005 guidelines and based on lesion sizes. “What we’ve found is that the approaches are dosimetrically comparable, but RapidArc improves efficiency substantially,” says Haisong Liu, PhD, director of radiosurgery physics.

For example, in one representative case, SRS was planned for three tumors as follows:

<table>
<thead>
<tr>
<th>DOSE</th>
<th>TUMOR LOCATION</th>
<th>TUMOR SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 Gy</td>
<td>Left frontal convexity</td>
<td>0.8 cc</td>
</tr>
<tr>
<td>20 Gy</td>
<td>Left paracentral frontal</td>
<td>2.0 cc</td>
</tr>
<tr>
<td>16 Gy</td>
<td>Left cerebellar</td>
<td>2.5 cc</td>
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According to Liu, treating this case using Gamma Knife Perfexion would have required 43 shots. Delivery time using a new source was estimated at 83.5 minutes. Comparable dosimetric results were achieved with a RapidArc radiosurgery plan using one isocenter and four noncoplanar arcs. The RapidArc treatment, however, was estimated to require 10 minutes. “In some cases, up to six noncoplanar arcs are needed to achieve dosimetric equivalence, especially to achieve acceptable low-dose spillage plans,” says Liu, “but we estimate those treatments can still be completed in about 15 minutes.”
Clinically, the Jefferson team currently accomplishes linac-based radiosurgery using a Novalis machine along with the Brainlab ExacTrac patient positioning system for frameless radiosurgery. “Moving forward, we will also have cone-beam CT capacity on the new TrueBeam STx system,” Shi says. “Our goal is to preserve the patient’s quality of life, independence, and neurocognitive functioning,” explains Shi. “We’ve seen patients who have had multiple courses of radiosurgery and remain fully functional. These are low-impact treatments.”

UCSD: Frameless radiosurgery guided by optical surface imaging

The Rebecca and John Moores Cancer Center at the University of California, San Diego (UCSD) moved into a new facility in 2005 and recruited Arno J. Mundt, MD, to serve as chairman of its yet-to-be developed radiation oncology department. “It was the opportunity of a lifetime,” Mundt says. “There was a renaissance going on in technology, and I was excited by the prospect of helping to shape the development of image guidance and frameless stereotactic radiosurgery techniques.”

In 2006, Arno Mundt, MD, and a team of top clinicians established a new radiation oncology department at UCSD with a particular emphasis on frameless radiosurgery for adult and pediatric patients. At the time they chose Varian’s Trilogy® system for treatment delivery, and since then, they have added a second Trilogy and a TrueBeam system.

“Right from the start, the clinical team began investigating technologies for doing frameless radiosurgery. “We haven’t utilized a headframe for cranial fixation since 2006,” says Kevin Murphy, MD, vice chair of the department of radiation oncology and director of the pediatric program. “Our first system used a bite block and an infrared imaging system, both for initial patient setup and for intrafraction motion tracking. We did a lot of redundant kV and cone-beam CT imaging to prove to ourselves that we were getting good tracking information from the system.” Murphy and his colleagues aggregated and published their data.8, 9, 10

According to Murphy, over time the UCSD team’s results in terms of outcomes and side-effects profiles were shown to be comparable to the results others were getting using fixed immobilization techniques. Nevertheless, Murphy continued to look for better frameless immobilization techniques that were effective with diverse patient populations. “The bite block wasn’t always ideal,” he says. “Sometimes people would swallow in a way that shifted it, or push on it with the tongue, which could cause delays. You really couldn’t use it at all with some patients.”

Murphy and his team experimented with modifications of an aquaplast mask. “We cut out the face around the mouth, nose and eyes,” he says. “We found that you can get sufficient immobilization from an open mask that just covers the forehead and chin.”

In 2007, the team began working with Vision RT, makers of a 3D optical surface imaging solution for patient setup and real-time tracking during treatment. “We installed our first surface image guidance system and began providing Vision...”

“There were two compelling reasons for working optical surface imaging: patient comfort and efficiency. This technology makes it possible to deliver a radiosurgery treatment in a conventional treatment time slot.”

—Todd Pawlicki, PhD, University of California, San Diego
RT with clinical input,” says Todd Pawlicki, vice chair and director of medical physics and technology. “By October 2009, we were using the system routinely for cranial radiosurgery.” 11

“There were two compelling reasons for working optical surface imaging: patient comfort and efficiency,” Pawlicki explains. “This technology makes it possible to deliver a radiosurgery treatment in a conventional treatment time slot. The clinical flow is the same as with every other patient. The treatments take 20 to 30 minutes, depending slightly on the prescription dose. That means we don’t have to save all the radiosurgery treatments and do them at the end of the day, when we’re finished with conventional treatments. We can treat our radiosurgery patients throughout the day. Using Varian’s delivery system plus surface imaging, we can treat a wide variety of targets, even those often reserved for CyberKnife® or Gamma Knife® systems.”

The optical surface imaging system consists of three cameras that are attached to the ceiling of the treatment vault, one at the foot of the couch and two on either side of the linear accelerator. Once a patient has been set up for treatment, the system generates a 3D surface image of the patient, compares it to a reference image from CT simulation, and indicates the patient’s position relative to the treatment isocenter. The patient is then moved as necessary.

Members of the UCSD clinical team position a patient for frameless radiosurgery using 3D optical surface imaging technology. Images courtesy of the UCSD Moores Cancer Center.

When the patient is within about half a millimeter and half a degree, the therapist leaves the room and acquires a cone-beam CT image. “The cone-beam CT is still considered the ‘ground truth,’” Pawlicki says. “We shift the table based on the cone-beam CT image and start monitoring from there for the entire duration of the treatment. If the patient moves at any time, we see it and pause the treatment.”

Mundt, Murphy, and Pawlicki all stress the fact that optical imaging doesn’t add any additional ionizing radiation during treatment.

“Our goal is always to control the treated lesion with the least amount of side effects possible, whether it’s a metastatic tumor or a benign meningioma,” Mundt says. “This is an exciting development because it allows us to use image guidance while limiting exposure to ionizing radiation.”

Treatments are delivered using RapidArc radiosurgery as much as possible. They treat multiple metastases using RapidArc plans with a single isocenter. They also use cones on occasion, for treating single lesions that are less than one centimeter in diameter, or for trigeminal neuralgia. Treatment plans are all created using Eclipse™ treatment planning software.

Pawlicki sees other uses for optical surface imaging on the horizon. “We’re already using it to manage deep inspiration breath-hold techniques for patients with left-sided breast cancer,” he says. “We also use it when treating limbs, to get a leg or arm quickly into position without multiple x-ray images. Perhaps one day it will supplant lasers: instead of localizing the patient based on three points in space, we’ll be able to use surface images, which provide you with more complete information.”

A typical three-arc RapidArc treatment plan.
Hippocampal avoidance using RapidArc for whole-brain radiotherapy

Established in 1804, the Royal Hobart Hospital is Australia’s second oldest hospital. It serves the people of Southern Tasmania. Clinicians have seen many changes in equipment and techniques since the Royal Hobart Department of Radiation Oncology commenced operation in 1953. Today the department has three Varian linear accelerators, including a Trilogy machine.

While many of the treatment centers profiled here are attempting to deal with negative cognitive impacts of WBRT by omitting it in favor of radiosurgery alone, a team of researchers in Australia has been looking at another approach when treating melanoma brain metastases. They are using RapidArc to deliver WBRT with hippocampal avoidance.

“We have to assume that, at least in some cases, micro-metastases are present in the brain along with gross disease,” says Raef Awad, MD, consultant radiation oncologist at the Royal Hobart Hospital, Australia. “And while many say that WBRT negatively impacts neurocognitive function, these unwanted side effects may be due to hippocampal irradiation, which we can minimize using modern radiotherapy techniques like RapidArc.”

According to Awad, another advantage to this approach is that the WBRT and the stereotactic radiotherapy (SRT) can be delivered at the same time on one machine, through the use of a simultaneous integrated boost. “The treatment is basically a combination of WBRT and SRS,” he says. “It’s a blend of the two, and much easier than delivering a course of WBRT, and then following it with SRS separately, which requires two separate courses of radiotherapy and two different plans, and often means treating on different machines or perhaps even at different treatment centers. We also use less integral dose because the radiosurgery dose is delivered as part of the WBRT treatment.”

“While many say that WBRT negatively impacts neurocognitive function, these unwanted side effects may be due to hippocampal irradiation, which we can minimize using modern radiotherapy techniques.”

—Raef Awad, MD, Royal Hobart Hospital

Finally, Awad says, the use of RapidArc to deliver WBRT plus a boost all at once confers an efficiency advantage. These treatments, in terms of beam-on time, can be delivered in two to three minutes. In a recently published study, he and his colleagues at Australia’s Royal Hobart Hospital concluded that VMAT for brain metastases is feasible, safe, and associated with similar survival times and toxicities to conventional stereotactic radiotherapy with or without whole-brain radiotherapy. “The advantage of VMAT is that WBRT and SRT can be delivered at the same time on one machine,” he says.12
Brain metastases arise in 20 to 40 percent of all cancer patients, according to the NCI. As more and more treatment centers accrue experience with linac-based radiosurgery in the treatment of brain mets, it is likely that many of these patients will have opportunities to benefit.

The clinical protocol that Awad and his colleagues follow utilizes a face mask for patient immobilization. The treatment plan incorporates a 2 to 3 mm margin for the boost to each brain metastasis. Image guidance is based on cone-beam CT imaging. “We were doing that daily in the beginning,” says Awad, “but now, as we have gained experience, we image each day during the first week and then weekly thereafter.”

Awad is currently part of a global team of researchers accruing patients for a randomized phase 3 trial looking at whole-brain radiotherapy following local treatment of melanoma brain metastases. The trial is being sponsored by the Australia and New Zealand Melanoma Trials Group (ANZMTG), the Sydney Neuro-Oncology Group (SNOG), and the Trans-Tasman Radiation Oncology Group (TROG).

Patients will be randomized into either a WBRT arm or a “no further treatment” arm. Within the WBRT arm, a variety of treatment approaches will be permissible, including IMRT with a simultaneous integrated boost or VMAT with a boost. Hippocampal sparing will be allowed for patients in the trial who are randomized to the WBRT arm. The patient cohort treated with hippocampal sparing will be analyzed as a hypothesis generating substudy.

“The goal of the trial is to improve the treatment of brain metastases for patients with stage IV melanoma by using WBRT to improve disease control while maintaining cognitive performance and quality of life,” Awad says.
At the University of Michigan (UM), a program for using stereotactic body radiotherapy (SBRT) to treat liver cancer has been in place since 2005. A long-standing multidisciplinary liver tumor clinic is staffed by surgeons, radiation oncologists, hepatologists, interventional and diagnostic radiologists, and medical oncologists, who converge to discuss cases. “Referrals come to us through any of those disciplines,” says Mary Feng, MD, associate professor in the UM Department of Radiation Oncology. “Through this strong, collaborative approach, we have steadily expanded the role of radiation oncology to the point where now we’re often the preferred treatment modality.”

The UM liver tumor board sorts patients into three groups: those with local, regional, and systemic disease. “We match the therapy with the type of disease,” Feng says. “For a patient with local disease and one to three tumors, we use a local treatment that doesn’t blanket the entire liver in order to better preserve liver function.”

“All treatments can be completed in about 45 minutes, including the cone-beam CT evaluation. Then patients go home or to work. Most drive themselves. Radiotherapy has really come a long way.”

—Mary Feng, MD, University of Michigan

Nonsurgical treatment modalities

Two modalities, SBRT and radiofrequency ablation (RFA), are available to the team for treating liver tumors nonsurgically. “While RFA is the preferred standard in most institutions, we have developed a preference for SBRT in many situations, particularly for tumors near the liver dome, gall bladder, or large vessels; and for tumors over 3 centimeters,” Feng says. “RFA involves the insertion of needles; it’s basically burning the tumor from inside. But livers are delicate and prone to bleeding and other complications. SBRT is noninvasive and doesn’t require anesthesia. Our own research, which we have presented at an ASCO GI Symposium, shows equivalent rates of local control with RFA and SBRT.1,2 That has allowed us to offer SBRT as a less invasive option that appears to produce comparable outcomes.”1
Also, it is important to do as little damage as possible when treating to preserve the possibility of additional treatments in the future, Feng points out. “For some patients, we are able to turn a diagnosis of liver cancer into more of a chronic disease for several years, more like bad diabetes or heart disease, rather than something frightening and immediately fatal,” she says. “Patients can come in for treatment, live their lives for six months or a year or more, and then, if we discover another tumor, we treat that locally as well. I tell them it’s like having a periodic tune-up.”

No “one-size-fits-all” dosing

According to Feng, the dosing schedule varies depending on whether a patient has primary or metastatic liver cancer. “We don’t use a ‘one-size-fits-all’ approach, but rather, we take the risk of liver damage into account,” she says. “Patients with metastatic liver tumors have otherwise healthy livers that just happen to contain tumors, which makes them easier to treat with SBRT. In cases of primary liver cancer, we are often dealing with patients who have cirrhosis, or previous surgery or RFA treatments. In those cases, we individualize the dose prescriptions not just based on geometry, but also based on the estimated liver tolerance. Instead of everyone getting 50 Gy, some get 40 and some get 60, depending on both geometry and safety considerations.”

How is tolerance determined? Feng and her colleagues use a liver function test that they administer prior to treatment, and again after three of five fractions. This involves injecting a specific green dye into the bloodstream and measuring how quickly the liver removes it.

“We give patients this test before delivering any radiation at all to establish a baseline for their liver function,” Feng says. “Some people’s livers clean the blood at the same rate after a few fractions; some really slow down, even after a moderate dose. In the latter case, we would give less radiation after the test, or even none at all. If the liver function stays good, we can give an extra dose to improve the chance of tumor control. We really like this because we can test each patient’s sensitivity instead of making clinical decisions by using general guidelines or population averages.”

SBRT workflow

The SBRT workflow at the University of Michigan starts with an MRI scan acquired in multiple phases using IV contrast. This scan is then used in treatment planning for precise delineation of tumors. Clinicians use cone-beam CT (CBCT) imaging to position patients for treatment. “We rely on the CBCT to not only pinpoint the tumor, but also to make sure we’re minimizing dose to the stomach, duodenum, and colon, which are all nearby,” Feng says.

Tumor motion is assessed using the 4D CT scan data. “For patients whose tumors move during respiration, we have them hold their breath during ‘beam on,’” Feng says. “All treatments can be completed in about 45 minutes, including the cone-beam CT evaluation. Then patients go home or to work. Most drive themselves. Radiotherapy has really come a long way.”

For Feng, success means either disease-free survival or turning liver cancer into a controlled disease. “I just treated a patient who had her first liver SBRT treatment in 2005. She didn’t need anything further until she had another course of SBRT in 2009, and then again in 2011 and 2013. Each time we treated two or three tumors. She’s still alive seven plus years later, and hasn’t needed any chemotherapy.”

3. As a medical device manufacturer, Varian cannot and does not recommend specific treatment modalities or techniques.
4. Individual treatment results may vary.
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