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Technology in Healthcare

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In this issue...

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA
Pittsburgh Engineers' Building
337 Fourth Avenue
Pittsburgh, PA 15222
Tel: 412-261-0710
Fax: 412-261-1606
e-mail: eswp@eswp.com

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Guest Editor Column

Eric Cartwright

Technology in Health Care:

The Future is Now

Eric Cartwright

A major technological evolution is unfolding in health care. Engineers have become the indispensable partners of doctors and other care givers. How and where we receive health care, the quality of that care, and the physician-patient relationship are all changing with technological advances in telemedicine, medical robotics, and medical engineering. These innovations are driven by science and collaborative technologies that are transforming both the practice and delivery of modern medicine.

"Engineers have become the indispensable partners of doctors and other care givers"

In this issue of Pittsburgh Engineer we explore the front line of health care as it shapes our region, our world, and our future. We look at scientific advances in the fields of tissue engineering and cellular therapies unfolding at the McGowan Institute for Regenerative Medicine. How can healthy cells be induced to grow at injured sites? Physical rehabilitation experts are exploring the extension of injured extremities and the regeneration of bone. Vision assist devices, miniature pediatric heart pumps, and blood purification devices are in development to maintain, improve, or restore function.

For decades joint replacement surgery has led the collaborative field of medicine and engineering. As techniques and technologies continue to evolve, researchers and clinicians also are focused on the interface of science and the patient experience. Experience-based design tools are dramatically altering the way care is delivered at the Orthopaedic Program at Magee-Womens Hospital of UPMC. Video and tracking technologies are being used to bridge art and science and create optimal patient experiences and clinical outcomes.

Telemedicine is transforming both the practice and delivery of health care. Remotely delivered care is defining global medicine for the 21st century, connecting medical providers for a seamless flow of information to improve care quality and reduce cost. Telemedicine is connecting public, private, and military providers of care through teleradiology, load-balancing, and theatre informatics services. We look at infrastructure, carrier networks, and state-of-the-art teleconferencing.

Hospitals are increasingly relying on technology to improve patient care, control and eliminate the transmission of disease, and improve efficiencies. We offer an overview of emerging technologies in health care such as bar-codes for tracking medications, wireless communications networks, minimally invasive surgery, and automated facilities.

Medical simulation is increasingly the state-of-the-art in clinical training. Training labs are using audio-visual technologies to present real-life scenarios in emergency settings diverse as parking lots and living rooms. We present the latest in simulation equipment.

In this issue we also look at a paradigm shift in the workflow of frontline clinical staff. The health care technology solution called Smart Room™ uses real-time location-tracking technology to provide relevant clinical information to staff at the patient's bedside. This technology makes retrieving the right patient information at the right time as simple as walking into the room.

All of these ground-changing technologies are evolving right here in western Pennsylvania, long an innovator in science and industry, energy, and cutting-edge technology. The breakthroughs discussed herein would have been impossible without close collaboration between engineers and health care professionals. Explore the horizons of medicine and engineering in this issue of Pittsburgh Engineer.

Mr. Cartwright currently serves as the Vice President, Corporate Construction and Real Estate of the UPMC and has been in that role since January of 2007. In his current capacity at UPMC Mr. Cartwright has overall responsibility for the administration and management of all design and construction projects as well as oversight of the owned and leased corporate real estate portfolio. Prior to his promotion to Vice President, he served as Associate Vice President, Facilities and Construction starting in July of 2001. Before coming to UPMC in 2001, Mr. Cartwright was the Vice President of Development for Oxford Development Company. He is a registered Professional Engineer and received his bachelor's degree in Civil Engineering from the University of Notre Dame and a master's degree in Business Administration from the University of Pittsburgh. PE

Leading the Drive to Rebuild Damaged Bodies Thru Regenerative Medicine

By Alan J. Russell, PhD

We live in exciting times. The scientific advances in the field of regenerative medicine are progressing at a rapid pace, and a worldwide effort is in play to change the way we treat disease. The field of regenerative medicine is vast, and research is being focused on a variety of disease areas. The critical element that all this research has in common is that instead of simply treating the symptoms of disease or trauma, regenerative medicine seeks to cure these conditions by helping the human body repair itself.

"Regenerative medicine seeks to cure conditions by helping the human body repair itself"

Finding ways to rebuild bodies requires a global collaborative effort, and the McGowan Institute for Regenerative Medicine of the University of Pittsburgh and UPMC is proud to be a part of it. Established in 2001, the McGowan Institute for Regenerative Medicine serves as a single base of operations for these organizations' leading scientists and clinical faculty working to develop tissue engineering and biomaterials, cellular therapies and medical devices, and artificial organs.

Innovation is driven by collaboration, and for this reason the McGowan Institute has focused on creating a cross-disciplinary environment and culture. The McGowan Institute has more than 230 faculty members with appointments in more than 30 academic departments. Below are examples of the most promising research programs under way, including some that are contributing to the development of powerful clinical applications.

"Understanding and manipulating the complex relationship between cells and scaffolding materials are essential for functional tissue engineering"

TISSUE ENGINEERING

Combining cells with scaffolding materials to generate functional tissue constructs is tissue engineering at its most basic level. Understanding and manipulating the complex relationship between the cells and the scaffolding materials, however, is essential for functional tissue engineering. What cells should be used, for example, and should the combination of cells and materials occur in vitro or in vivo? What scaffolding material will best facilitate development? How can development be guided using humoral or mechanical cues? How will the tissue construct be functionally integrated? These questions are being answered by McGowan Institute faculty.

Examples of tissue engineering projects:

- Extracellular matrix — Extracellular matrix (ECM), a naturally derived scaffold material, has applications in a variety of therapies and treatments. ECM provides structural support for healthy cells to grow at injured sites in the body, thus restoring healthy tissue.
- ECM for esophageal reconstruction — McGowan Institute faculty have identified an alternative approach to esophageal repair using an ECM scaffold. After two months, the use of ECM in esophageal repair led to less stenosis and less contracture of the cervical and distal esophagus compared to traditional procedure.
- ECM for fingertip regeneration — A powdered form of ECM has shown a capability for digit regeneration. The material has been used to facilitate the regeneration of amputated fingertips, and is now being evaluated to help extend the length of fingers that have experienced more extensive amputations. Physical rehabilitation specialists suggest that the extension of a partially amputated finger by 1 cm could significantly enhance the functionality of the injured hand. Studies in collaboration with the U.S. military already have demonstrated that extension of up to 0.7 cm is possible, and work is continuing.

"Bone tissue engineering is now experiencing the growth previously seen with soft tissue engineering"

- Bone tissue engineering — Bone tissue engineering is now experiencing the growth previously seen with soft tissue engineering. McGowan Institute faculty have invented a new bone cement that serves as a scaffold for the formation of new bone. The material may prove extremely useful in treating nonunion fractures, which in some cases can require amputation of a limb because of the massive loss of bone. The new bone cement, which is still in the preclinical study phase, provides load-bearing strength soon after application, and also serves as a scaffold for the formation of new bone. This new approach also has potentially broad application in the repair of craniofacial disease and trauma.

CELLULAR THERAPIES

The field of cellular therapeutics is vast, affording an exciting array of potential applications. McGowan Institute faculty are developing a broad range of

treatments for many genetic conditions, as well as for diseased, injured, or metabolically deficient tissues. Critical questions shaping much of this work are which cells to use, and how to deploy them. Differentiated (specialized) cells, nondifferentiated progenitor cells, and stem cells each present unique benefits and drawbacks, and each day yields new insights into their advantages and disadvantages.

Examples of cellular therapy projects:

- Stem cell therapy for heart disease — McGowan Institute faculty are exploring a minimally invasive procedure for those who suffer from certain types of coronary disease. The procedure involves harvesting a patient's own stem cells for injection directly into the damaged cardiac muscle to correct the deficiency.
- Stem cell therapy for nerve regeneration — Researchers are exploring adipose precursor cells' ability to differentiate in vitro into cartilage (chondrogenic), bone (osteogenic), fat (adipogenic), and muscle (myogenic) cell types. This cell type has shown promise for the full regeneration of the sciatic nerve in preclinical studies.
- Identification of cancer stem cells — McGowan Institute faculty are exploring the identification, isolation, and characterization of cancer stem cells for liver and prostate cancers. Accompanying this research is the development of specific markers for liver and prostate cancers and the identification of new drug targets for these cancers.

> "Organ assistance and substitution devices will play an ever-larger role in managing patients with end-stage disease by providing a bridge to recovery or transplantation"

MEDICAL DEVICES AND ARTIFICIAL ORGANS

An important goal of the McGowan Institute is to develop and define technologies that will maintain, improve, or even restore the function of diseased organs. The need for these technologies is substantial, and growing. Improved health care has resulted in increased life expectancy, and people who live longer have a greater probability of needing an organ replacement at some point. The continuing shortage of donor organs makes it clear that organ assistance and substitution devices will play an ever-larger role in managing patients with end-stage disease by providing a bridge to recovery or transplantation.

Examples of medical device projects:

- Pheresis intervention for sepsis — McGowan Institute faculty are developing an extracorporeal blood purification device that removes the inflammatory molecules that cause severe sepsis, a severe and potentially fatal systemic infection. The device is packed with adsorbing polymer beads covered in biocompatible coating. Cytokines involved in sepsis are adsorbed on the beads, thus cleansing the patient's blood.
- Vision assist device — Through the Louis J. Fox Center for Vision Restoration of UPMC and the University of Pittsburgh, a joint program of the UPMC Eye Center and the McGowan Institute, researchers are investigating therapies for a variety of ocular diseases and afflictions. One project that falls under this broad scope involves a vision assist device called the BrainPort® from Wicab Inc. This technology enables the perception of vision for those with sight loss by using a tongue sensor and camera. Researchers are working with patients to improve the technology and increase benefits for potential future users.
- Pediatric heart pump — McGowan Institute faculty are developing a miniature pediatric ventricular assist device (VAD) that will be fully implantable and can serve as a bridge to a heart transplant or a bridge to recovery for infants and toddlers. The new VAD is in preclinical studies, and appears to offer substantial improvements over the current methods for treating infants with severe cardiac failure.

CLINICAL TRANSLATION

Through its affiliation with UPMC, the McGowan Institute for Regenerative Medicine has access to one of the nation's finest health systems. UPMC is consistently ranked by U.S. News & World Report as one of the best health systems in the country, with a well-established and well-organized clinical trial infrastructure, and a large, diverse population from which to draw study subjects. PE

For more information on the McGowan Institute programs, please visit www.mcgowan.pitt.edu

Alan J. Russell, PhD, is director of the McGowan Institute.

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Merging the Art and Science of Performance in Joint Replacement Surgery:

Experience-Based Design for Health Care

By Anthony DiGioia, III, MD; Pamela K. Greenhouse, MBA; Branislav Jaramaz, PhD; Constantinos Nikou, MS; and Stephen DiGioia

INTRODUCTION

Joint replacement surgery, introduced in the 1970s, is now among the most frequently performed surgical procedures. Approximately 600,000 knee replacements and 200,000 total hip replacements are performed annually in the United States[1] and it is estimated that as "boomers" continue to age, by 2030 the demand for total hips and knees in the U.S. will exceed 4 million procedures annually[2]. New technologies and processes for the delivery of care will need to be developed to handle these demands.

We have learned, however, time and again, that technology cannot solve all of these problems, and that process is of equal importance to technology. In the end, only a combination of process and technology leads to the best outcomes. The less invasive joint replacement "craze" in the early 2000s led to specialized imaging and instrumentation, but process improvement and the models of care delivery must be of equal or greater priority. Process in joint replacement surgery includes better preparation of patients and families, improved anesthesia techniques, multimodal pain management, rapid rehabilitation protocols, and the use of focused care teams defined as health care professionals who work together and specialize in these areas. Focusing on the end-user experience needs be an essential component in the development of techniques and technologies moving forward. In other words, merging the science of joint replacement surgery with the art of focusing on the patient and family experience creates performance improvement over the full cycle of care and, ultimately, is pivotal to optimizing outcomes.

AN EXAMPLE OF THE EVOLUTION OF THE NEW GENERATION OF SURGICAL TOOLS: THE SCIENCE

Although the first clinical system using robotic technology for joint replacement surgery was an autonomous robot designed to accurately mill a femur, or thigh bone, in preparation for total hip replacement, the most popular systems of the past two decades have been non-robotic navigation systems. These systems use principles similar to GPS, but reduced to a room scale, and guide the surgeon while the surgeon is still in charge of the action. This improved visualization and guidance played a large part in the development of less invasive surgical procedures from which all patients have benefited.

Two technologies that are currently attracting a great deal of attention in orthopaedics are semi-active or "collaborative" robotics and patient-specific templating. Semi-active robotic tools combine the strengths of the surgeon with the precision and rapid reaction of a navigation system.

The Precision Freehand Sculptor (PFS) from Blue Belt Technologies, Inc., located in Pittsburgh, builds on this basic concept, allowing a high-speed surgical bur to remove bone only as determined by a preoperative surgical plan. PFS extends the conventional framework of surgical navigation by adding robotic control of the bone removal tool and tracks the bone and tools of interest in real time, comparing this information to the surgical plan, and communicating it to the surgeon. PFS prevents inaccurate cutting of the bone by either withdrawing the bur into a protective sleeve or by controlling the rotation speed of the bur. This results in a light, handheld, less expensive portable device that enhances the surgeon's ability to move without restriction and with smaller and smaller incisions (Figure 1).

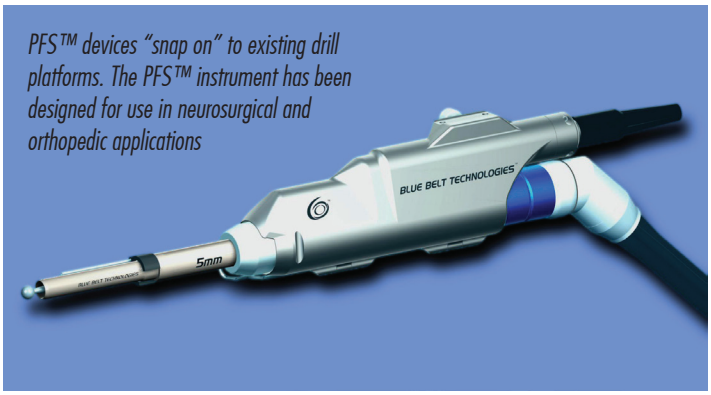

Figure 1. The Precision Freehand Sculptor (PFS) provides precise control to surgeons via an intelligent, hand-held bone-cutting tool.

The concept of patient-specific templates combines 3D surgical planning with rapid design and custom manufacturing based on CAD/CAM technologies. These templates uniquely mate with the bone and incorporate guides consistent with the surgical plan. The idea was originally introduced in spine surgery for screw placement. This approach, however, did not appear to be practical for joint replacement until more recently, since all mating surfaces areas must be clearly visible in the CT or MRI scan. Any areas with cartilage would not be suitable as mating surfaces, therefore requiring unacceptably wide surgical access. Recently introduced systems now circumvent this limitation by allowing the templates to be directly applied to the joint surface.

Both PFS and patient-specific templating are beginning to inspire a new generation of implants — patient-specific and bone-sparing — permitting the development of a new generation of less invasive techniques for both large and small joint surgery.

AN EXAMPLE OF EXPERIENCE-BASED DESIGN: COMBINING THE ART AND SCIENCE OF PERFORMANCE

Experience-based design tools are based in the "design sciences" and are "low tech" and inexpensive, yet will dramatically change the way care is delivered. They will result in value-added improvements from the patient and family perspective, as well as improve clinical outcomes and patient safety. The Patient and Family-Centered Care Methodology and Practice (PFCC M/P) is one care experience-based design tool that optimizes the patient and family experience by viewing the full cycle of care through their eyes. Developed by Anthony DiGioia, MD, and refined over the past several years, it has been initiated in over three dozen clinical and non-clinical care experiences throughout UPMC. [3-5]

Transforming Care in Six Steps: Patient and Family-Centered Care Methodology and Practice

Step 1: Select a care experience for performance improvement and define the beginning/end of the selected experience.
Step 2: Establish a PFCC Care Experience Guiding Council.
Step 3: Evaluate the current state of the care experience by using PFCC tools such as Shadowing, Care Experience Flow Mapping, patient storytelling, and patient surveys.
Step 4: Develop a PFCC Care Experience Working Group.
Step 5: Create a shared vision of the ideal patient and family care experience.
Step 6: Identify performance improvement projects and form project improvement teams.

Table 1

As an experience-based design tool, PFCC M/P incorporates the scientific process of Plan-Do-Study-Act and takes it to the next level of performance improvement. PFCC M/P[6] is a six-step process (Table 1) that continually examines every aspect of patient and family experience over the full cycle of care using a set of observation tools, including Shadowing and Care Experience Flow Mapping. These observation tools[4] enable care givers to understand what patients and families experience, creating a sense of urgency among care givers to drive change. The stepped process is self-sustaining and leads to the development of high performance care-delivery teams and cultural change. PFCC M/P is simple to learn and works in any clinic, department, hospital, or health care organization.

AN EXAMPLE OF BRIDGING THE ART AND SCIENCE OF PERFORMANCE: REALITY TV AND WORKFLOW TRACKING

Video and tracking technologies merged with experience-based design can create optimal patient experiences and clinical outcomes. Another example that bridges the art and science is the use of video recording, or "Reality TV for Care Givers," that was implemented in the Joint Replacement Program at Magee-Womens Hospital of UPMC. While video recording isn't new in health care, using it to document entire patient-care experiences and workflow is new.

In an effort to document and analyze post-operative care, digital video recording (DVR) systems were installed in two inpatient rooms on the Orthopaedics Unit of Magee-Womens Hospital of UPMC. The system includes two DVRs and two small color cameras in each room that are infrared for low-light situations. Camera locations are selected to allow tracking of patients and staff while allowing the patient and family to draw a "virtual" curtain around the bed for privacy. The DVR system is also motion activated in order to reduce the total recording times, and can record only when a care giver enters the room.

These tools allow us to evaluate the number and type of interactions staff have with patients following surgery, as well as the quality and nature of the interactions so that both the experience and the outcomes can be optimized. Some surprising results for 20 patients observed that over 28 different types of staff are involved in patients' care over a two-to-three day stay, with an average rate of 80 staff/patient contacts over each 24-hour period (Figure 2). This information is used to change the care experience for patients, families, and care givers alike.

Within the Orthopaedic Program, the average length of stay was 2.9 days for knee replacement (compared to 3.8 days nationally) and 2.5 days for hip replacement (compared to 4.9 days nationally) with 93 percent of patients discharged directly home. Most importantly, 99.7 percent of patients would recommend the program to a friend or relative.

The PFCC M/P also has been adopted for over 30 different care experiences and eight hospitals at UPMC with very positive results for patients, families, and those that deliver care in such diverse areas as Level I Trauma, Surgical Care, Organ Transplant, Home Health Rehabilitation, Women's Care, Lobby/Wayfinding, Dining Experience, New Hire Orientation, Employee Inclusion, and the Care Giver Experience, just to name a few.

CONCLUSION

In joint replacement surgery, as in all of health care, technology will continue to be important to physicians and patients alike. At the same time, performance-improvement tools such, as PFCC M/P will likely rival and maybe even surpass

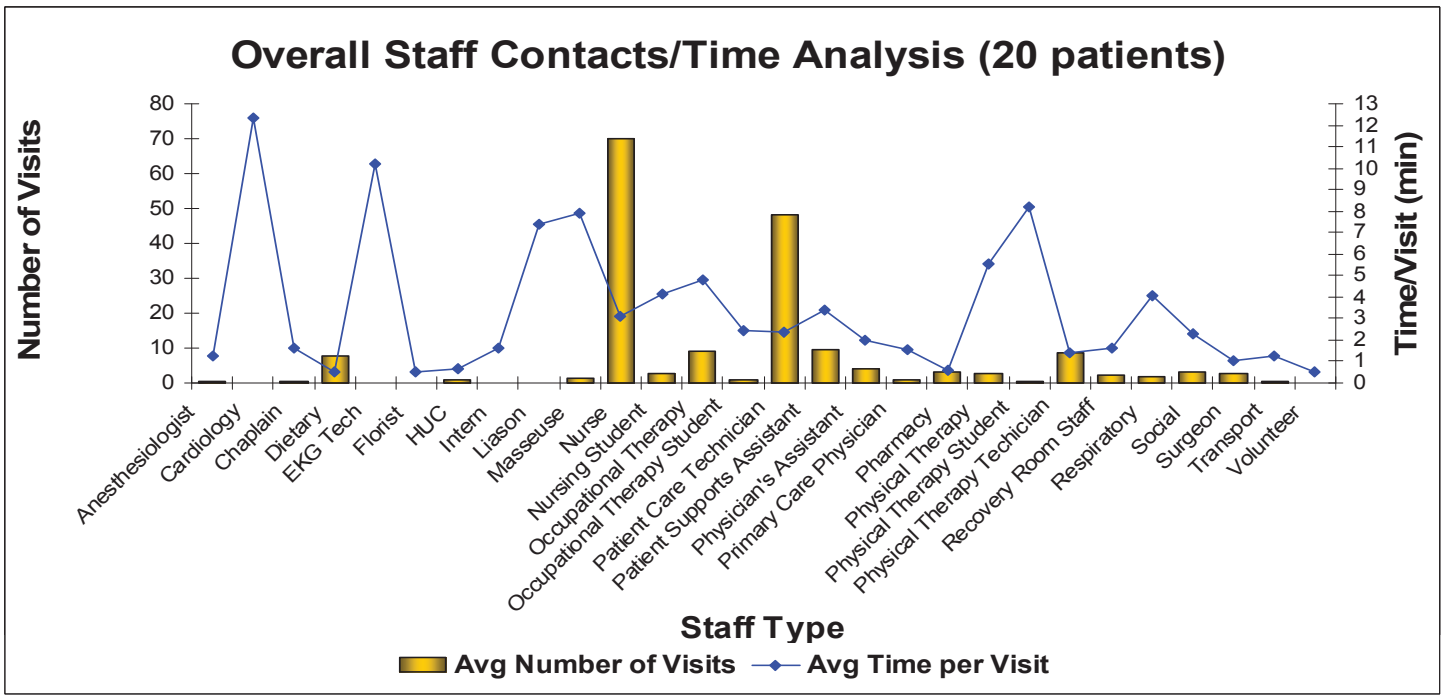

Figure 2. Staff contacts/time analysis chart

technology by proving to have even more potential for adding value to patient care. Combining the art and science of technology and performance is the key to optimizing care experiences and clinical outcomes while reducing costs.

The PFCC M/P is an experience-based design approach that has been developed specifically for health care and has shown itself to be replicable and sustainable. A key by-product is the cultural transformation that results by viewing all care through the eyes of patients and families. It is our belief that the PFCC M/P can potentially have an industry-wide impact as the performance-improvement tool of choice customized for all of health care. It is the missing component in redesigning patient-centered care delivery systems that address the quality gap. In the near future, Medicare payments will be directly linked to patient- and family-care experiences. Delivering exceptional experiences is going to be very important to physicians and hospitals in the years to come. Care-delivery models and payment platforms will change as health care reform proceeds. Accountability for clinical outcomes combined with the ability to provide exceptional care at less cost will be key to survival for care delivery organizations. These goals can be achieved by combining the art and science of performance, and Pittsburgh is proudly at the leading edge of these efforts. PE

Anthony DiGioia, III, MD, Renaissance Orthopaedics, P.C., is medical director of the Innovation Center of UPMC and the Orthopaedic Program at Magee-Womens Hospital of UPMC. Pamela K. Greenhouse, MBA, is president of Pamela Greenhouse Associates. Branislav Jaramaz, PhD, is co-founder and chief technology officer of Blue Belt Technologies, Inc. Constantinos Nikou, MS, is director of software development at Blue Belt Technologies, Inc. Stephen DiGioia is director of technology development at the Innovation Center of UPMC.

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TELEHEALTH:

Tomorrow's Medicine Today

By Andrew Watson, MD, and Robert A. Hardie

Around the world, health care providers continually pioneer techniques, treatments, and tools for treating disease and caring for patients. Unfortunately, these advanced procedures and technologies do not always reach their full potential in the current, disconnected system of outdated technology, isolated computer and communications systems, and inefficient record keeping.

"The new field of telemedicine, or telehealth, is transforming both the practice and delivery of medicine"

The new field of telemedicine, or telehealth, is transforming both the practice and delivery of medicine. Telehealth has already made strides in the delivery of remote care. Through store and forward telemedicine, for example, images or test results can be captured at remote sites and sent to a central facility for evaluation. This allows specialists at the central facility to use the information to create a treatment plan, which is then administered locally.

Telehealth also allows for monitoring devices to be set up in a patient's home. These devices use cellular signals, Bluetooth technology, or specially-designed interfaces to answer medical questions and collect medical data, such as the patient's weight, blood sugar levels, heart rate, and oxygenation. This data is instantly sent to a hospital to be monitored.

Video conferencing provides patients in remote areas with access to specially-equipped clinics and specialists in real-time without the need to leave their homes. Specialists can obtain the history of each patient and examine, diagnose, treat, and follow up remotely.

"Connected medicine is integrating technology for a seamless flow of information and communication between providers and patients"

Connected medicine is integrating technology for a seamless flow of information and communication between providers and patients to improve efficiencies, health care costs, delivery of care, and most importantly, the quality of patient care. This constant communication places patients' needs at the center of health care.

THE GROWING ROLE OF TELEHEALTH

Telehealth has a limited role in fee-for-service medicine of today, but will have a defined and financially prominent role in future accountable care models. Health care reform will change the value proposition of telehealth, as telehealth can decrease the cost and utilization of health care resources. Although a handful of companies are financially successful in niche markets, no telehealth provider, neither a private company nor academic medical center, has yet bundled a complete offering with all telehealth types into a viable, scalable financial model. UPMC is currently investigating the creation of a broad-based and all encompassing telehealth offering for its western Pennsylvania and international operations.

A number of key indicators show that telehealth is on the cusp of change: technology costs are falling; broadband is available on cell phones and in homes; health care reform will drive increased utilization of telehealth services; and consumer awareness is increasing. Also indicative is a 25 percent increase in attendance at American Telemedicine Association (ATA) meetings, and an emergence of new state-based telemedicine networks, as well as state-reimbursement legislative changes.

"Consumer telehealth services can efficiently leverage scarce clinical resources for acute needs, augment pay for performance through better transitional care, and lead to substantial cost savings that can be passed onto employers and patients"

The national health care environment is evolving from today's inefficient fee-for-service model. New focus on reimbursement reform, accountable care organizations, and patient-centered medicine are realigning provider and payer incentives. Growing physician and nursing shortages are incentivizing

integrated health care systems such as UPMC to extend medicine virtually to patient's homes, primary care physicians, and rural clinics. Improved access to high quality clinical resources will augment community health.

Consumer telehealth services can efficiently leverage scarce clinical resources for acute needs, augment pay for performance through better transitional care, and lead to substantial cost savings that can be passed onto employers and patients. Health care reform also is driving the increased prevalence and use of electronic health records, and both regional and, eventually, national health information exchanges (HIE's). In conjunction with the inevitable growth of HIE's and health information technology, telehealth will provide complementary health care services that will also scale and enable accountable care organizations to be financially successful.

TELEMEDICINE IN PITTSBURGH AND BEYOND

In western Pennsylvania, UPMC telehealth programs exist across 14 service lines and include approximately 1,900 encounters each year. Provider interest in telehealth also is increasing. UPMC telehealth offerings are expanding both within and outside the hospital network, both domestically and internationally in telepathology, teleradiology, teledermatology and eICU (electronic intensive care unit) in both developed and developing markets.

Telehealth services in Pittsburgh currently include:

- Live Telemedicine: Psychiatry, Stroke, Subspecialty Clinics (GI Surgery, Liver Cancer, Movement Disorder, Gastroenterology, Cardiology, Maternal Fetal Medicine, Telerounding, and eICU (pilot near implementation).
- Store and Forward Telemedicine: Radiology, Dermatology, Pathology, Ophthalmology, eVisits, and Wound Care.
- Home Monitoring: Congestive Heart Failure

PARTNERING WITH THE U.S. MILITARY

UPMC has established a partnership with the U.S. Air Force Medical Service (AFMS) to develop telemedicine health and e-Health initiatives. UPMC and AFMS are addressing similar challenges with respect to medical staffing and image sharing. To meet these challenges, several innovative telemedicine initiatives have been implemented.

UPMC's enterprise-based solutions provides diagnostic and referential images that serve to increase medical staff productivity, decrease medical costs, and enhance patient care. These have proven applicable to AFMS regardless of staffing constraints, systems capabilities, or patient location. Beginning with teleradiology, dynamic workflow allocation and supporting components for distributing images across AFMS and the Military Health System (MHS) were introduced regardless of modality or medical discipline.

The UPMC model creates a system of load-balancing in which physicians can complete their own local patient studies first, then diagnose any remaining cases in the system. This model maximizes physician workload regardless of location, in sharp contrast to traditional models that are typically designed as hub-and-spoke workflow systems. Hub-and-spoke systems have frequently increased the caseload gap between large central medical centers and smaller community hospitals.

The innovative symmetrical load-balancing model has enabled UPMC radiologists to significantly improve productivity and to provide better patient care at their local hospitals and at other hospitals in the health system. AFMS also has seen significant improvement with this model. Adjunctive telemedicine and theatre informatics services in support of readiness and peacetime missions has proven ideally suited to the AFMS health care infrastructure.

Working hand-in-hand with other federal health departments, including Army, Navy, and Veterans Administration, strong relationships and strategic partnerships with key players in telemedicine communities are being fostered. Collaborative development of health care technology tools is emerging. In this manner, innovation can be fully leveraged to the greatest possible benefit for both civilian and military populations.

Major barriers to successful implementation of telemedicine solutions continue to be overcome. Barriers have included provider acceptance of technologies, potential disruption of established referral patterns of care, lack of reimbursement as an incentive to providing telemedicine service, lack of proof of benefit to the practitioner, and arrangements to provide services and information at a distance. Accreditation of practitioners, as well as issues of privacy and security under HIPAA, the Department of Defense (DoD) network security process, and other information assurance requirements must also be addressed.

The Military Health System continues to face significant reductions in clinical manpower, and at the same time, a heightened readiness mission. As a result, it is actively exploring creative alternatives to traditional approaches in health care delivery. Telemedicine products and processes have been demonstrated in some operational settings for clinical product lines. Valuable tools have been created and progress has been documented. There has been large DoD investment, as well as Congressional R&D and smaller local medical treatment facility investment in telemedicine. How telemedicine will fit into the overarching Military Health System strategic plan is still evolving.

PATIENT ADOPTION OF TELEHEALTH

Consumers are now heavily using smart phones, such as the android platform and iPhone, with an ever-increasing number of applications available. Availability is on the rise of portable telehealth units and telehealth sensor-based devices that can be used at home with smart phones and broadband. A device-based health care environment for the home, called body area network (BAN), will link to clinics, hospitals, and private companies. Through these technologies, patients will continuously send weight, INR readings, hemoglobin, white blood cell count, blood pressure readings, and glucose levels back to their physician's office, health plan care manager, or hospital, with little effort. On the consumer side, primary care givers may invest in these technologies to better monitor family members.

It is clear from current UPMC experience that patient adoption of telemedicine is high. With less travel, better access to specialists, and more convenient care, telemedicine is a valuable tool for virtualizing high quality health care in western Pennsylvania.

THE FUTURE OF TELEMEDICINE

The Center for Connected Medicine (CCM) is a groundbreaking collaboration of UPMC and partners in information technology, communications, and health care that showcases the patient-centered health care model developed at UPMC. Collaborations of this kind are extending the reach of telehealth regionally, nationally, and globally.

> "Telemedicine fundamentally changes the way health care is delivered through enabling patients to receive the services of highly trained specialists without making long and expensive trips"

Several mission-critical tools are at the center of a future telemedicine strategy. These include infrastructure, carrier grade networks, data centers, and state-of-the-art teleconferencing.

Telemedicine fundamentally changes the way health care is delivered through enabling patients to receive the services of highly trained specialists without making long and expensive trips. Each type of telemedicine has a high degree of satisfaction among patients, their families, and their health care providers and fundamentally changes the way health care is delivered now and into the future. PE

Andrew Watson, MD, MLitt, FACS, Department of Surgery, UPMC, is medical director of the Center for Connected Medicine, and vice president, International and Commercial Services Division, UPMC. Robert A. Hardie, MBA, is vice president, Information Services Division, UPMC.

ESWP Member News

More than 75 firms are currently represented in the Engineers' Society of Western Pennsylvania (ESWP) Corporate Member program. Corporate Memberships are available at 3 levels: Gold, Silver and Bronze. Gold members are entitled to 14 individual memberships; Silver, 9; and Bronze, 5 — annual dues are $2400, $1700, and $1000 respectively.

NEW! For Government Agencies, Corporate and Individual Memberships are available at a 50% discount!

In addition, ESWP Corporate Member Firms may add 2 additional individuals in our Under-35 age category at no additional cost. More information can be found at eswp.com. Please contact the ESWP Office (412-261-0710) for additional details.

Membership in ESWP comes with a long list of benefits! From our continuing education opportunities to earn Professional Development Hours (PDHs) to the business networking events in our fine dining city club, there is something for everyone in your organization. Also, ESWP is helping the next generation of engineers with student outreach programs, giving you the opportunity to participate in many rewarding programs.

ESWP Gold Corporate Member Firms

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Technology in Healthcare

By Ronald E. Mann, RCDD and Arthur A. Bell, Jr., P.E.

The mission of any hospital is to provide safe, affordable, quality health care services and facilities for the community. This has become very challenging considering the rising operational costs, regulations and reduced insurance payments. Hospitals increasing rely on technology to improve patient care, control and eliminate the transmission of disease, and improve working efficiencies. Current technologies in hospitals today provide vast improvements over methods used in previous generations.

Emerging technologies include advancements in electronic medical records, robotics, rapid growth of minimally invasive surgery, interactive video conferencing, infrared technologies, bar-coding, high-resolution cameras, patient entertainment, visitor management systems, and video surveillance, to name just a few.

"The use of technology can improve patient care, reduce human error, improve patient & staff safety and provide operating efficiencies while reducing overall operating costs when defined with a specific goal in mind and implemented properly."

The advancement in electronic medical records, such as X-rays that once were printed or mailed to referring physicians, are now available over the hospital network or Internet within minutes. Another important quality is the reduction of medical errors and improvement in patient safety.

Infrared technologies assist in tracking personnel, patients and supplies within the hospital. Infrared technologies allow a hospital to track staff or patients through an infrared badge. In addition to locating individuals, hospitals use tracking technologies to locate and account for supplies. The problem of managing patient care assets is challenging healthcare professionals daily. Managers, administrators as well as primary medical providers all agree that keeping track of mobile assets is essential for organizational performance, patient care, regulatory compliance and legal exposure. Maintenance staff spend hours searching for specific items in need of repair or calibration. Hundreds of thousands of dollars worth of equipment are unaccounted for, misplaced, or stolen. To compensate, many hospitals have found it easier to over-procure.

Bar-coding technologies in hospitals allow a cost effective method for the tracking of medications and assist in the prevention of dosing errors.

Modern Minimally Invasive Surgery (MIS) OR suites are constructed to provide the entire surgical team with a better view of surgery, and to properly display and store information during the surgery. These rooms include ceiling-mounted cameras, OR light mounted cameras, large wall mounted video monitors, touch-screen or voice-control interfaces from a nursing station, vital patient monitoring equipment, and videoconferencing capability which allows the surgeon access to consultation from outside the OR.

Robotics are currently used to securely deliver medications, relieving the need for trained medical professionals to push medical carts around and allowing staff to focus on more important tasks.

Nurse Call Systems no longer consist of just a call cord console and indicator light. These systems provide communication from the patient bed station to various caregiver devices. When a patient places a call, in addition to it reporting to the system console, the message can be sent to a number of mobile devices including pocket pagers, wireless phones, and wireless badge devices. These same systems integrate with various medical devices (pumps and ventilators). The system notifies the assigned staff of a call on a priority and/or assignment basis and provides the staff with a path to communicate with the calling station. Extending this notification to a caregiver's device shortens the response time, which provides greater care and patient satisfaction.

Patients and family expect to have the same level of entertainment in a hospital as they do at home.

Keeping patients and guests occupied, alleviates boredom and makes them less dependent on nursing staff for their communication and entertainment needs. Today, patients expect on-demand movies, games, an Internet connection, and inexpensive ways to keep in touch with classmates, friends and family. This requires a PC-driven monitor to provide the user-friendly interface, performance and flexibility patients expect.

Visitor Management System allows the hospital to track visitors, and deliveries as they enter and exit the facilities. The system includes printing of custom designed visitor passes with expiration date, access area, host being visited, and purpose of visit.

Video Surveillance includes megapixel cameras, monitors and video storage providing the security staff with the ability to view and monitor the hospital campus. The system is a tool used to keep the campus safe, and detect and view unauthorized entry/exit and store video images.

There are a multitude of local area network (LAN)-based technologies that can be employed within a healthcare facility. These systems require both a wired and wireless communication network. The network includes structured cabling (copper and optical fiber cabling), the data switches, building automation, telecommunication, security, fire alarm, medical records, imaging, and other intelligent building systems. Technologies currently available for the built environment offer tremendous value opportunities that are many times unsuccessfully implemented.

Implementing new technologies require a robust and redundant IT network. This network is used to collect, store, retrieve and transfer information electronically. This network must be secure, reliable and available 99.999%. In addition, properly installed IT networks allow medical and nursing staff at remote sites to discuss and determine the appropriate treatment for a patient over the Internet using video and audio interaction.

In addition to the IT network, to properly implement new technologies, major systems such as chilled water, heating water, steam, normal electrical service, and emergency electrical service should be provided with standby/redundant equipment, so that in the event of a failure of a single piece of equipment, the facility will not have a loss of services.

The key elements for all the HVAC, electrical, plumbing and fire protection, services within a facility are redundancy, reliability, maintainability, and future capacity for growth. System capacity for future growth can be accomplished by allocating space for equipment to be installed in the future as hospital growth warrants the expenditure. Allocating space for future equipment also means allocating equipment delivery and move-in paths. In addition, the distribution infrastructure has to be installed to allow for the installation and connection of the future equipment without shutdown of these systems.

Because a facility's electrical system is energized under emergency power through the normal power circuits, almost all of the mechanical equipment is capable of being supplied with emergency power. This affords some unique operational characteristics for the facility. The mechanical systems take advantage of this electrical system design by integrating the BAS into the operation of the emergency power system. The BAS receives a signal from the electrical system to indicate the number of service transformers and the number of generators that are operating. Based on the information provided by the electrical system, the BAS determines how many chillers, boilers, pumps, AHUs, and other mechanical equipment to operate based on an extensive priority table. Almost all of the mechanical equipment can be installed with energy efficient variable frequency drives (VFDs). This design feature enhances the mechanical system operation on emergency power.

In conclusion, there is significantly more to designing and implementing new technologies into a medical facility beyond the individual system. One must also consider the brick, glass, steel, concrete, pipe, duct, and equipment. All stakeholders put forth a monumental effort to make the facility a success. Resolutions to design and construction challenges are accomplished through the perseverance, dedication, and hard work of many individuals. The success of a project cannot be attributed to any one individual or company; it is the result of the collaboration of owner, design and construction teams.

New technology in hospitals is shaving minutes — and sometimes days — off the time it takes to diagnose and treat a patient if installed and integrated properly. PE

As a Telecommunications Specialist at Astorino, Ronald E. Mann provides cost-effective solutions for infrastructure design, network design and implementation. He has extensive experience in communications technology, strategic planning, design and implementation management. Mr. Mann has developed advanced technical skills in voice, local area networks, wide area networks and video technologies and has successfully implemented multi-million dollar communications projects and premises equipment configurations.

Arthur A. Bell brings more than 25 years of experience in HVAC, plumbing and fire protection design to his role as Principal/ Department Head at Astorino. He has recently written text books in the field of mechanical engineering for McGraw-Hill, Inc. and served as an instructor for the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), an international membership organization of engineers. As department head, Art's responsibilities include mechanical and HVAC design for healthcare, commercial and institutional projects. He is also responsible for HVAC quality control and general project management.

Sim Lab

sim lab - ***ABBR*** **noun** simulation laboratory \sim-yə-'la-shen 'la-b(ə-)rə-tor-ē\:

1. robotics technology, medical simulation and the audio and video industry come together in a digital recording systems used in medical scenario simulations.

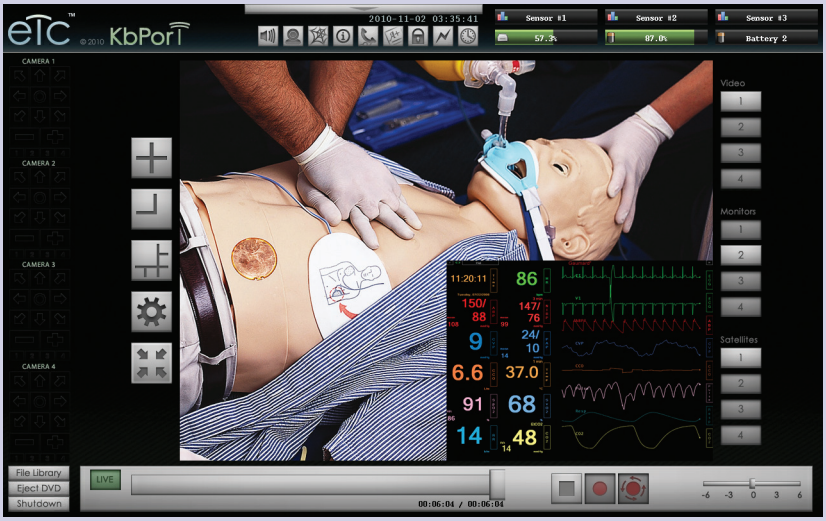
By Chuck Miller

Over the past 20 years the integration between audio visual equipment (AV) and medical simulation training is and will continue to be a hot topic between medical simulation labs around the globe. Medical emergencies happen anywhere any time. How then will medical simulation labs be able to create a simulation scenario in the middle of a parking lot? A living room? On the street? Yet alone in the hospital and still maintain a real life experience for the student?

The obvious answer is: by using the right equipment. But what is the 'right' equipment? And, how do you know you are purchasing the right equipment for your lab?

GETTING STARTED

Before a consultation potential customers should have a list of questions ready for meeting with vendors. What is it that they want to accomplish? The answer is not as easy as saying "I want to video and play back a medical simulation scenario to assess a student's ability."



Why? It's important to remember that during a training scenario, the students have the free will to act and that those actions may not have been thought of during the design of the scenario. So you can't expect everyone to react the same way, or do the same things at the same time. For this reason, camera placement becomes an important aspect of the layout of the room. One important question to ask is: During the video what do you need to see to be able to evaluate the student's performance? We know how we would do it, but at the end of the day it is up to the customer.

TAGGING THE VIDEO AND LOGGING NOTES

Understanding that each student is different and as such each scenario played out will be different, brings us to: tagging the video and logging notes

The Simulator produces an on going log file showing information such as vitals, speech, student interaction, and so on. This log file is an important factor of the scenario as it will be used during the debriefing process. The log file is linked to the audio, video, and other data files. The instructor can also manually enter logs live or in post production during review. During playback you can click on the time stamped log file and it will instantly pull up all of the files that were recorded at that exact time. Off-the-shelf equipment simply cannot support these features.

THE VOICE

The value of a simulation scenario is in how life-like it can be made. The more life-like a scenario the easier it is for the student to "buy in" to the training. This means the AV equipment used to capture the training must be relatively invisible to the student. It also means the AV equipment must be more than an off-the-shelf home security package.

The educator needs to think about play acting and "voice". This can usually be accomplished with an in-depth conversation about this aspect of the project. The information received will determine what type of equipment is recommended.

HIRING THE RIGHT PEOPLE

Often times the person(s) responsible for the design and development of the medical simulation facility is well versed in medical teaching practices, but they are not informed in the technology used/needed to create the end result they require. More times than not they've fallen into the jaws of the off-the-shelf monster product that promises much, delivers little and costs a fortune.

Can off-the-shelf equipment work in a simulation lab? Yes, it can. Are there major short comings to using this equipment? Yes, there are!

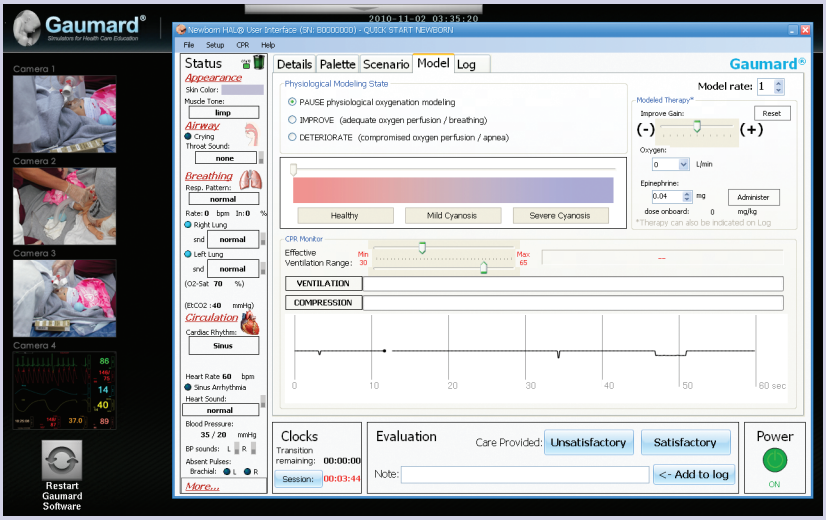
Take for instance a medical simulation lab I was recently called in to evaluate. They were not happy with the equipment they purchased and wanted to know what options were available. Unfortunately, they hired an AV company unfamiliar with the medical simulation industry—a fact they did not find out until training day. Yes, the system could record, play back and even archive their footage. But when it came to reviewing the log files and data streams from the simulator, they found out too late that it was not an option. Turn around time

for the video to be used in debriefing took precious time away from the class. The customer bought a system that did not meet their needs. They also realized that the system takes up a lot of space, and requires extra cooling in the control room and data closet.

This scenario repeats a thousand times. The person responsible for looking at the technology did not have a technology background, did not know the right questions to ask, and did not understand what the vendor was selling.

DESIGNING A LAB?

The architectural firm you partner with should have experience with medical projects. The vendor you purchase your recording and audio visual equipment from will need to be involved from day one. Network hook-ups, cabling, camera placement, and other equipment in some cases will need to go in before the walls are closed in.



Several local Pittsburgh companies teamed up to help educate the end user on designing their lab. It is a consortium of companies who know and understand the simulation market. From that effort, MySimLab.com was created to help the end user to design and build a medical simulation lab from the ground up.

ADVANCING THROUGH RESEARCH

Robotics Engineer Cliff Olmstead, a partner in Kb Port, and I designed the ETC (Event Triggered Camera System) recording technology that is used for several applications including medical simulation. We work closely with simulator manufacturers so that our equipment digitally integrates with their simulators to combine all of the data onto a single device.

We are constantly researching new technology, talking to our customers to get their view point on what they have and what they would like to see in the future. We understand the high stake decisions our customer needs to make to create the lab of their vision and they can be assured that we make every effort to bring about that vision. PE

Chuck Miller is a partner in Kb Port, LLC. Kb Port is a multimedia solutions provider, drawing upon nearly two decades of audio visual consulting and technical service experience within the medical, industrial, and educational industries. We provide clients with end-to-end technology and software for a multitude of recording applications.

Upcoming issues include:

ISSUE	FOCUS	CLOSING DATE	DELIVERING
Spring '11	*MARCELLUS SHALE*	*February 22, 2011*	*March 25, 2011*
Summer '11	*IBC '11 SPECIAL CONFERENCE ISSUE*	*May 13, 2011*	*June 3, 2011*
Fall '11	*PITTSBURGH'S WATERWAYS*	*August 26, 2011*	*September 23, 2011*
Winter '11	*DEVELOPMENT: THE ENGINEERING CHALLENGES*	*November 26, 2011*	*December 30, 2011*

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For additional advertising information contact: Douglas Smith by phone at 613-536-5540 or by Email: dougsmith2@cogeco.ca

The Engineers' Society of Western Pennsylvania presents our 127th ANNUAL AWARDS BANQUET

FEBRUARY 23, 2011

Engineers' Society of Western Pennsylvania

127th Annual Engineering Awards Banquet

Wednesday, February 23, 2011

5:30 PM Cash Bar; 6:30 PM Dinner

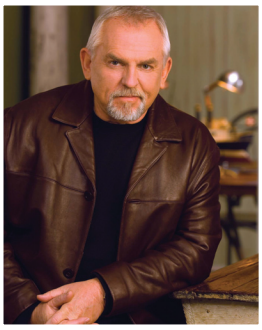
David L. Lawrence Convention Center (Ballroom), Pittsburgh, PA

The Engineers' Society of Western Pennsylvania (ESWP) Annual Banquet is the premier networking event for the technical community in this region. Our 127th banquet, scheduled for February 23, 2011 at Pittsburgh's David L. Lawrence Convention Center, is poised to uphold the highly valued networking, and advance ESWP's primary mission: engineering education. Highlights for this years's event include....

Chip Ganassi

Mr. Chip Ganassi is the recipient of ESWP's inaugural President's Engineering Excellence Award to recognize the significant contributions that engineers make to our world. Mr. Ganassi, owner of Ganassi Racing, just completed the first-ever achievement of the "Triple Crown" in auto racing, winning the Daytona 500, the Indy 500 and the Brickyard 400.

After building his reputation as a team owner for more than two decades, last year Chip Ganassi became an "overnight" sensation when his cars won America's three biggest races. "Chip Ganassi Day" was even declared in his hometown, Pittsburgh.



John Ratzenberger

John Ratzenberger will appear as Guest Speaker. John is the 6th most successful actor of all time as measured by total box office receipts. His ten years performing in over 28 films in Europe and his 15 year association with Pixar studios has yielded a total of more than $3 billion for projects featuring the well known actor.

John is noted as the only actor to have voiced a character in every Pixar movie since Toy Story. John is best known for playing mail carrier Cliff Clavin on the sitcom Cheers. Cheers won 28 Emmy Awards, ran for 11 years and is one of the most successful sitcoms in history.

John also founded Eco Pak Industries, a company that developed and manufactured packaging alternatives made from biodegradable and non-toxic recycled paper as a safe alternative to Styrofoam "peanuts" and plastic bubble wrap.

"Made in America", a show he produced and hosted for the Travel Channel, celebrates the work ethic that built America to be its strength. John also co-authored the book *We've Got it Made in America: A Common Man's Salute to an Uncommon Country.*

John Swanson

Dr. John Swanson, ANSYS Corporation, has been selected to receive the 2011 William Metcalf Award, presented by the Engineers' Society of Western Pennsylvania (ESWP). The Metcalf Award has been presented annually since 1963, and represents lifetime achievement in the engineering profession. Dr. Swanson is the founder of ANSYS, Inc. The company, headquartered in Canonsburg, Pa., designs, develops, markets, and globally supports engineering simulation solutions used to predict how product designs will behave in manufacturing and real-world environments.

Sponsorships! Again, this year we are offering 3 different sponsorship levels for you to choose from. Each level provides great value and unlimited opportunity –please refer to the Annual Banquet web site for details and rates. To provide maximum visibility, sponsorships are limited in number so you'll want to act fast.

For the latest updates on the ESWP Annual Banquet, please visit our web site at: http://www.eswp.com/eswp/annual_banquet.htm

Questions: Call 412-261-0710

Smart Room: Helping Caregivers on the Front Line of Patient Care

By David Sharbaugh and Michael Boroch

Many innovations that have made their way to the hospital bedside have unintentionally increased the burden and complexity of front-line health care. At UPMC, a "smart" patient room is shifting this paradigm by organizing and simplifying the workflow of front-line clinical staff.

> "Smart Room makes retrieving the right patient information at the right time as simple as walking into the room"

UPMC has teamed with IBM to create a health care technology solution different than most new technologies. This new system, called Smart RoomTM, makes retrieving the right patient information at the right time as simple as walking into the room. The results are more reliable care, higher patient satisfaction, improved efficiency, and lower costs.

Jointly funded by UPMC and IBM, Smart Room improves clinical workflow by providing in-context information for clinicians at the bedside, allowing caregivers to spend more time providing high quality care to their patients. Smart Room changes the norm by subtracting effort and waste in health care. This new technology is designed to eliminate between 50 and 70 percent of the unnecessary effort associated with documenting routine clinical care.

A recent statistically valid study shows registered nurses spend 35.5 percent of their time documenting their work. Smart Room allows them to spend more time with patients. In addition, Smart Room has taken on some of the more challenging patient safety problems, and is working to solve them through well-designed technology and workflow.

SECURE PATIENT INFORMATION IN REAL TIME

Using real-time location-tracking technology, Smart Room identifies health care staff as they enter a patient's room, and provides the relevant clinical information needed at the bedside. The system includes a detector in the room, as well as ultrasound tags worn by health care staff that emit inaudible signals received by the detector. When a caregiver walks into the room, the system identifies the person wearing the ultrasound tag and displays that person's name and professional role on a monitor for the patient to see. The wall-mounted monitor also is used as the patient's television and a place where the patient can access patient education specific to their disease state. They can

see their scheduled tests and watch a short video that explains what to expect before, during, and after clinical tests. They can receive e-mails from family and friends sent to a generic e-mail account with a special code that routes the e-mail to the patient's Smart Room screen. The patient portal also allows patients to play games, view photo albums of pictures sent by e-mail, and to request non-urgent tasks.

"The home screen of the caregiver system represents the patient at a glance, with key information, such as allergies and precautions that every caregiver needs to know to keep patients safe"

Smart Room gathers role-specific information about the patient from the patient's electronic medical record to be displayed on a second monitor for the caregiver. A physician will see different data than a nurse or housekeeper. A phlebotomist who needs to draw blood from the patient sees only current lab orders and allergy information. The home screen of the system represents the patient at a glance, with key information, such as allergies and precautions that every caregiver needs to know to keep patients safe. Real-time clinical information is a few touches away. From medications to vital signs and allergies, information is displayed for caregivers to know the patient's status immediately.

Smart Rooms allow care-team members to access relevant patient information quickly. Features are built into the Smart Room to protect patient confidentiality. For example, if someone enters the room who isn't authorized to view certain information, the staff member viewing that information can press a button to quickly hide the data. Smart Rooms also keep a record of each time a caregiver visits the room.

"Smart Room increases the efficiency of electronic medical records allowing quick documentation at the bedside, saving nurses time by eliminating extra steps"

DOCUMENTATION AT BEDSIDE

Through a simple, touch-screen interface, a nurse or other caregiver can document the completion of work in just a few seconds, rather than writing down that information and waiting to batch-document later. In contrast, more commonly used computers on wheels require a login and sorting through multiple screens to get to the right place, and pose the added risk of spreading unwanted microorganisms. With UPMC's solution, Smart Room has essentially closed the time and space gap for documentation, improving quality and efficiency. This feature is a very important part of the solution because it addresses a problem in health care that has been difficult to solve with existing systems. Smart Room increases the efficiency of electronic medical records allowing quick documentation at the bedside, saving nurses time by eliminating extra steps. Documentation is always quickly available to health care staff who need it.

EVALUATING AND GUIDING WORKFLOW

Some of the latest additions to Smart Room's functionality include an algorithm that evaluates all of a caregiver's tasks for each patient. It determines which are the most important to complete at any point in time. A workflow analytics module is in development to alert the unit manager when routine work is falling behind, including an objective analysis of workload and a simple view to help care team members support one another without a lot of meeting time and discussion. We are automating the evaluation of hand hygiene use and will use that compliance data to help drive hand hygiene rates and continue to reduce hospital-acquired infections. We also are working on several other patient-safety features that will be instrumental in driving the value of Smart Room for caregivers and patients alike.

REFINING TECHNOLOGY THROUGH SIMULATION

To further refine Smart Room technology, UPMC is using a former nursing unit that's been transformed into a design and simulation center. In this 10-bed space, a team of clinicians and IT specialists work out the step-by-step details and human-factor issues essential to successful implementation. The design team has found that having a physical nursing unit adds value in working out the details and getting a real-life feel for the product in use. We have used patient surrogates to simulate various aspects of the product to get the best understanding of fit in the environment. We also have used simulation to train caregivers to the Smart Room and to execute time and motion studies aimed at quantifying values for improvement of the Smart Room solution.

ADVANCING SOLUTIONS FOR EFFICIENCY AND SAFETY

After four years of development, Smart Room is a commercially viable product, ready for a broader rollout at UPMC and at other health care providers. As the recent health care reform debate has underscored, our industry is desperately in need of solutions to reduce costs, improve quality, and provide consistency and reliability. UPMC believes that with the Smart Room, it can help meet that challenge.

David Sharbaugh is president and founder of Smart Room and worked as a senior director of the Donald D. Wolff Jr. Center for Quality Improvement and Innovation at UPMC. Michael Boroch is CEO of Smart Room, International and Commercial Services Division, UPMC. They may be reached at sharbaugh@smartroomsolutions.com or boroch@smartroomsolutions.com.

Spotlight on ESWP Outreach Programs

By Christopher Savinda

This is one in a series of updates that highlights student outreach programs presented by the Engineers' Society of Western Pennsylvania (ESWP). This issue will focus on the Chain Reaction Contraption contest. Please look for future articles on other ESWP programs in the next issue of the Pittsburgh ENGINEER.

The number 10 was something special as the Chain Reaction Contraption Contest (CRCC) held its' 10th annual contest on December 10, 2010. The contest, powered by Westinghouse Electric Company, and presented in cooperation with the Carnegie Science Center and the Engineers' Society of Western Pennsylvania (ESWP), is one of the Science Center's National Engineers' Week® programs. This contest is for students in grades 9-12 and is intended to complement other National Engineers' Week® programs, such as the Future City Competition.

The goal of the CRCC is to foster an interest in engineering by challenging students to create a contraption that will accomplish a specific task using a series of steps. The task changes each year, and the fun comes from taking that common, simple task and making it complex and exciting. "I have been interested in going into a career in engineering" said one student from Hempfield Area High School. "This project reinforced that this is what I really want to do." This year's task was to make change for a dollar. The students must complete this task in 20 steps or more.

The contest has grown from less than 10 schools registered in the first year, to over 40 registered this year. Under the guidance of an optional engineer mentor and a teacher sponsor, the teams spend many hours from late September until contest day, in early December, to design, plan, build and troubleshoot their contraptions. Since only 1 team, of no more than 4 students, can represent each school on contest day, a variety of approaches are used to prepare for the event. Some teams have the entire class or science club work on the contraption and then choose the team to represent them, some break into groups and hold their own contest to decide who will go to the Science Center, and some have only the 4 student team from the beginning to the end. Jim Pottinger, of Gateway High School claims that "the contest brings together all aspects of learning and problem solving better than any classroom could ever offer! It brings together the best of Science, Technology, Engineering and Math, all wrapped up in a box"

Through this contest, the students get a chance to apply the physics principles they learn in class to a "hands-on" project helping to reinforce the concepts and providing a practical view of engineering. "This event gave me experience of putting physics into practice" said a student from Laurel High School. In addition to the obvious learning in the STEM (Science, Technology, Engineering, & Mathematics) education areas, the contest is set up to help drive project management and teamwork skill development among the students. Sherri Fochler, a teacher from North Allegheny Intermediate High School, is sold on Chain Reaction Contraption. "This is my ninth year taking my gifted 9th & 10th grade students to the contest. It is by far, my favorite competition of the year! It is my job as a gifted support teacher to challenge and enrich my student's curriculum. This contest is a winner!"

There are milestone dates in the completion of the project, including a conceptual design, and various progress reports, all leading up to the judging on contest day. Each team is judged twice during the morning on contest day; once for the special awards and once for the contraption operations. The special awards are sponsored by various companies in the Pittsburgh area and

a tour of that sponsor's facility is the prize. Among the eleven special awards handed out this year were People's Choice, Longest Successfully Executed Contraption and Best Design and Construction.

The official handbook, provided to each team at the beginning of the contest, identifies all the criteria on which the teams will be judged. For the operations judging, the judges evaluate the projects based on functionality, complexity, and creativity in achieving the task. Each team has three minutes to present themselves and their contraptions to the judges. Then they must operate their contraption, reset it, and operate it again before their turn is complete. Eight teams move on to the final round of judging and must present, operate, reset and operate their contraption again.

There are several elements of the contest designed to stimulate creativity from the students. Each team is expected to incorporate a theme into their contraptions, and many go an extra step. The winning team from last year presented their contraptions to the judges as cavemen, complete with cavemen costumes. Other elements include a requirement for a minimum of 20 steps, and a run time that must be between 30 seconds and two minutes. This year's winning team, Greater Latrobe Senior High School, tackled this time challenge with a transfer of water. Their contraption could be adjusted to change the run time based on how they inserted a tube into the lower reservoir. This team was also able to adjust the contraption to deliver one of 11 possible coin combinations during any given run, from 4 coins (all quarters) to 12 coins (1 quarter, 4 dimes and 7 nickles); a fact that impressed the judges during both rounds of the competition. The teams are also under a size constraint as their contraption must fit inside an imaginary 5' x 3' x 2' box. This limits the total potential energy (no plug in items are allowed and battery use is discouraged), so the students must decide on how to effectively 'power' their contraptions.

The teams are also under a strict budget for the contraption and can spend no more than $100. The purpose is to get them to look at the items around them and figure out how that item can be re-purposed to do something completely new. Using these types of items can provide unique challenges for the students, quickly showing Murphy's Law. Quipped one student from Somerset Area School District, "If it can fail, it will."

The students learn that engineering isn't just about sitting in a room all day and doing calculations. A Smethport Area High School student mentioned "I realized how much work goes into actually creating something before it really works." A student from Seneca Valley Intermediate High School put to words what all us engineers understand, "There was so much self-satisfaction when the machine would work correctly that it wiped away all the frustration from the steps that took so long to fix."

To learn more about the Chain Reaction Contraption Contest, please visit our website at www.chainreactioncontest.org. PE

GREAT FEATS FOR PITTSBURGH-AREA ENGINEERS WITHOUT BORDERS

Attendees Gather to Celebrate the EWB-USA Northeast Regional Workshop held in Pittsburgh in November 2010

Building upon many successful years of collaboration, the engineering students and professionals of the Pittsburgh area chapters of Engineers Without Borders USA (EWB-USA) had an action packed 2010 schedule with much more planned for 2011 and beyond. Volunteers from Pittsburgh continued to build on past efforts on two separate projects in the countries of Ecuador and Mali, and also found time to host a workshop for over 300 EWB Volunteers from the Northeastern United States for a weekend at the campuses of the University of Pittsburgh and Carnegie-Mellon University (CMU). The group shows no signs of slowing down as ambitious plans are ongoing for more success in 2011.

FISH FARM FOR MALI

University of Pittsburgh applied for and received a fish-farm construction project in 2007. The goal of this farm was to provide a significant source of protein and stimulate economy for the villagers of Makili, Mali. Since then, several teams have gone on multiple assessment trips focused toward the implementation of a design for the football field-sized fish farm to raise tilapia which was ultimately constructed in March 2010. Completion of the pond was successful, and villagers have been working hard since to develop the stock of fish. Prior to construction, a comprehensive community and health survey was completed. A second survey was done in August 2010, and volunteers from the village were trained to continuously perform the surveys to track public health patterns for the village. Data collected by the villagers over the next five years will help to assess the impact of the project.

March 2010: Construction of Fish Farm Designed by EWB-University of Pittsburgh in Makili, Mali

Although Makili now has a fish farm, the work is not done. Another element of the post-assessment trip in August 2010 was to aid in pond education for the villagers and examine the constructed pond now filled with water. The pond is entirely fed by rainwater and runoff, which means that sanitation monitoring projects will need to be carried out to optimize water quality. Technical drawings, volume calculations and pond analysis need to be carried out before the next site visit in May 2011. Many developmental projects fail due to inadequate follow-up, and EWB-PITT is working hard to ensure that will not be the case in Makili. If you'd like to donate, become involved, or simply learn more about our project, please contact EWB-PITT Student President Benjamin Zaczek at ewb.usa.pitt@gmail.com.

BRINGING WATER TO A MOUNTAINOUS COMMUNITY IN ECUADOR

The CMU chapter of Engineers Without Borders has been working closely in partnership with the Pittsburgh Professional and University of Pittsburgh chapters on the Tingo Pucará Development Project. Tingo Pucará is a small indigenous community in an impoverished region of the Ecuadorean Andes Mountains. Residents are subsistence farmers who travel over very steep land in order to get water from nearby springs, which are contaminated through contact with animals and waste. Consequently, waterborne illness is common and the mortality rate is 30% in children under five. The community has asked EWB to finalize a design to pump and treat water to their village from the bottom of their mountain, 1000 feet below. In September 2010, travel team members from all three chapters visited the community to gather final solar, wind, grid energy, soils and survey data required for a strong, sustainable water system design. They also met some important in-country contacts and came back with a renewed dedication to the community and the project. A preliminary design report was approved in November and the chapter is now preparing a final draft of their 90% design document, which they hope will be given early in 2011. With

funding from a local municipality in Ecuador and help from the non-profit group Builders Beyond Borders, the team hopes to break ground on the project in the spring. Please contact EWB-CMU Project Manager Melissa Day (mday@andrew.cmu.edu) if you are interested in learning more about the project.

September 2010: Members of all three Pittsburgh Area EWB Chapters with Villagers of Tingo Pucara, Ecuador

HOSTING THE 2010 EWB-USA NORTHEAST REGION FALL WORKSHOP

On November 5-7, 2010, the area chapters of EWB-Pittsburgh jointly hosted a workshop for EWB-USA volunteers from around the Northeastern United States at the University of Pittsburgh and Carnegie-Mellon University campuses. The event was attended by over 300 students and professionals and a wide range of presentations and speakers were invited to share both technical and non-technical knowledge of a variety of subjects related to providing sustainable engineering solutions to developing communities. In addition, several social events were planned as well as a networking fair for local companies and non-profit organizations to interact with the energetic EWB workshop attendees. Pittsburgh was well represented as the workshop highlighted many of the successes and lessons learned in the past year by the EWB-Pittsburgh area volunteers and several local volunteers made presentations and participated in panels. The event was well received and attendees provided a plethora of compliments for the speakers and sessions, the facilities and accommodations, and the wonderful organization of the event. Many thanks goes out to a very hard working and dedicated group of EWB-Pittsburgh volunteers who formed the core to the success of this workshop. PE

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