Transformative Design: From Consultant to Clinician

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Abstract

The paper will describe how digital information gathered in medical diagnostic practices has been utilized in an area traditionally reliant on manual medical sculpting techniques. Working in conjunction with iRSM (Institute for Reconstructive Sciences in Medicine), the authors have participated in the development of systems and processes that have resulted in: enhanced surgical planning, elimination of surgeries and improved accuracy of prosthetics. As iRSM is the only centre in Canada to provide these services, it has attracted many international medical facilities and practitioners to use these digital workflows in their own practice.

Industrial Designers were originally consulted by iRSM on a project-by-project basis, consistently demonstrating the value of design research strategies. This demonstration of value resulted in the demand for a full-time designer within iRSM's interdisciplinary team, opening new insights and opportunities within the clinical environment. The integration of design into this area of medicine resulted in the development of a new field of design interaction, education and research. The collection of numerous case studies over an eight-year period provided the background for the development of a graduate program of study dedicated to this new field. The result of this work has been presented exclusively within the medical arena both at conferences and workshops. This academic year, the first student to be enrolled in a Master of Science in Rehabilitation Medicine with a specialization in Surgical Design and Simulation came to fruition. The creation of this new field of study is a continuation of this relationship, as the first candidate has a degree in Industrial Design, but will gain the necessary skills to become a clinician and researcher within a clinical practice. This new "species" of designer is at the forefront of new opportunities for design education and research with a focus on patient-centered health care delivery.

Keywords

Health care; Industrial Design; Computer Aided Design; Reflective practices; Visualization; Rapid prototyping.

Like many interesting research projects, the collaboration between the ID (Industrial Design) Program at the University of Alberta and the medical unit iRSM (Institute for Reconstructive Sciences in Medicine, formerly known as COMPRU - Craniofacial Osseointegration and Maxillofacial Prosthetic Rehabilitation Unit) arose from a series of unplanned coincidences. This paper will discuss the involvement of Robert Lederer as consultant; Ben King as a full-time member of the interdisciplinary team and the transition of Heather Logan from design student to clinician. Based upon the authors experiences' and observations, there is an increasing opportunity within health care for designers to define new roles that will have a significant impact on patient care.

Beginnings

In early 2000, Robert Lederer was appointed the coordinator of the ID program at the University of Alberta and sought to introduce various rapid prototyping (RP) systems into the undergraduate program. During the time Robert was investigating different systems, Rosemary Seelaus, an Anaplastolgist with iRSM, was also researching the integration of various technologies into her profession. Anaplastology (Fig. 1) is defined by the IAA (International Anaplastology Association) as a branch of medicine dealing with the creation of prosthetics to rehabilitate an absent, disfigured, or malformed portion of the face or body, typically caused by cancer, trauma or a birth defect. Anaplastology techniques traditionally rely on labor-intensive hand sculpting, physical impressions and mold making with very limited use of computer software of digital planning. Rosemary and Robert were introduced by a sales representative from a 3D printing company, as he felt the common interest in prototyping applications may benefit both parties. After discussing a potential collaboration with Rosemary, it became apparent that the opportunity to inject new technology driven techniques into the field of Anaplastology seemed plausible, but further expertise in Computing Science and a source of funding were major hurdles.

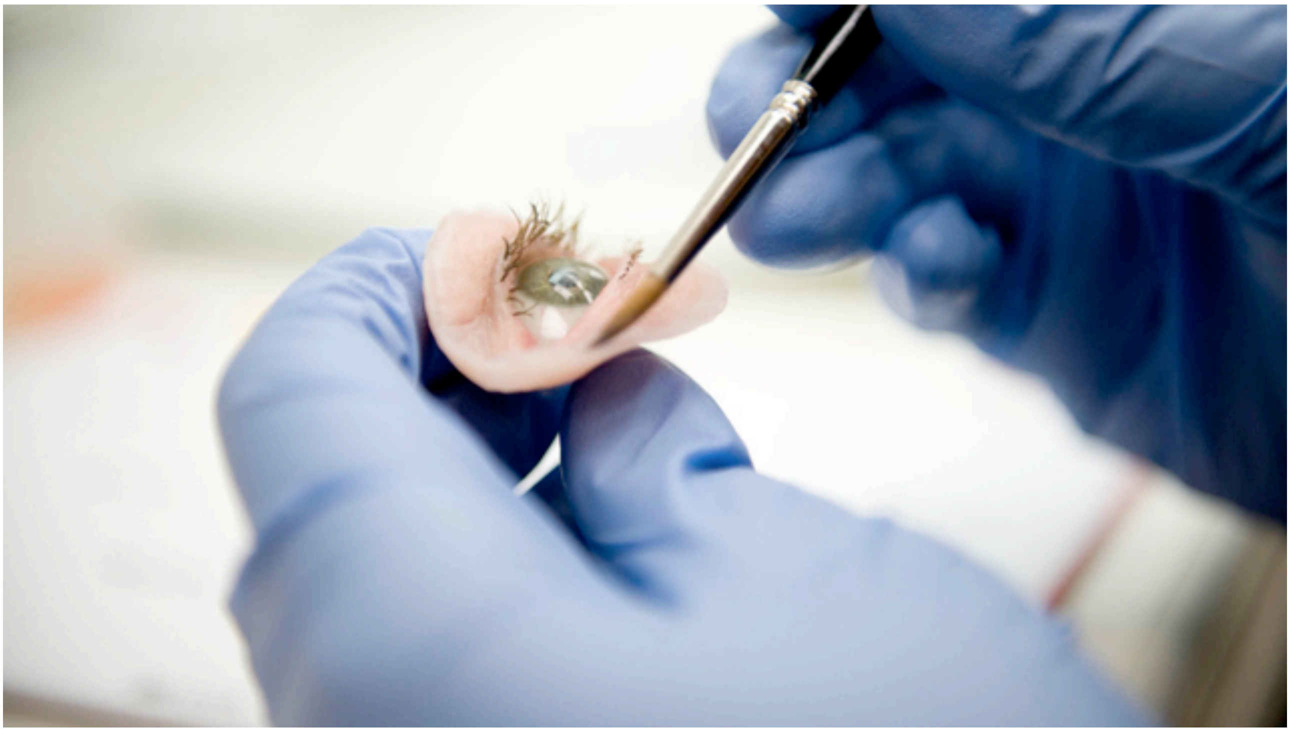

Fig. 1 Example of an Anaplastologist colouring a prosthetic eye

These hurdles quickly dissipated thanks to the involvement of Jonathan Schaeffer from Computing Sciences at the University of Alberta. Dr. Schaeffer received a large grant ($20 million MACI-Multimedia Advanced Computational Infrastructure) to develop digital data processing systems by linking PCs across Canada; it became apparent that a small part of the MACI grant was devoted to visualization. This potential funding source instigated research into various programs and input data from MRI (Magnetic Resonance Imaging), X-ray and CT (Computed Tomography) to comparatively assess the best means of acquisition, output and visualization for clinical applications. Once it became evident that CT could produce accurate and reliable scans that could be translated into 3D (three-dimensional) prints, an initial attempt at establishing a medical modeling process was formulated. As Bibb (2006) explains, medical modeling originates from the 1990s when it was realized that RP machines could potentially use a variety of 3D computer data, which included formats from medical scanners. Computer-Aided-Design (CAD) software served as the basis for medical modeling software, which can be used to translate and manipulate medical data and communicate with RP devices to print highly accurate medical 3D models (Fig. 2).

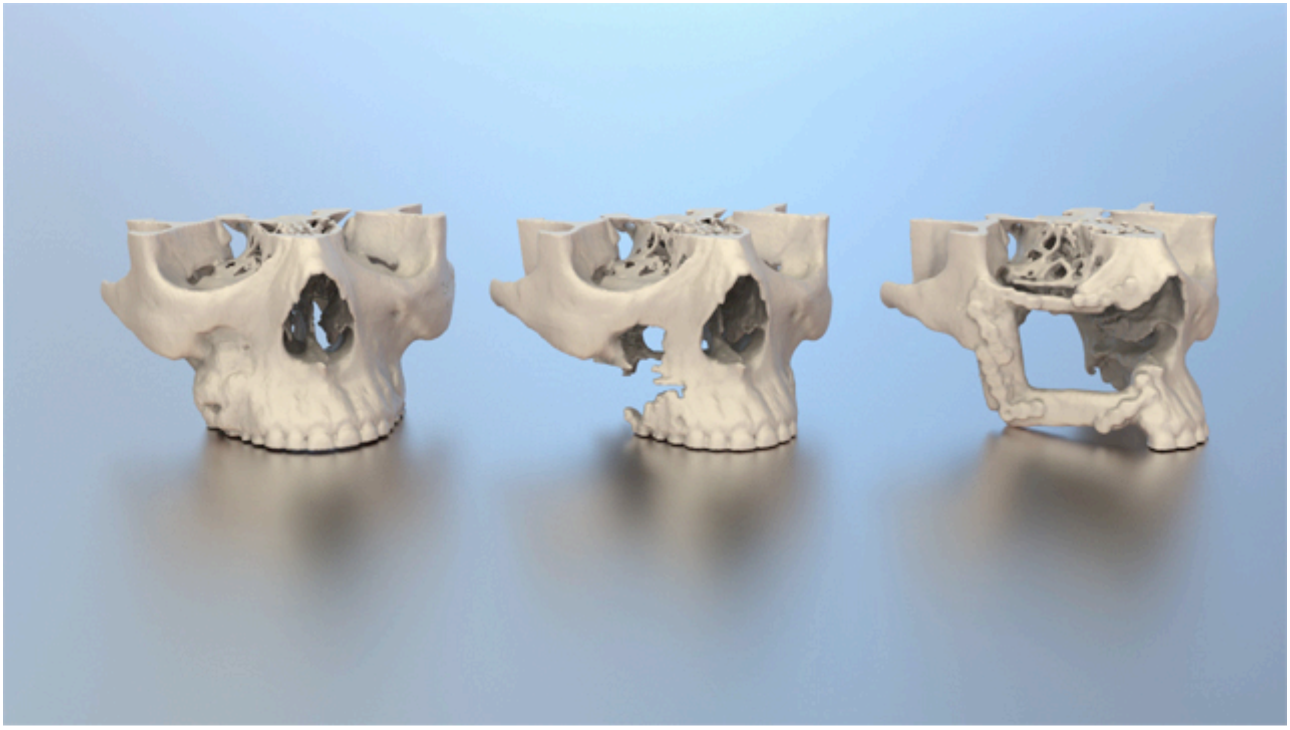

Fig. 2 Example of medical models used to identify, remove and reconstruct a maxillary cancerous tumor

The first 3D print generated was to be used as a surgical guide to reconstruct a patient's outer ear. The patient was born with microtia, which Medline defines as a congenital condition that causes an underdeveloped outer ear. The patient was going to have autogenous ear reconstruction, which is defined as the procedure of sculpting a new ear from the patient's own rib cartilage. Using a 3D laser scanner, the patient's fully formed left ear was scanned and a digital mirror image was produced to act as a template for the microtia affected right side. A 3D print was produced from this replicated ear as a guide for the surgeon in planning the shaping of rib cartilage as well as epidermis trimming and stitching. This visualization of digital information fit within the parameters of the MACI grant and funding was allocated to enable the purchase of a 3D printer.

The luxury of having a 3D printer and the freedom to experiment with limited parameters provided Rosemary and Robert the chance to explore numerous medical procedures. The first major project came after 6 months of exploring various medical modeling software and 3D printer applications and unraveling the true depth of change digital technologies could inject into the medical field. This first significant project dealt with a patient that had recently had a brain tumor removed; in order to access the tumor, a portion of the patient's skull had to be temporarily removed. Unfortunately, this section of skull incurred postoperative infection, resulting in permanent removal. The patient had undergone two previous operations to remove infected regions of bone and now required a prosthetic implant to cover the missing portion of skull to protect the brain. The medical procedure that was in place at the time required two operations; the first operation involved peeling the skin away from the affected area which exposed the skull. The use of a non-sterile molding material similar to putty was pressed into the cavity to form an impression of the defect. The incision was then stitched and the patient was provided with a protective helmet to wear while the impression was sent to a lab to be converted into a custom prosthesis for implantation during the next surgery. The second surgery, which normally occurs 2 weeks after the first, began the same way as the first surgery: by peeling back the patient's skin to access the cavity. The surgeon cut and cleaned the areas of both the patient's skull and the prosthesis to ensure a proper fit. The surgeon then had to decide where to place titanium attachment screws for securing the prosthesis to the skull while relying on the two-dimensional imagery provided by X-ray and CT scans to analyze the quality and thickness of bone. Unbelievably, all this work and decision making was being done while the patient was in surgery.

The challenge presented by Dr. John Wolfaardt (one of the co-founders of iRSM) was to find a means of improving this procedure using a digital workflow. Part of the earlier experimentation involved working with tolerances and accuracy related to processing digital medical information and 3D printing outcomes. With the knowledge accumulated from various experiments, there was confidence that the surgeon could be provided with a 3D print of the defect area. This model would presumably allow the surgeon to pre-operatively examine the bone structure around the defect and pre-plan where he would trim bone to allow a better fitting prosthesis. With input from the surgeon, alterations were made to ensure the prosthesis fit the defect area based on proposed surgical changes; the model also allowed the surgeon to examine areas for attachment and select the best sites. The 3D model and prosthesis were sterilized and brought into the surgical field for referencing and installation. To the relief of everyone involved, the procedure went incredibly smooth and the surgeon was able to install the prosthesis during one operation in significantly less time than it typically took for the traditional two-operation process. More importantly, the entire first invasive operation where impressions were made was eliminated. This resulted in less chance of infection for the patient as well as less operating time for the surgeon. The result was clearly an improvement in the quality of patient care and procedural outcomes as well as a reduction in operating time and costs. These models continued to be provided as visual aids for the next twelve months, while the 3D techniques continued to be refined. This case demonstrated incredible potential, which resulted in other researchers investigating the use of 3D modeling in surgical planning in areas such as: Maxillofacial Surgery, ENT (Ear, Nose and Throat) Surgery, Plastic Surgery, Prosthodontics, Pediatric Cardiology, Pediatric Surgery, Neurosurgery and Orthopedic Surgery.

Due to these successes, iRSM received a grant of $1 million dollars in 2005 from Western Economic Diversification Canada, which was supplemented by Caritas Health to setup the first Medical Modeling Research Laboratory (MMRL) in Canada at the Misericordia Hospital in Edmonton. It was outfitted with surface laser and probe scanning, a variety of CAD software, haptic stations (Fig. 3), Stereolithography prototyping, 3D Multi-jet Modelers in Acrylic and Wax, as well as CNC (Computer Numerically Controlled) milling. Previous to the setup of this lab, work was split between the prosthesis lab in iRSM and the ID studio; now everything was in one location. This consolidation also facilitated the ability to have graduate students work, learn and develop their thesis projects. Similarly, this enabled undergraduate students to take practicum courses to assist on various tasks and projects. This has led to a variety of results from tactile models for teaching plastic surgeons rhinoplasty surgery (Zabaneh, 2009), to developing and evaluating new digital workflows for a variety of medical processes such as mandibular reconstruction (Dziegielewski, 2010). The facility has also enabled a variety of medical product based projects such as concept designs for bone anchored hearing aids and otoscopes. Like the playful experimentation in the early stages of this collaboration, ID students at the University of Alberta will continue evolving and discovering while facilitating this beneficial relationship between medicine and design.

Fig. 3 Example of the use of a SensAble haptic device and Freeform software to virtually sculpt a cranioplasty implant

Infiltration

Ben King was one of the first students to take a semester long practicum in the MMRL, and was a willing guinea pig in deciphering potential future collaborations between ID and iRSM. His first visit to the MMRL was swiftly met with panic, as the clinician that was meant to introduce the practicum project had double-booked their first meeting with a patient consultation. Needless to say, the patient consultation was prioritized in this scheduling showdown and Ben was left alone in this newly assemble million dollar laboratory surrounded by shiny, futuristic devices. The clinician made the assurance that there “were instructions around somewhere” and that designers were perfectly capable of “figuring these kinds of things out”. Instead of disintegrating into panic and frustration, this situation quickly revealed itself as a tremendous opportunity. Not many students are fortunate enough to stumble upon the design equivalent of Willy Wonka’s Chocolate Factory.

The practicum project that was presented involved finding a way to measure facial volume changes in a patient pre/post surgery to aid in assessing facial reconstruction outcomes. Being able to reference quantifiable numbers instead of clinical assumptions and arbitrary opinions eliminates egos from this evaluation stage of patient treatment. This information would also improve outcomes of future surgeries by providing tangible reference material, as opposed to simply referencing anecdotal evidence from someone’s surgical experience. Other than using a 3D scanner and a digital workflow, there was no structured handout or rules to follow. The clinical staff had all but abandoned this project and seemed amused that a student would be willing to spend the required time to repeat their missteps.

Like many challenges, this was a problem of process. Industrial designers are generally well-versed in the development of process and its application across multiple platforms. Once the medical jargon was deciphered, the project became a simple case of data acquisition, manipulation and output. Using available software and open-source programs, a set of work instructions were created that outlined a simple clinical workflow that would eventually be used in several clinical evaluative studies. These studies included titles such as “A Comparison Study: ‘Proposed Digital Position’ of Auricular Implant Retained Prostheses Using Computer Aided Design Versus the ‘Final Position’ of Fitted Prostheses” and “Free Tissue Transfer Flap Reconstruction of Parotidectomy Defects; A Paired Outcomes Analysis Using Three Dimensional Laser Surface Scans”. These studies were presented at the 2008 Advanced Digital Technology Conference in Head and Neck Reconstruction in Cardiff, Wales; although the wording is complicated, the ability to perform these studies evolved from the willingness to ask seemingly simple questions. That is where designers hold a competitive advantage over many professions, both artistic and pragmatic: designers are often required to step outside of comfort zones to ensure a fundamental understanding of users, projects or processes.

By asking simple questions and providing not so simple results, iRSM was impressed enough with the potential of integrating designers into a clinical environment to offer a one year full-time Industrial Design position. During the interview process, Mr. King asked what the expectations were of the position, and was promptly told, “You tell us”. Not very many clinical facilities have the fortitude to take risks and place such a large amount of trust into a young professional with no formal training in the medical field, but proof of concept resonates through all fields. A one year contract is a relatively small risk, but the reward of new collaborations can perpetuate for many years. In recognizing that creative professionals can blossom under less defined structures, iRSM has benefited from the eclectic array of designer skills. Industrial design has played a vital role in iRSM projects ranging from product development, branding and marketing, visualization, surgical planning, medical model production and surgical workshop development.

iRSM intentionally provided minimal training, and instead emphasized exploration. This puts the pressure on the designer but also allows for flexibility not typically found in the structured positions occupied by medical professionals. In fostering new ideas and skill sets, it became apparent that “we all have a creative side, and it can flourish if you spawn a culture to encourage it, one that embraces risks and wild ideas and tolerates the occasional failure” (Kelley, 2001, p.13). In addition to this creative freedom, the emphasis on interdisciplinary teamwork facilitated jargon related stumbling blocks. Individuals such as Andrew Grosvenor, a Maxillofacial Prosthetisist, acted as an invaluable resource in breaking down clinical jargon and explaining medical concepts and procedures. As Andrew recalls, once Ben understood the principles of medical modeling “he promptly tore up the instructions” and began writing new information so that it would be both usable and easier to learn. Medical modeling software is derived from Computer-Aided-Design, and like CAD software, desired results can be achieved from many combinations of steps and toolsets. A workflow was designed that would introduce new users to a variety of functions, and encourage non-linear thinking when using the software. This was intended to persuade the users to work around problems, as opposed to quitting when the established method did not work. The instructions were written in plain language to encourage researchers from a variety of backgrounds to learn how to use the software and hardware. Technology can be daunting, and if it is presented as exclusive and impossible to learn, an unnecessary hurdle has already been put in place. These instructions were used internally and later as the basis for a series of ongoing training seminars (Fig. 4) for both established clinicians and medical residents.

Fig. 4 Example of a web advertisement for one of a series of 3D modeling workshops

The dichotomy that occurs in these two groups is that medical residents express their lament that digital technologies were not introduced earlier in their education, and the established clinicians insist that although useful and interesting, technologies are too complicated to incorporate into everyday workflows. The simple deduction that can be derived from these two groups is that technologies that have proven to benefit patient care should be introduced much earlier in the education process for medical practitioners. Any new skill requires time and dedication; two ingredients that are particularly challenging when an individual has a full clinical workload. This leads clinicians to either plateau at an early stage of their career, or become reliant on information and training from workshops and conferences. This can work if an individual’s peer network is strong enough in technology research, development and communication, but clinicians are generally focused on addressing the sheer number of patient cases and not necessarily the process of their treatment. An unfortunate scenario involves clinical professionals attending conferences and being swayed by new technologies without realizing the associated costs and learning curve, all with the risk of the technology not addressing their needs. Simply put: medical professionals need a guiding hand with a deep-rooted understanding of technology that can interpret their needs.

Unfortunately, medicine is often guilty of projecting complication and red tape, which does not necessarily entice other professionals. Industries such as film and video games set the bar both creatively and technically for technological applications, and much can be learned or adopted by medical facilities. As Robert Lederer demonstrated in his early exploration, by researching RP for medical applications, surgeries have been eliminated, dollars have been saved, and patients receive safer treatments. The struggle is in promoting change and teaching medical professionals that it is both acceptable and encouraged to learn from professionals outside of their expertise, even though they may be from the ‘creative’ world.

Although the initial Industrial Design position held by Ben King with iRSM was upgraded from a one-year contract to full-time permanent (a first for an Industrial Designer in our Health Region), there will continue to be areas that are near impenetrable for designers. It seems that combining the inquisitive nature and technological savvy of designers with medical knowledge and clinical skills may result in a hybrid that will truly address the needs of patients. Dr. John Wolfaardt also recognized this potential value of design within a clinical environment and in conjunction with the faculties of Rehabilitation Medicine and Industrial Design at the University of Alberta initiated a new field of study to address these needs in 2009. Dr. Wolfaardt sees in designers what Pink (2005) details as the ability to empathize to ensure the patient is at the focus of care. Medicine has largely been “standardized – reduced to a set of repeatable formulas for diagnosing and treating various ailments” (Pink, 2005, p. 168). As Pink further details, this is reminiscent of a computer, but computers are essentially emotionally autistic. This has triggered changes at places such as the Yale School of Medicine, where medical students “are honing their powers of observation at the Yale Center for British Art, because students who study painting excel at noticing subtle details about a patient’s condition” (Pink, 2005, p.52). There is value in established rules and processes, but equally important is the recognition that human emotions play an integral part in the health care environment; patient-centered design and delivery of care will be instrumental considerations for the next (and current) generation of clinicians. An Industrial Designer can infiltrate quite far in the medical realm, but a clinician with the skills and empathy of a designer presents a tremendous amount of possibilities for new conversations, research and change.

Transformation

As an ID undergraduate student at the University of Alberta completing the last year of her program, Heather Logan was interested in gaining experience in the medical field. Heather has always had a strong interest in finding educational and professional opportunities that involved helping people. After speaking with several professors and peers about her interests, Heather was directed to contact Ben King at iRSM. A four-month practicum and design project ensued, with the task of redesigning a Bone Anchored Hearing Aid (an implantable hearing device). During this practicum valuable experience was gained in the clinical world while interacting with professionals of various backgrounds and learning about and interviewing patients with various conditions. Heather was also able to gain knowledge and insight into a new application of digital design and rapid prototyping. The experience inspired her to pursue a career in a clinical environment, which fortunately coincided with the opportunity to apply for a Masters of Science in Rehabilitation Medicine with a specialization in Surgical Design and Simulation. The program began in September, 2009 and Heather affectionately became known as the “new species”.

Program

The Masters of Science in Rehabilitation Medicine with a specialization in Surgical Design and Simulation program is designed to teach the necessary skills to become a clinician and a researcher within a clinical practice. It is composed of three main areas of learning: course work, clinical training and independent research. The course work is completed at the University of Alberta and includes advanced digital technology training, anatomy and physiology of the head and neck, issues in rehabilitation science and conducting rehabilitation research. The second area of learning is clinical teaching and training at iRSM. This section includes learning from a team of interdisciplinary health care professionals with a focus on surgical prosthetic care, research and advanced digital technologies. It is composed of clinical training, laboratory exercises and seminars. The final component involves independent research and completion of a thesis. Heather will be conducting research that will focus on advanced digital technology, and the value the technology brings to surgeons, their process and patient outcomes. There is a substantial array of research (Eggbeer, 2005) that discusses and describes advanced digital technology, including its accuracy and applications, but there is limited hard evidence that scientifically evaluates the surgical or patient specific outcomes. This type of evidence is what is needed to convince more medical professionals and health authorities of the benefits of incorporating new technologies. Unfortunately, most facilities do not have direct access to facilities such as iRSM, but with hard empirical evidence, this could change quite drastically.

Challenges

Although this new field of study was thoroughly planned, challenges developed in the early stages; it was obviously a shocking transition from an ID workshop to a clinical environment. Clinical environments are fast paced, continuously busy and people within that environment have strict methods to which they adhere to ensure team members can work in a smooth flow for optimal patient care. Injecting a student that requires frequent explanations slows down the intricacies of the activities going on in the clinical setting. It can be challenging for a student to feel comfortable asking questions and feel relaxed in a patient care environment. An expected, although none the less monumental challenge, has been absorbing and retaining medical terminology and vocabulary. Often designers have very little background in medicine and learning medical terminology, anatomy and physiology can be a tremendous learning curve. The course work that was initially planned to cover this material was joining a head and neck anatomy and physiology class with speech and language pathology students. Although this course presented important material that was of great value, there were areas of relevance that were not covered in the course. In order to acquire pertinent information, added readings, questions and an oral exam have been used as a supplement. The anatomy and physiology course work is essential to understanding and communicating with medical professionals and clinicians; an in-depth knowledge of these areas is critical for understanding and exchanging information.

Transferring from an art and design world, which is often qualitative and descriptive, to a scientific world that is more quantitative and evidence based presents a unique challenge for designers. Rehabilitation medicine and science has a strong relationship with empirical based research and methods; there are many strict methodologies that scientific research follows in comparison to design research. Scientific research focuses on experimental design, testing hypotheses and quantitative research; design research involves elements of scientific research, but it has a much greater focus on the user, user observation, user experiences, thoughts and relationships. Rehabilitation medicine has only recently begun to focus on quality of life and user experience. As troubling as it is, “current healthcare tends to be organized for the convenience of the organization and the clinical staff and most solutions are geared to the needs of these two stake holders” (Macdonald, 2007, p.27). The challenge as a designer is to explore new ways to implement design research skills and processes. Macdonald (2007) further discusses that clinical professionals often struggle to understand the role of design in health care, but eventually come to acknowledge the boundary-less approach of design as yielding incredible clarity to medical environments. As a designer, the understanding of human activity and human experience is an important focus, and can bring strong contributions to the clinical field. It is critical to bring new skills to a team and to add a new dynamic and perspective to clinical care. Advanced digital technologies have brought positive benefits to the design process and the design field. Exploring the benefits and applications of these technologies in surgical design and simulation as well as in patient experience and patient care is an intriguing area for future exploration. Rehabilitation Sciences is evolving and a fresh perspective adds a unique dynamic to established methods related to clinical care.

This journey as a designer transitioning into the medical world has brought positive and exciting experiences as well. There is a strong interest from medical professionals wanting to know more about the design world and what designers have to offer to the medical world, which has already stimulated greater understanding, learning and collaboration. There has been exposure to innovative and exciting ways in which the medical world has applied advanced digital technology and made great contributions to medical procedures and patient outcomes. Areas that Ben King mentioned in the previous section, such as head and neck cancer patients, craniofacial, orthopedics and cardiovascular surgery as well as preoperative and operative planning are greatly assisted using surgical design and simulation. Simultaneously, there is a lingering need for a greater universal understanding and awareness of technologies across all areas in the medical field. It has become evident that technology is a necessary and useful tool and in order to discover new areas and applications we must have a deeper and stronger evidence based understanding of its potential.

Conclusion

The roles of designers and the level of understanding regarding design from professionals outside of the field strengthens through collaborative efforts; the authors have experienced the benefits of such endeavors and the mutual value that medicine and design can enjoy. The current developments, advancements and growing collaborative potential between industrial designers and medical professionals at iRSM reflects a widening window of opportunity for aspiring designers interested in the medical realm. Whether industrial designers utilize their skills as consultants, members of staff, or clinicians, a beneficial relationship between medicine and design has created new opportunities of knowledge growth, research and collaboration within the two fields. As medicine continues to shift to technology driven workflows, there will be increased demand in a variety of areas such as user-centered approaches, interaction design and user interface design. New collaborations may arise from coincidence, but the hope of the authors is that medicine and design will work together based on a growing resume of results driven by patient outcomes.

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Author Biographies

Robert Lederer

Has practiced as an Industrial Designer both as a staff designer and a freelance consultant in Australia and in Canada. He joined the University of Alberta as a sessional instructor in 1986 and as Assistant Professor and Program Coordinator in 1999. He is currently Associate Professor of Industrial Design. His research at present consists of a collaborative venture with the Steadward Center at the U of A developing exercise equipment for spinal cord injured persons, and more recently along with researchers at IRSM (Institute for Reconstructive Sciences in Medicine, Misericordia Hospital), examining “seamless technological interface” in patient treatment systems utilizing rapid–prototyping 3D imagery and other digital formats. A long term collaboration project with the Faculty of Rehabilitation Medicine in the development of student projects in the utilization of Universal design methodology and principles for the design of products for an aging population received a commendation by the American Society on Aging for Exemplary Program in Industrial Design (2002). Robert teaches classes in design principles, advanced industrial design practice and human factors.

Ben King

Is an Industrial Designer with iRSM (Institute for Reconstructive Sciences in Medicine, Misericordia Hospital) and a Master of Design candidate at the University of Alberta. He has extensive experience with Computer Aided Design and Rapid Prototyping for surgical planning as well as product visualization and development. Ben incorporates user-centered and participatory design strategies to achieve innovative approaches within interdisciplinary projects, which have included products and services for rehabilitation medicine, otolaryngology-head and neck surgery, audiology and pediatric medicine. Ben has experience designing and teaching courses on 3D modeling, and is dedicated to improving patient health care experiences and enhancing the abilities of health professionals while promoting the value of design within health care environments.

Heather Logan

Is a graduate from the University of Alberta Industrial Design Program in Edmonton, where she specialized in psychology and sociology. Heather is currently pursuing graduate studies at the University of Alberta and will be completing a Master of Science in Rehabilitation Science specializing in Surgical Design and Simulation. Heather will be conducting research that will focus on advanced digital technology, and the value the technology brings to surgeons, their process and patient outcomes. She has a strong passion to work with people and believes that the understanding of human activity and human experience is essential to design. Her seven years of experience working with people with disabilities and growing up in a family with a physically and mentally impaired brother has given her the knowledge and motivation to work as a successful and innovative cross-disciplinary designer. Her passion to work with people, learn from people and interact with people, joined with her knowledge and skills from her education gives her the greatest inspiration to design.