Center for Health Organization Transformation (CHOT)

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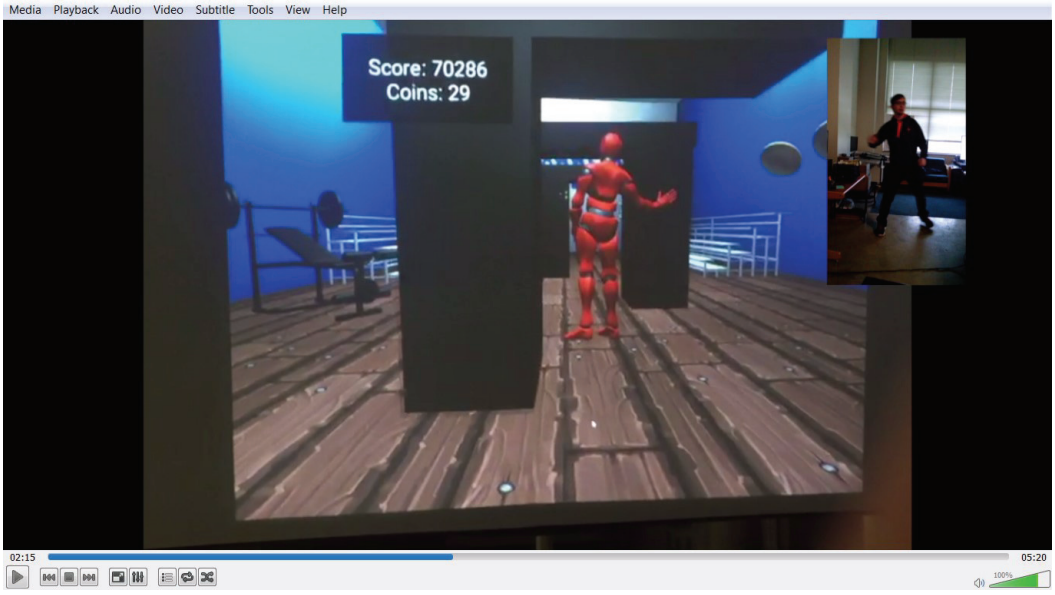
Achieving Enhanced Patient Wellness Outcomes through Gamification

The term "gamification" is an emerging paradigm that aims to employ game mechanics and game thinking to alter behavior and improve desirable outcomes by promoting better patient compliance. The objective of innovative project was to investigate the fundamental aspects of gaming (both traditional hardcore gaming and casual mobile gaming) that make them engaging, rewarding and stimulating and to apply those to immersive, and fun, healthcare wellness management solutions that can be adopted by patients.



An individual performing physical activities by following the challenges presented in the virtual gamified environment.

The current physician-patient relationship is most often top-down in nature; a physician provides a patient with a specific set of instructions with which they are supposed to comply. The patient is then to go home to manage their care until the next provider/hospital visit. In the context of healthcare, gamification aims to transform the patient-physician relationship into a more collaborative experience, where patients become

more motivated to succeed in their care and wellness management goals because of appealing features designed to keep them engaged.

This work addresses the question of whether patients exposed to "wellness gamification" have better health outcomes, compared to patients that are not. The scientific contributions of this work have the potential to transform the manner in which patients are motivated to adhere to medication regimens, physical guidelines, and other wellness initiatives by incorporating the features of games that make them engaging, motivating and social in nature.

It is relatively well established that individuals who are prone to use similar self-improvement platforms are already committed to the success of their wellness management. This complicates work in this area. The main limitations of existing self and wellness care techniques are that too many patients do not engage with such systems for a prolonged period of time.

This research has resulted in the creation of: 1) a theoretical framework that outlines the factors needed for a successful gamification wellness solution; 2) a gaming system platform that explores the practicality of the proposed theoretical framework in influencing patient behavior, towards better wellness outcomes, and; 3) new knowledge about the extent to which patients attain better wellness outcomes when exposed to a gamification-based wellness management system.

In addition to patients, the concept of gamification has the potential to transform healthcare officials by creating incentive structures that encourage them to be more efficient, productive and engaged in the overall process of patient-centered care.

> **Economic impact**: Unlike the current healthcare paradigm, a more gamified healthcare system has the potential to enable patients to transform from passive consumers of health-related content, to proactive agents who are motivated to play a conscious role in their overall wellness. This breakthrough gamification work has the potential to transform medication adherence and compliance from a task into an activity in which patients are more motivated to partake.

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Perioperative Surgical Home (PSH) Study

This work of researchers at Texas A & M's Center for Healthcare Organization Transformation (CHOT) is a first-of-its-kind, large-scale national survey and systematic literature review focusing exclusively on perioperative safety and quality. The resulting Perioperative Surgical Home (PSH) Model is a physician-led care delivery model that includes multi-specialty care teams and cost-efficient use of resources. Simply put, PHS is a patient-centered continuity of care delivery model that incorporates shared decision-making. The two-year study focused on how the PSH reduces surgical care costs while improving clinical outcomes. It included: 1) a systematic literature review of PSH activities focused on clinical outcomes and cost savings; 2) an in-depth survey of 15 leading PSH programs in the U.S. designed to identify and better understand key PSH activities, and; 3) a gap analysis of residency training requirements for anesthesiology, internal medicine, surgery, and family medicine. The work has demonstrated that the model is capable of serving as a guide for future curriculum development.

Researcher and trial participant. Credit: National Center for Complementary and Integrative Health, National Institutes of Health

Results have demonstrated that successful evolution of the PSH requires the concomitant expansion of the perioperative clinicians' roles suggested by the PSH Model. Results have provided support for the CHOT sponsor ASA's framework and approach to alternative payment models by identifying the economic benefits of the PSH. They also suggest that anesthesiologists, hospitalists, surgeons, and nurses need to be actively involved in organization-wide strategy development and initiatives to improve care quality and reduce cost.

Subsequent follow-up studies by CHOT have identified gaps in medical education related to competencies for successful PSH development, helping to initiate conversations within ASA and with the American Board of Anesthesiology regarding medical education.

This breakthrough study has the potential for policy-relevant cost savings for policymakers, payers, administrators, clinicians, and patients across the perioperative continuum of care. This is due to the demonstrable substantial improvement its use provides in both safety and quality outcomes. This study also identifies specific areas of improvement for residency training programs that are necessary to address key PSH activities.

> **Economic impact**: Surgical care is too often not standardized or coordinated. This can result in duplicated and/or unnecessary care that costs an estimated $18 billion annually in the United States. Many Western countries have developed preoperative testing and assessment guidelines to improve surgical outcomes and the reduce costs of surgical care.

Based on results of this study, the PSH has potential for dramatic cost savings due to: 1) Better coordinated preoperative testing, potentially resulting in patient cost savings; 2) Improved rehabilitation programs; Improved preoperative patient education; 3) More effective operating room (OR) scheduling initiatives that have demonstrated 22.5% decreases in OR turnaround time; 4) More effective blood use programs that have the potential to save over $100 per patient after implementation of group-and-save policies; 5) Improved nausea and vomiting protocols with 16% more patients achieving response standards with standardized protocol; 6) Improved early mobilization programs that demonstrated $756/patient cost savings due to 1.8 day reductions in overall length of stay; 7) Better coordinated discharge planning initiatives that demonstrate $412/patient reductions in total costs), and; 8) Overall, surgical cost savings estimated to be estimated to be $112 per surgical patient when using evidence-based pre-operative test ordering practice guidelines.

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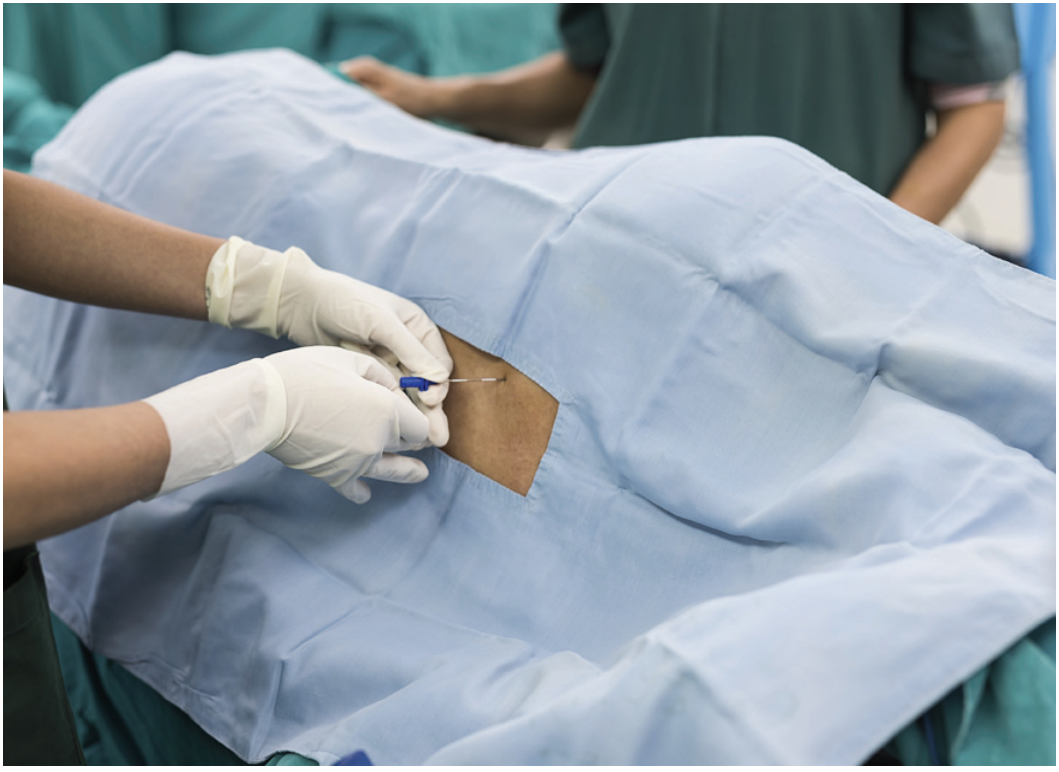
Outcome-Driven Treatment Delivery & Personalized Medicine

CHOT researchers focused on an evidence-based approach to treatment delivery. Two teams of investigators were involved: 1) a personalized treatment design team for diabetic patients, and; 2) an optimizing epidural analgesia procedures team.

The potential consequences of failed or misplaced epidural needles are well known to obstetric anesthesiologists. Inadvertent intravenous injection of local anesthetic into a vein in the epidural space can lead to seizures or fatal cardiac arrhythmias. Equally worrisome are inadequate epidural blocks leading to complications during caesarian sections.



Applying an epidural to a patient.

This study sought to establish and quantify the safety and efficacy of a large-dose needle-based epidural technique in obstetric anesthesia. Through systems modeling and predictive analytics, a safe and quickly effective epidural dose is established that can then be administered through the epidural needle prior to the insertion of the epidural catheter.

The results indicate that a needle-based approach is 22% faster and more dose-effective (18% less drug) in achieving comparable sensory levels than the traditional catheter-based approach. The findings also suggest that injecting large doses (up to 20mL) in the epidural space through the epidural needle is generally safe and results in good outcome for the patients.

The end product of this work is a decision support system that can identify patients-at-risk of complications. It also highlights the best practice clinical practice guideline (CPG) that allows for standardized, safer, and more cost-effective epidural delivery with minimum complications.

The cumulative costs of approximately four million annual births are well over $50 billion. This research demonstrates that it may be possible the use fewer drugs to achieve desired sensory responses with minimal hypotension. Reducing hypotension may also lead to safer process and possibly better long term outcomes. Providing quality of care with minimal complication is of paramount importance. Effective training of our new physicians (anesthesiologists) means more treatment success and improved efficiency. Given that physician time is expensive, this work thus reduces wastes in physician time and maximizes their productivity.

The management of gestational diabetes mellitus (GDM) requires close monitoring of patients' blood glucose levels while clinicians experiment with dosing based on a combination of clinical guidelines and their experience and judgment. However, conflicting guidelines and wide variation in practices can result in less that optimal care.

A challenge in diabetes management comes from the fact that different patients have different dose-responses and different disease progression characteristics. Hence, a personalized treatment plan tailored specifically to the patient's unique dose-effect characteristics may be more effective and efficient than current trial-and-error approaches.

In this project, CHOT researchers designed a novel outcome-based decision support tool that couples a predictive treatment-effect model with a planning optimization model. Specifically, a predictive model first uncovers treatment effects based on pharmacokinetic and pharmacodynamics (PK/PD) analysis of anti-diabetic drug dosages. Blood glucose levels are then recorded (self-monitored blood glucose) during the titration period of each patient. This information is then incorporated within a personalized planning model for optimal treatment. The decision support tool makes possible continuous learning for each patient as new treatment outcomes are recorded.

Tested on a group of 200 patients, using the first 2-3 weeks of treatment to establish the predictive drug effect, results indicate that the optimized treatment plan may offer improved glycemic control with lower drug usage compared with current practice.

The predictive PK/PD treatment-effect model becomes more precise as outcome data accumulate. Most PK/PD models require drug concentration levels in the blood but these are not generally measured. This new approach seems to overcome this obstacle while establishing more direct relationships between drug dosages and drug effects. Incorporating this information within a treatment planning optimization model allows clinicians to tailor outcomes and medication regimens to the individual patients' specific needs. Over time, this approach may lead to better treatment decisions and possibly improved outcomes.

In summary, the PK/PD treatment-effect model is a mechanism-based that captures each patient's underlying glucose dynamics and drug effects. By doing so it offers predictive estimates of dose glucose response

characteristics. It captures disease progression over wider treatment horizons. This helps assure that complying patients have the adequate glycemic control that is necessary for safe drug delivery. Because it uses only drug dosage and self-monitored blood glucose levels (SMBG) that are hopefully recorded accurately by patients at home, for compliant patents it is readily implementable with current clinical and patient practice. Last and most importantly, the model is tailored to each individual patient to obtain a personalized dose response and disease progression. This predictive information is then incorporated into a mathematical programming-based treatment model that optimizes their glycemic control and drug dosage.

The end product is a real-time clinical decision support system that enables clinicians to tailor treatment design to the needs of the patients. It should help clinicians make better treatment decisions.

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