

Putting Systems and Complexity Sciences into Practice

Billings Clinic

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Commons

**2nd International Conference
Systems and Complexity in Health**

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Abstract

Book



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Pitfalls in Identifying High Performers in Diabetes Overtreatment: Positive Deviance may be neither Positive nor Deviant

David Aaron

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Objective: Identification of best practices constitutes an important strategy for organizational improvement. We compared different criteria (different measurement thresholds, different comparators, and performance consistency over time) on identification of high performing facilities, especially positive deviants.

Methods: The design was serial cross-sectional, using yearly VHA administrative data (2009-2013). Our primary outcome measure was facility level rate of HbA1c overtreatment of diabetes in patients at risk for hypoglycemia. Outlier status was assessed by a facility outlier value measure standardized within year and comparator group and by model residuals. Comparators included: (1) all VA hospitals; (2) hospitals within the same regional network; and (3) hospitals within the same facility complexity level. Facilities with outlier values in the lowest decile for all years of data using more than one threshold were considered high performing outliers.

Results: From 2009 to 2013, the rate of overtreatment overall based on a threshold of 6.5% decreased from 28.6% in 2009 to 22.7% in 2013; the rate of undertreatment increased from 7% to 10.3%. Facility outlier values were correlated across time, but correlations decreased over time. Facility complexity was not a significant predictor of overtreatment. Using each of the three overtreatment thresholds, 14 facilities were identified in the lowest decile of overtreatment. Seven facilities were identified by all three thresholds and five more by two thresholds - modest overlap. Undertreatment rates among these facilities were assessed and compared to the undertreatment rates among all VA facilities; several facilities identified as positive deviants based on overtreatment rates had exceptionally high rates of undertreatment.

Conclusion: Statistical identification of outlier status was dependent upon the specific measures used and the period of analysis. Because two facilities may arrive at the same results via very different pathways, it is important to consider that a "best" practice may actually reflect a separate "worst" practice.

The Impact of Relational Coordination on Collaboration, Care and Thinking

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At Billings Clinic an appreciation of complexity science and the central place of self-organization in determining healthcare outcomes have become more than an interesting intellectual endeavor. This appreciation is informing decisions on the introduction of new, promising improvement processes.

Because it places interactions at the center of its framework, Relational Coordination proved particularly attractive to leaders at the Clinic. Relational Coordination (RC) is a theory that explores attributes that enable teams to accomplish complex tasks (Hoffer Gittell, et al. 2000). It proposes that learning and performance are enhanced in teams where members share goals, and knowledge, interact respectfully, and communicate frequently, accurately and in a timely and problem-solving manner. As leaders learned about RC, attention turned to where experience could be gained with this novel theory of collaboration. The intensive care unit (ICU) was suggested because it was moving to a larger facility and staff members were afraid the size of the unit would diminish face-to-face communication and working relationships. The ICU also rose to the top of the list because staff placed a high value on collaboration and was constantly searching for new ways to enhance how they worked together. They recognized that rapid adjustments (learning) to changing patient conditions were key to good care.

This presentation will cover the story of RC implementation in the ICU and the impact it has had on collaboration and strategies for improving patient care. It will also highlight the impact RC has had on how a cross-section of Billings Clinic understand and approach complex problems. These insights were gained through semi-structured interviews.

Transforming Monitoring and Improving Care with Variability-derived Clinical Decision Support

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Monitoring of patients with existing or impending critical illness routinely involves the recording of multiple physiological waveforms. However, tracking response to interventions, gauging clinical trajectory and making informed clinical decisions still mostly rely on vital signs and laboratory tests summarized and charted over hours to days. Utilizing the currently untapped information contained in waveform data has the potential to reduce the diagnostic and prognostic uncertainty inherent in critical care, even when patients are managed by trained intensivists. This uncertainty results in delayed diagnosis, unnecessary or inappropriate therapy and increased complications, mortality and cost of care.

Heart rate variability (HRV) and respiratory rate variability (RRV) time series derived from the continuous physiological waveforms help characterize the degree and complexity of the patterns of the inter-beat and inter-breath interval time series. Decreased variability is associated with age and illness and correlates with illness severity, indicating reduced adaptability and/or increased stress. Combining waveform-based variability analysis with predictive modeling, we can enhance timely clinical decision making at the bedside by providing probabilistic prediction of upcoming clinical events.

Using examples from our ongoing research studies, we demonstrate the added value of variability-based predictive models compared to models based on commonly used clinical and laboratory data. Specifically, using data from two recent large prospective studies, we address the issues of early identification of septic patients at increased risk for future deterioration in the emergency department (ED) and the prediction of failed extubation in the ICU. Predictive models using optimal sets of variability metrics, clinical and laboratory data were derived and their performance assessed to highlight the clinical, economic and societal impacts of our approach. Finally, we show how these clinical decision support tools can integrate within the current processes of care to optimize individual patient care and manage resources more efficiently.

The multiple networks of multimorbidity

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We previously described multimorbidity as the manifestation of interactions between a person's physiological, socio-cultural and resilience networks. These networks include genomic, metabolomic, proteomic, neuroendocrine, immune and mitochondrial bioenergetic elements, as well as social, environmental and healthcare networks. Stress systems and other physiological mechanisms create feedback loops that integrate and regulate internal networks within the individual. Minor (e.g., daily hassles) and major (e.g., trauma) stressful life experiences perturb internal and social networks resulting in physiological instability with changes ranging from improved resilience to unhealthy adaptation and "clinical disease".

The understanding of multimorbidity as a complex adaptive systems response to biobehavioural and socio-environmental networks is essential for health system redesign. How can we build a truly patient-centered adaptive healthcare system that

- more adequately address the underlying disease processes as the manifestation of a state of physiological dysregulation?
- shapes care delivery approaches that meet the individual's care needs in the context of his underlying illness experience?
- eliminates personal, social and environmental stressors responsible for the detrimental activation of the physiological stress response?
- integrates emergent targeted personalised biotechnology interventions such as small molecule therapeutics?
- gives equal weight to building social capital and community development as a means to overcome a person's/community's psycho-socio-cultural impediments and their negative effects on resilience?

This presentation proposes a model for discussion to address the networks of multimorbidity.

Why the Interdisciplinary Team Approach Works: Insights from Complexity Science

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Background: Although an interdisciplinary approach is considered best practice for caring for patients at the end of life, or in need of palliative care (PC) services, there is growing tension between healthcare organizations' need to contain costs and the provision of this beneficial, yet resource-intensive service.

Objective: To support the interdisciplinary team (IDT) approach by recognizing organizations, teams, patients, and families as complex adaptive systems, illustrated by a qualitative study of the experiences, roles, and attributes of healthcare professionals (HCPs) who work with patients in need of PC services.

Design: In-depth, semi-structured interviews of PC health professionals were conducted, transcribed, and independently reviewed using grounded theory methodology and preliminary interpretations. A combined deductive and inductive iterative qualitative approach was used to identify recurring themes. Setting/Subjects: The study was conducted in a physician-led, not-for-profit, multispecialty integrated health system serving three large, Western, rural states. A purposive sample of 10 HCPs who regularly provide PC services were interviewed.

Results: A positive team/patient experience was related to individual attributes, including self-awareness, spirit of inquiry, humility, and comfort with dying. IDT attributes included shared purpose, relational coordination, holistic thinking, trust, and respect for patient autonomy. Professional and personal motivations also contributed to a positive team/patient experience.

Conclusions: Interdisciplinary PC teams have the potential to significantly impact patient and team experiences when caring for seriously ill patients. Findings from this study support interventions that focus on relationship building and application of a complex systems theory approach to team development.

Linking elevated genome instability to Gulf War Illness: searching for the general mechanism

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Gulf War Illness (GWI) impacts approximately 25-30% of Gulf War veterans in the United States. The complex etiology and diverse symptoms of GWI make diagnosis and treatment difficult, which also slows down the acceptance of this clinical condition within the medical community. Recently, an increasing number of symptoms, exposures, and molecular defects have been identified/validated for GWI. However, the general mechanism of GWI remains elusive, which prevents any further development of common biomarkers and treatment options. By considering GWI as a common and complex illness, we have searched for the somatic evolutionary mechanism of GWI. Because many trigger factors of GWI occurred over 25 years ago, it is logical to treat GWI as an adaptive system that follows the principles of somatic evolution. In particular, based on the recently introduced genome theory, which suggests that genome-level variations play an important role in both the initiation and progression of various diseases/illnesses, we have examined the chromosomal aberration statuses of short-term culture lymphocytes and linked the elevated genome instability to GWI patients (the frequencies of non-clonal chromosome aberrations is about three times higher than in the control population). Furthermore, the cellular stress profiles were analyzed for some GWI patients. Together, stress-mediated genome alterations can serve as a common mechanism to unify the diverse etiology and symptoms of GWI. The approach shall serve as an example of studying other common/complex diseases/illnesses which are hard to define using common causative factors and shared molecular pathways, as well as symptoms.

Accelerating Technology Integration Through Emergent Design

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Background: Care process interruptions and failed integration of technology into workflow are commonly cited contributors to the lag between technology adoption and significant gains in organization and patient health outcomes. This presentation reports on the first implementation of predictive monitoring (PM) in an adult care setting. Unlike traditional continuous physiologic monitoring data that represents a patient's current-state, PM detects subacute physiologic changes to calculate a patient's risk of emerging respiratory and cardiovascular instability. Thus predictive monitoring data are very different from traditional forms of patient data and cause uncertainty among clinicians when they are unable to detect physical signs of impending crisis. This uncertainty may cause delays in clinician interpretation and intervention and may be a barrier to adoption and integration of PM into care practice.

Aim: We identified strategies that promote and sustain collaborative work that fosters technology integration into care the Surgical Trauma Burn Intensive Care Unit (STBICU) of the University of Virginia Health System.

Methods: Over the course of one year, we used a novel, complexity science-inspired approach to implementation, emergent design, to engage care team members of the STBICU in the adoption of PM. Complexity and emergent design recognize that each complex system is characterized by a unique set of interaction patterns, and it is these patterns that underlie emergent outcomes, such as whether and how a new technology is adopted. To positively impact these emergent outcomes, the science suggests the patterns of everyday conversations must be changed. Only participants in the system, in this case the STBICU staff, can affect these changes.

Results: We will describe the emergent design process; how different engagement strategies animate staff, reveal diverse perspectives, build connections and foster sensemaking; and the results achieved. We will explore lessons learned and plans for next steps in research.

Conclusion: Unlike traditional technology implementation methods, the emergent design approach draws on the strength of individual perspectives and fosters learning through small experiments that may eventually lead to lasting behavior change.

Changing the Medical Paradigm: Why the Allostatic Model Makes More Sense

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In the process of evolutionary adaptation to our environments we have gained many defenses that protect us from environmental challenges. They are strongest where we are the most vulnerable—at the openings to our bodies—our GI, respiratory, and urogenital tracts. These defenses are primary; they work all the time without our awareness or participation. Stomach acid, digestive enzymes, and protective bacterial biofilms are the primary defenses of the GI tract. Mucociliary cleaning washes the respiratory tract, and a lactobacillus biofilm and regular washing protects the urogenital tract.

These primary defenses, however, are regularly challenged and overwhelmed. When this happens in the GI tract we get a back-up washing defense we know as gastroenteritis. When it happens in the respiratory tract we get a similar washing defense known as rhinitis. Unfortunately we have seen these defenses as illnesses representing an imbalance in our homeostasis and developed drugs to counter them. If we hobble the defense of our favorite football team they are going to lose the game. The steady increases we have seen in bowel and respiratory diseases suggest we may be in this boat.

There are ways to help these defenses but they don't add to the GDP and are little known. Oral rehydration is the use of a proper balance of salt, sugar and water that optimizes GI washing by the simple expedient of keeping the body's fluid tank full. This mixture is not a drug and has no possibility of becoming one since the ingredients are commonly available and lack the profits needed to get 'drug' approval.

In a similar way xylitol works both osmotically to pull water into the airway surface fluid and by competitive inhibition to decrease pathogen adhesion in the respiratory tract. It too shares the problems of oral rehydration in that it is commonly available and lacks 'drug' status.

Recognizing these 'illnesses' as the defenses they in fact are will make our people healthier and help shift the medical paradigm from a homeostatic model, where adverse symptoms are seen as illnesses, to the allostatic model, where these symptoms are more likely to be seen and valued for what they are, and supported rather than hobbled.

New Ways of Knowing and Researching: Integrating Systems and Complexity into a Translational Health Sciences PhD

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Putting systems and complexity thinking into practice in healthcare necessitates the integration of complexity science early in graduate curricula to facilitate the epistemological paradigm shift critical for practitioners, educators and researchers to re-envision the future of healthcare (Mennin, 2013; Norman, 2013). This integration is particularly poignant for doctoral students in translational health sciences who will enact a new paradigm of research based upon cross-disciplinary, multilevel knowledge generation aimed at high social impact (Hesse-Biber, 2016; Hirsch Hadorn et al., 2007; Norman & Yip, 2013; Stokols, 2006; Woolf, 2008;). In the first semester of our new PhD in Translational Health Sciences at GWU, we have integrated systems thinking and complexity science with foundations of translational health and collaboration science in order to encourage students to think beyond disciplinary and practice boundaries and recognize the need for new ways of knowing, practicing and researching to respond to complex health and health systems problems. The purposes of this panel discussion are to: 1) present our approach to curriculum integration, focusing on the scaffolding of knowledge and skills and a collaborative approach to teaching and learning and 2) explore methods by which we can continue to foster this paradigm shift” to promote ready translation and implementation of new knowledge. Topics we will address in the discussion include:

- Benefits and challenges in creating an interdisciplinary program which integrates complexity science, collaboration science & translational health science in the first semester of a curricula
- Benefits and challenges in creating a new research paradigm integrating complexity concepts to facilitate translational research
- An approach to doctoral research which allows students to engage in cross-disciplinary, multilevel knowledge generation

Implementing Triple Chrono Therapy: A Story of Collaborative Inquiry

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This session highlights one team's journey from initial inquiry, to implementation of an innovative evidenced-based protocol manipulating sleep and wake cycles to treat adolescent depression, to original clinical research. The journey began with a patient. Challenged by a severely depressed teenage patient who refused all medication, this frontline team of psychiatrists and nurses took a chance on an innovative procedure known as triple chronotherapy. Basing their protocol on an impressive study done in adults, this team received bold leadership support to trial this procedure with subsequently amazing results. The initial patient went from severe depression to no clinical signs of depression in a matter of weeks. Excited to know more, the team began to review the literature, finding a handful of promising studies treating adults. Most importantly, no studies had been conducted in the adolescent population. Soon what began as innovative patient care had become a process of collaborative inquiry and finally, in response to a gap in the literature, the team went on to pursue original research.

As evidence-based practice becomes a more integral and accelerated part of complex healthcare systems, interdisciplinary participation in a larger culture of inquiry is essential. We will explore the role of collaborative inquiry in interdisciplinary research by highlighting key aspects of the inquiry process as a creative process of collaborative dialogue and co-learning. Observations on the organizational structures, both formal and informal, which foster participation in collaborative inquiry and interdisciplinary research will be illustrated with examples from our team's experience. An excerpt of a Tedtalk presentation from one of the team members, and a visual presentation on the protocol itself will engage participants in the team's unique approach to collaboration. A Q&A discussion will solicit questions and valuable input from participants.

Putting health back into the healthcare system

Joachim Sturmberg

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While we call it a healthcare system, the system's focus is on the identification and the management of diseases. While we take "good health" for granted, it is our "illness experience" that brings us in contact with the "healthcare system". Healthcare systems are built on Rokeach's model of "clinic-pathological correlation" – our "subjective experiences" correlate with an "objective seat" of disease. Kerr White's "ecology of medical care" provides a very different picture, only a small number of our "illness experiences" have a "seat of disease". Healthcare systems undoubtedly provide exceptional services for those with a "seat of disease", but equally they miserably fail the many whose illness has none.

It is this paradox which is at the centre of this presentation. It challenges the notion of "health care" as the basis of the "healthcare system". How can we put "health" back into our "healthcare systems" without losing the undeniable benefits of "disease-specific care"?

A Complexity Sciences Perspective in Social Learning & Knowing as a Collective Process in Interdisciplinary Health Care Settings

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Background: This research seeks to leverage insights from Complex Adaptive Systems Theory, focusing our attention on patterns of interactions that are co-evolving within their embedded context in supporting (or not) collaborative behaviours in the delivery of healthcare.

Aim and Objective: This study examines (1) how learning and knowledge exchange processes unfold within and across interdisciplinary and interorganizational teams, and (2) identifies what factors contribute to the development of effective collaborative practice in primary healthcare settings.

Methodology: In depth semi-structural interviews were conducted with a convenience sample of thirteen Community Care Coordinators embedded in multiple interdisciplinary teams of healthcare professionals providing integrated care to patients with complex needs. Interviews were complemented by observations of group meetings and listening-in on patients case study group discussions. Results were validated in a focus group of Community Care Coordinators.

Results: The data highlighted that much of what makes collaborative practice successful or challenging is based on the quality of the inter-professional interaction and the type of social engagement determined by attitudes, preferences, and expectations of the individual providers in the interface. Also, how each team member defined and enacted the concept of collaboration and communication in the context of care provisions was important. Interdependence and collaboration among team members generally increased over time as team members recognized the value of others' knowledge and expertise and became accustomed to drawing on that knowledge in care provisions. Learning occurred through active participation as a collective social process, rather than an individual process without points of contact.

Conclusion: The need for a greater understanding of the conditions necessary for collective learning and the link between participant behavioral interaction and intervention initiatives is one that requires a more thorough comprehension of the social processes involved, extolling the values of learning, through experimentation, flexibility, and rejection of universal solutions.

Dealing with complex clinical decisions

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The organization of the distinctive practices of healthcare providers and the system of healthcare is a key element in decision making for a patient with complex complaints.

During observations in a hospital I was confronted with conflicts between caregivers. Interviews with these caregivers indicated complex and conflicting policies. It became obvious that these policies resulted in dichotomous and irreconcilable positions relating to irreversible decisions concerning issues of life and death.

A case will be discussed as an example. A female patient was hospitalized in the Intensive Care Unit in Amsterdam with severe HIV infection. The medical team started prolonging the life of the patient by treating her opportunistic infection. After one month no therapeutic progress was made. The medical team wanted to prolong treatments. Subsequently, because they saw the stressful patient suffering, the nurses proposed to discontinue the treatment. Physicians and nurses were not able to convince one another with their arguments. At a given moment both doctors and nurses critically questioned themselves. They started open communication with each other admitting their uncertainties. In the course of time, physicians and nurses imagined some value in the potential life of the patient. In this novel approach properties of complexity thinking might be recognized. Crossdisciplinary interconnectivity replaced hierarchic parochialism. Dichotomous positions were no longer separated or reduced, but interconnected. Ambitious and goal oriented practices were moderated. Imagination released new perspectives. Unpredictable preferences of the patient were included. Permanent decisions were transformed into provisional decisions. The outcomes were beyond expectations from the efforts of caregivers, due to the resilience and the supportive environment of the patient. Equipped with a portable oxygen bottle, a laptop and a mobility scooter, the patient enjoyed an acceptable quality of social life in a nursing home until she died.

Learning: Contemplating the Unexamined Core of Learning Health Systems

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Creation of Learning Health Systems (LHS) is advocated by the U.S. Institute of Medicine (IOM) as a way to “produce high-quality health care that continuously learns to be better” and “provide Americans with superior care at lower cost”. Most LHS literature focuses on information technology and the infrastructure needed to capture, analyze and disseminate data in the learning process.

Interest in Learning Health Systems at Billings Clinic emerged as an outgrowth of the organization’s efforts to employ insights from complexity science to improve care and organizational performance. Together, nurses, physicians, researchers, therapists, and leaders formed a Learning Health System Network to advance this issue. Early in its development work, the group discovered there is scant attention in the LHS literature on the actual process of learning and how it can be cultivated.

This presentation reports on the work of the Network to rectify this oversight. Drawing on literature from complexity science, social psychology, human development, organizational psychology, self-determination theory, and from personal experience of the authors, a set of principles to catalyze conversations about a deeper, more nuanced and complex understanding of the unexamined core of Learning Health Systems—learning—are proposed.

- Draw on wisdom of groups and value connections
- Embrace sense making over decision making in dealing with the unexpected
- Bring diverse perspectives and strategies to complex challenges
- Animate people, provide direction, update regularly and interact respectfully
- Appreciate the power & ubiquity of emergent change and the limitations of planned change
- Concentrate on small wins and characterize challenges as mere problems

These principles are beginning to influence how learning and improvement is approached at Billings Clinic. The presentation will conclude with examples.

Healthy smoker: An Oxymoron?

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Tobacco use reliably increases the likelihood of chronic disease development and premature death. However, the initiation of tobacco use does not immediately result in clinical disease manifestation. We recruited 24 healthy smokers and 24 age-, sex-, and BMI-matched never smokers to examine changes in immune function prior to clinical disease manifestations (e.g., no diagnosis or drug treatment for chronic health conditions). In addition to immune cell reactivity to lipopolysaccharide (LPS) and dexamethasone (DEX), we collected psychosocial and physical and mental health data. Smokers were highly addicted to nicotine and had been smoking for an average of 13.08 years (SD 9.82) and had 9.48 pack years (SD 9.42) of tobacco exposure. Smokers endorsed poorer sleep as well as greater distress compared to never smokers. In addition, smokers' immune cells were less reactive to LPS than never smokers'. Thus, smokers exhibit poorer mental and physical health and modulation of their immune response compared to never smokers, indicating that the term "healthy smoker" is an oxymoron. However, the reduction of immune function observed in smokers was also found in never smokers who had higher levels of loneliness. Hence, loneliness may be as immuno-dysregulating as smoking and it is also related to self-reported health. Upon further investigation, replacing smoking status with self-reported health explained more of the variability in immune cell responses (models R2 .21 and .28, respectively). Overall, these findings caution the use of one facet, like smoking, as a definitive factor driving health status. When determining global health functioning, we must factor in as many facets as possible, as a longterm or trait-like negative emotion can be just as "unhealthy" as a negative health behavior. In this sample, individuals appear to be aware of their "healthiness" and it is linked to immune dysregulation.

Fuzzy inheritance challenges the concept of precision medicine

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Advanced –omics have promised to transform medicine with molecular precision. At first glance, the enthusiasm seems to have a solid basis. With the rapid accumulation of molecular big-data, we should soon dissect most diseases into a manageable number of molecular parts, such as a few defined genetic pathways, or a handful of common gene mutations. These molecules can then be specifically targeted, leading to precision medicine. While precision medicine is gaining popularity, it is at odds with the fact that many common and complex diseases in fact belong to adaptive systems, which are hard to understand by simply characterizing their parts. Especially due to the involvement of somatic cell evolution, it would be challenging to precisely predict disease progressions based on high resolution molecular profiles. First, individual genes/pathways are limited to predict somatic cell evolution where the genome level selection dominates; Second, the recently realized ‘fuzzy inheritance’ concept, which explains the mechanism of genetic and non-genetic heterogeneity, suggests that even genetically coded information is not precise; and Third, environmental dynamics including medical intervention can impact the status of fuzzy inheritance functioning as stress to change the trajectory of cellular evolution. Together, the genotype-phenotype interaction during somatic evolution clearly represents a note of caution for the precision medicine movement. Using cancer and Gulf War Illness as examples, we propose a new approach to disease research: to treat disease as an adaptive system and to search for the general principles of common/complex diseases by integrating ongoing stress, genetic profiles, heterogeneity-mediated cellular adaptation and trade-offs (both short and long term effects), and the pattern of higher levels of system constraint/response. Such genome-based-holistic medicine requires monitoring the system’s behavior within a somatic evolutionary context, rather than solely relying on the detailed characterization of individual molecular parts in isolated conditions.

Social-Spatial Organizational Context and Patient Outcomes

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Background: As the Affordable Care Act continues to cover the uninsured we can see the fragmentation that characterizes our delivery system as we struggle to coordinate care for newly insured populations and deliver timely, quality care for existing populations. We know health care varies widely across racially and linguistically diversity communities. Hospitals are tasked with responding to the needs of their communities with the delivery of timely, appropriate care. This includes the delivery of language services to facilitate communication and potentially, address issues of health disparities and literacy.

Aim/Objectives: We wanted to study language services on the outcome of patient satisfaction with provider communication.

Methods: We used GIS and logit regression to analyze hospital-level data within the context of population factors.

Results/Conclusions: We found that hospital ownership, location of the hospital with respect to the need for language services, defined as the proportion of the population that was limited English proficient were associated with the provision of language services. Overall 68.8% of hospitals offer language services in the U.S. Most are Not-for-Profit. While language services are offered at all need levels it appears that hospitals had the greatest odds of offering language services at local context areas of moderate need by not for profit hospitals (AOR).

From Clinical Ethics to Big Data Analytics: Applying Systems and Complexity Science to the Care of Hospitalized Patients

Evan DeRenzo

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For almost 30 years, this presenter has been in the field of clinical ethics; first at the National Institutes of Health and for the last 17 years at the Center for Ethics, MedStar Washington Hospital Center, Washington, DC. During these decades, this presenter has been thinking about how complex hospital systems help or hinder the care of research subjects and/or clinical patients. Early on, this presenter collaborated with Jack Schwartz, JD; first when he was Assistant Attorney General for the State of Maryland and since he retired becoming a Fellow at the University of Maryland Law School. Along the way he and I have conducted research at MedStar Washington Hospital Center. More recently we created an expanded consulting group working with physicians, IT personnel and others at Main Line Health Systems (MLHS), Philadelphia, PA.

The MedStar research examined a subset of a 6 year span of closed Risk Management cases, looking for associations between risk-related variables and the cost of legal claims. We identified a group of variables that represented almost 80% of the costs of the subset of claims we selected as the universe of ethically complex cases.

In the work at MLHS, the expanded consulting group conducted a pilot study assessing whether the MLHS patient database could support research on whether the methodology of big data analytics might help us validate the variables previously identified.

Along the way, we have contemplated the degree to which tools such as Enterprise Application Modeling, such as that used by the United States (US) military to manage complexity in their systems globally, might help patient care. The ultimate goal of all this work is to help us build process improvement programs supporting ethically complex hospital patients. This presentation will explain more about that mentioned here and present our progress to date.

Visualisation in Simulation of Complex Systems in Healthcare

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Visualisation is an important tool in Simulation of Complex Systems in Healthcare. It is used to effectively address complexity and diversity of stakeholders' perspectives and facilitate articulation and communication of these perspectives.

The proposed oral presentation will include the following applications of the visualisation on:

- Representation of Healthcare Processes
 - Exposes processes at multiple levels of abstraction which are used to manage complexity, facilitate stakeholder engagement and “buy-in”, example Suicide Prevention Model.
 - Enables access and transparency of the process representations, model logic and results, example Chemotherapy Process Model.
- Lucidity of description of human behaviour patterns
 - Multiple examples of AnyLogic agent based models.
- Comprehensiveness of description of internal states and processes
 - State charts, multiple AnyLogic based examples.
- Construction of building blocks for user interface simulation
 - Provides visual cues that reduce cognitive load when setting up simulation inputs such as parameters or data sources. Example NSW Alcohol Harm Reduction Model.
- Exposure of model logic
 - Exposes multiple facets of model logic which facilitates consensus building among diverse experts.
- Presentation of results or outcomes of simulation (Tableau based examples)
 - Provides facility for independent dissemination of the simulation results.
 - Aggregating simulation results allows for stakeholder interaction
 - Incorporates mechanisms for disambiguation of presented information, feedback and collaboration.

ECHO --Extension for Community Health Outcomes: A Learning Experience

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Cabin Creek Health Systems, a community health center in southern West Virginia has partnered with the WVU School of Medicine to implement project ECHO to address barriers in accessing timely specialty care due to barriers caused by distance and cost.

Project ECHO (Extension for Community Health Outcomes) is a model for bringing specialty knowledge to primary care practice sites. It involves regular weekly video-conference sessions that involve a “hub” of a multi-disciplinary specialty providing information and consultation for several “spokes” of primary care clinicians.

The ECHO model, as developed by the UNM-SOM, incorporates principles and practices that are consistent with effective teaching and adult learning. These are the basic simple rules that are embodied in the process.

- ECHO clinics are usually established to address a single clinical areas.
- The teaching is related to real and pressing needs of the learners. The consultation and education is primarily case-based.
- There is a brief didactic portion of each session – usually devoted to an exploration of an evidence-based approach to diagnosis or treatment.
- The participants practice respectful and non-judgmental interactions. There is opportunity for peer-to-peer learning as well and specialist to PCP learning.
- The specialists are vigilant for opportunities to appreciate the challenges and the work of primary care clinicians and health workers.

The ongoing supportive learning environment established by the specialist team in the sessions encourages primary care clinicians to take on clinical challenges that otherwise may have gone untreated or assessed and treated only after significant delay. Patients receive specialty level care from practices with whom they already have trusting relationships.

The presentation will describe the Cabin Creek Health Systems experience with bringing Project ECHO to the state of WV. In particular the speakers will focus on lessons learned throughout the implementation and also how Project ECHO connects to complex system principles.

Complexity and Real World Applications. Using the Tools and Concepts from the Complexity Sciences to Support Real World Decision Making Activities

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Background: Patients health trajectories are determined as much by their biological potentials as their environmental demands, be they physical, emotional and social, socioeconomic or the natural and work environments. While healthy people usually have a higher tolerance to perturbations of these factors, frail people often deteriorate with even minor or minute change. Being able to monitor the health trajectory and the responses to challenges in frail people may prevent unnecessary suffering and avoid unnecessary hospitalisation. For that reason, the lead author and her team developed the Patient Journey Record System (PaJR), a tool that uses algorithms and predictive analytics to better understand the complex dynamics of the health experience and identify those patterns most associated with poor health outcomes.

Theoretical background: Health is a personal complex adaptive state and has been described by the biopsychosocial semiotic model of health. Morbidity results from the multiple network perturbations at the internal and external physical networks and social networks – successful treatments aim to stabilise these networks at various levels.

Patient trajectories: While people adapt and maintain homeokinetic stability their health is stable. Exceeding homeokinetic stability leads to a tipping point and is associated with the appearance of clinical morbidity and potential mortality.

The PaJR system: The PaJR system is designed to avert potentially preventable hospitalisations in real time with patients who are at high risk of repeat hospitalisation. While specific chronic diseases such as heart failure and COPD are amenable to biometric monitoring, most repeat hospitalisations are for multimorbidity and frailty which are multisystem with complex dynamics. Hence a biopsychosocial and sense making approach is needed. PaJR consists of software and a workflow that probes, senses and responds to potential deteriorations in homeokinesis in individual journeys. It accomplished this at relatively low cost, with regular outbound phone calls carried out by trained and supervised mid-level providers. PaJR uses software to monitor the calls with algorithms and predictive analytics in the call software which generate a profile of each call and identifies stability or risks in that call and make alerts accordingly. A care manager acts on alerts according to their urgency and intervenes or directs care in an appropriate health or social care direction. It is a light touch approach focusing on detecting potential tipping points and alerting other services as appropriate.

Preliminary experiences with the PaJR system: PaJR has been pilot tested and evaluated in 3 locations in Ireland. The pragmatic trial aimed to prevent deteriorations/exacerbations – needing emergency department visit & hospital admissions (HAED) Between 2011-2013. a cohort of 199 patients were recruited, being at risk of readmission, and were telephoned according to their dynamically changing profiles around 2-3 calls/week. There were 11875 recorded calls to patients aged 76.3 ± 9 y, M:F 2.1:1 with follow-up 10 ± 3 months. HAED was statistical significantly reduced compared to a control group. Predictive analytics consistently predicted HAED in calls for up to 3 days prior to the tipping point event by detecting threats to homeokinesis in the calls. Compassionate human sense making worked to address these

threats with clinical or medication, psychosocial or environmental interventions.

Conclusion: Dynamic monitoring of health trajectories in high risk frail or multimorbidity patients applying complex systems theories and analytics is a very promising holistic person-centred approach to reduce HAED and improve care. A much larger deployment is being planned to further develop and test the approach.

Understanding the Emergency Department Ecosystem Using Agent-based Modelling - A Case Study of the Seven Oaks General Hospital Emergency Department

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Background: The Emergency Department (ED) can be viewed as a black box that takes in patients as input, processes the patients, and produces a desirable output. An ecosystem can be defined as a combination of physical and biological components in an environment. The ED ecosystem comprises of agents and available resources. The agents interact with each other and determine the output of the ecosystem. The agents include the physician, physician assistants, nurses, nurse practitioners and the patient. The patient agent serves as the input to the ED ecosystem. Understanding the causal links in the ED ecosystem can bring about optimum utilization of the ED resources, saving costs and improving the quality of care. The challenge is how to properly identify and process those causal links that contribute to a given ED ecosystem operation.

Objectives: Simulating the ED using a computer model developed on the agent-based NetLogo software help us understand variations in causal links that affect the ED process flow. This will provide the ED management with a decision support tool, which improves the quality of care and save costs by optimizing the use of resources.

Methodology: Seven Oaks General Hospital Emergency Department (SOGH ED) is located in Winnipeg, Canada and sees 45,000 patients per year (additional info at <http://sogh.ca/hospital-services/er/>). An SOGH ED process and ecosystem analysis were performed to build the agent-based model. Simulations for modeling complex systems were carried out on processes in the ED ecosystem and changes in the ecosystem were observed over a period of time. Simulations assist Physicians by providing insights of causal links within the ecosystem.

Conclusions: The developed agent-based tool helps the physician identify and deal with bottlenecks without adversely affecting another part of the ED ecosystem. It will help in the improvement and personalization of the patient ED experience.

Complexity of Knowledge in Primary Care. A Bibliometric Study

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Background: Complexity of professional knowledge addressed generally by A. Abbott (2001) means that each professional level repeats the knowledge of the profession fractally. For primary care B. Ellis (2013) describes professional knowledge as a complex adaptive system (CAS) improving quality throughout the profession's levels.

Aims: Our aim was to explore complexity of primary care's knowledge as represented by vocational exams' topics for complex adaptive and also fractal properties.

Methods: The reference framework comprehends theory of professions and a 3-level model of family medicine and its knowledge (R.N. Braun 1982, DEGAM 2012). Two samples of vocational exams' topics from the last ten years' most powered exams' cohort (2004/5) of Lower Saxony and Bavaria were compared bibliometrically with literature specific for the three professional levels of primary care (science, mode of operation, field of work). The samples were examined concerning their accordance with levels of professional knowledge. Key question concerning CAS was: which grade of accordance of topics with doctors' daily work shows the data? Concerning fractality: „does the data scale ?“ (B.J. West 2013)

Results: Exams' topics accord in descending order with mode of operation -, science -, field of work – level's themes. Focuses of provision from field of work - level also accord highly. Inside the science - and mode of operation - levels accordance patterns are repeated: the data scales.

Conclusion: Highest accordance of exams' topics with mode of operation - level and focuses of provision from field of work – level make the explored vocational exams an example of a complex adaptive system (CAS) focused on doctors' daily work and not some examiners' pet issues. Different grades of accordance of exams' topics with those of professional levels and its fractal iteration within two levels suggest complex properties of primary care's knowledge.

Social and institutional change in complex health systems: lessons learned

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The dominant paradigm of the last century, biomedical reductionism, is inadequate to meet the global health challenges of the 21st century. Healthcare reform, obesity, climate change, population health, quality improvement, rising healthcare costs, and the sustainable development goals are just some challenges that cross sectors and disciplines, and are constantly changing. Healthcare and public health organizations are increasingly recognizing the need for significant mindset, social, and institutional change to meet this challenge. In this presentation, we share the lessons learned – informed by complex systems concepts - of two small, but growing networks that aim to contribute to this change.

Systems Thinking for Capacity in Health is an informal network funded by the Doris Duke Charitable Foundation that aims to advance complex systems thinking and approaches in global health: <https://twitter.com/ST4CHHealth>. Revolutionize Health takes a complex systems approach to social change with a goal to catalyze or contribute to transformational change in health education: <http://www.revolutionizehealth.org/>. Through these networks, we have engaged in social media outreach, published relevant academic papers, networked with like-minded individuals around the world, and produced videos and other materials to make these ideas more accessible.

Dr. Chad Swanson, an emergency physician and founder of these groups, will share lessons learned from facilitating the formation and ongoing activities of these networks. He will apply complex systems concepts from thinkers such as Scott Page, Donella Meadows, and David Stroh. Five lessons that we think will apply to others that hope to catalyze change in complex health environments will be discussed: keep a relentless focus on the long-term vision; explore opportunities for shared vision and collaboration widely, and exploit high-leverage activities when the opportunity is right; limit engagement to those that share the vision; commit to continuous learning; and be prepared for surprises.

The key to implementing an accessible information standard across complex adaptive health and social care organisations

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Background: Digitising health and care is now a strategic priority within the English, National Health Service (NHS). A major component is NHS England's commitment to a new information standard supporting those with special communication needs - ISB 1605 accessible information standard (AIS). The standard aims to ensure that disabled patients, service users and carers with particular information or communication support needs have those needs met by health and social care organisations.

Objective: To identify key features relevant to implementing locally a national accessible information standard across complex adaptive health and social care organisations.

Method: Proof of concept study including a literature review, survey and workshop.

Results: Delivering on each stage of the standard - to ask, record, flag, share and provide - suggests an imperative to the implementation approach. An environment results in which learning processes, end-user and other stakeholder involvement, continuous feedback supported by informatics, and a willingness to foster innovation and diversity is facilitated. Changes in behaviours emerge that include listening, whole-system learning, evaluation and reflection, focused on making informed choices that leads to quality improvement.

Conclusions: The English Government's vision focuses on access to good information as the basis for genuine decision making for all who need it. Local policies relate to services centered on patients, and increased use of digital health and social care systems focused on improving outcomes by giving individuals greater control to access their health data in a variety of ways to make informed choices. Innovation comes through apps and assistive technologies, building on what works to help people to stay healthy and well. Exploring AIS shows what may well be possible through technology for those with the greatest needs. Older and disabled people not only have most to gain through innovative use of communications technology they also form the largest user group.

A body is more than a machine, a health care system more than machinery

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Each human being consists of a body containing organs that perform functions. However, beyond the machine is an individual which forms part of a complex adaptive system interacting with other individual, familial, social, professional, cultural, institutional and political agents.

The sum of experiences made by such interactions embodies unique stories, imaginations and mental pictures. These inner pictures play a key role for the dynamic maintenance of personal health, influence the development of each individual's illnesses and sustain the recovery processes. They must not match with the ongoing medical knowledge about the disease and the physician's own personal illness experiences and inner pictures.

We claim that the therapist has to know about each patient's inner pictures as well as his own meanings, ideas about sickness and health, and that the thus constructed common reality gives a vital direction in an individual health promoting process.

We suggest that inner pictures play a similarly important role for the opinion leaders who shape the societal political discourse and decide the further development of the health system.

As both, artists and therapists we want to explore the potential of such inner pictures and visual dimensions for individual self-competences and healing processes with the conference delegates. We want to explore societal reflections about purpose, goals, values and simple rules to drive the health care system in a commonly agreeable direction.

We propose to contribute with an interactive scientific artistic performance to the conference. With our creative work we will visualize the ideas raising out of the discussions. Together with the participants we want to experience the creation of unpredictable new pictures which evolve from this common mutually influenced learning process.

For practical and resource reasons we propose to participate virtually at the conference with a direct internet connection between our workroom in Berne, Switzerland, and the meeting rooms in Billings, Montana, USA.

The Complex Relationship Between Health Outcomes and Health Factors in the Pacific Northwest

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Background: The County Health Rankings and Roadmaps study supported by the Robert Wood Johnson Foundation has provided a wealth of information on the status of health and healthcare within each state. However, very little research has been undertaken to establish validity of the relationships.

Aims and Objectives: We explored the specific relationships between Health Factors and Health Outcomes in the 5-state Pacific Northwest (Washington, Oregon, Idaho, Montana and Wyoming) in order to better understand how to direct resources for health improvement.

Methodology: Multiple quadratic models were tested to relate Health Factors to Health Outcomes. The data were obtained from the University of Wisconsin County Health Rankings Center

Results: Overall, the goodness-of-fit of a quadratic model was found to be: Wyoming: $R^2 = 0.78723$; Oregon: $R^2 = 0.76949$; Montana: $R^2 = 0.75098$; Washington: $R^2 = 0.74335$; Idaho: $R^2 = 0.45464$. The fit in Montana was better for those counties scoring worse than average while in Oregon and Wyoming it was better for those scoring better than average. In Idaho and Washington, it was roughly the same for each.

Conclusions: An "Hispanic Paradox" (better than expected health outcomes related to percent of Hispanic population) was seen in Washington State when the percent of Hispanic population was above 28%, percent Native American population below 6% and percent of non-English speakers above 13%. This is consistent with the Hispanic Paradox seen elsewhere. Exploration of the overall percent Native American population showed no effect on Health Outcomes in Washington and Wyoming and a questionable negative effect in Oregon and Idaho. In Montana counties with a greater than 8% Native American population there was a linear negative correlation with Health Outcome with an $R^2 = 0.93883$. These findings have important implications for health disparities research and remediation, especially where improvement in Health Factors can be expected to have a good correlation with improved Health Outcomes.