Socially Responsible Innovation in Health Care: Cycles of Actualization

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Abstract:
This paper seeks to theorize the mechanism by which socially responsible innovation can provide high quality care for patients within the U.S. health care system. By analyzing three exemplary case studies of health care innovation using content analysis, we reveal the mechanism for socially responsible innovation and also suggest places for future implementation. Socially responsible innovation has already taken place in India through design problem solving at Aravind Eye Care System, and in the United States through the Chronic Care Model across hundreds of hospitals, and Lean Management ™ principles at ThedaCare. Unlike previous theories of organizational learning such as incrementalism and design problem solving, socially responsible innovation puts the patient at the center of systemic health care solutions. Also unlike previous definitions of socially responsible innovation, our conceptualization has a broader scope and a more practical application. When analyzing the three exemplary cases of socially responsible innovation, we drew out elements of previous mechanisms of organizational learning (e.g., psychological safety, trial and error, and positive applied theory, etc.) to create a novel reflective mechanism, cycles of actualization. This new reflective mechanism promotes continuous development and implementation of ideal models of practice. Finally, this paper suggests that medical waste management could benefit from socially responsible innovation. If the U.S. health care system adopted socially responsible innovation, facilities could think more holistically about their duties, enacting patient-centered change, and creating a culture of medicine that promotes learning, reflection, and action.

Keywords:
Healthcare Organizations and Systems; Incentives in Health Care; Clinical Practice Patterns/Guidelines /Resource Use/Evidence Based Practice; Quality Improvement/Report cards/Interventions

1. Introduction:

In order for medicine to advance, doctors must reframe their loyalty towards patient-centered innovation. All doctors took the oath to be "loyal to the profession of medicine and just and generous to its members." This loyalty, while honorable, may impede the doctor's ability to be "just and generous to its members." If practitioners stay loyal to their profession, whose epistemology may be resistant to change, how might medicine advance and innovate for the greater good? It appears that for medicine to advance, the profession might reframe loyalty as a commitment by medical and allied health professionals to patient-centered innovation.

The United States government has begun to incentivize research on how to improve patient-centered care. The US spends more on health care than any other industrialized nation, yet that spending has not equated to increased care quality. There is a disconnect between the magnitude of resources invested and the results from this investment [1]. Recent discussions and federal policy changes surrounding health care have incentivized research on low cost, high quality, patient-centered care [2]. Practitioners desire to make the most of this research and utilize it work to redefine what it means to be patient-centered and innovate in socially responsible ways. However, while this new federal research funding is helpful in creating opportunities for innovation of patient care quality, it does not embed a framework or methodology to do so effectively. Prior definitions of socially responsible innovation involved multifaceted innovation [3, 4], with cross-functional teams [5], based on local philosophy [3, 4], that challenges postcolonial dependency [3]. In this paper, we expand this definition to include reflection, goal setting, and data-driven changes.

1.1 Socially Responsible Innovation:

One origin of the scholarly interest in socially responsible innovation is rooted in a European Commission from 2011 [5, 6]. This early conceptualization of socially responsible innovation focused on reducing risks of new technology through the “close collaboration between natural and social scientists” [5, pg.134]. This definition of socially responsible innovation was primarily used as a way of integrating social and ethical considerations into research and development; it was summarized into a useful acronym of four elements for the socially responsible innovator to consider: aid, good tools, time, and chance [5].

Innovation is currently needed in healthcare to improve patient overall wellbeing. This innovation does not always begin within a laboratory or research group to be later transferred to practice. Instead, it can start with professionals striving to improve their local and daily practices in socially responsible ways. Our definition combines Filpse et. al's definition with other scholarly work where socially responsible innovation is a theoretical framework that includes four aspects: scientific innovation; organizational innovation; technological innovation; and "an underlying ideological orientation that is based on local philosophy (and challenges hegemonic understandings of postcolonial dependency)" [3, pg. 449-475]. In this paper, it has been expanded to include a philosophical shift toward collective reflection and goal setting, in a health care setting, that is data-driven and involves cross-functional teams. We also will be focusing on how institutions that endorse socially responsible innovation are challenging postcolonial dependency abroad and within the United States. Our new expanded definition is intended to increase the practicality of socially responsible innovation by providing a mechanism of application: cycles of actualization.

Socially responsible innovation represents a philosophical shift in innovation in medicine that might reinforce a culture of learning, reflection, and action allowing practitioners to be responsive to their patients' changing needs. Moving beyond traditional ideas of patient wellness that are only biological, health care might reframe what it means to create optimal health and protect patient wellness. Newer ideas of patient wellness might include physiological outcomes, patient financial wellness, and overall community wellness. Reframing optimal health might require cross-functional teams involved with care, conducting research to comprehensively improve their practices. Hospital leadership is interested in health innovation, however, a problem is that there is no consensus on how to measure the impact of innovation. Reliable processes of innovation challenge practitioners to reflect on whether their innovations align with their work mission. Socially responsible innovation might be a step towards medicine within the United States fulfilling its mission.

Socially responsible innovation actualized by teams within the hospital provides opportunities for implementing new (or existing) low-cost processes locally. These low-cost patient-centered innovation processes might lower costs associated with health care and improve the overall care quality for patients. The current health care innovation theories in the United States [7, 8] will benefit from learning from these newer case studies that exemplify a philosophy of socially responsible innovation and provide a mechanism to actualize innovation at the local level.

With this paper, we propose that the implementation of socially responsible innovation in the United States health care system might hold the key to fulfilling medicine's social mission: to give patients the best care possible. Ideologically, it creates

opportunities for medicine to advance in ways that are holistic for the patient – addressing aspects ranging from physical to fiscal health. In order to conceptually expand upon the definition of socially responsible innovation, this paper will begin by describing the literature on organizational learning. Next, it will lay out three exemplary case studies: Aravind Eye Care System, The Chronic Care Model, and Lean Management ™ in Health Care. A case study in India is studied first, socially responsible innovation is thus first defined by using an international case study in a less economically developd country, but is later refocused onto the United States by considering the changing healthcare climate. These case studies will then be analyzed using previous organizational learning theories. Subsequently, insights from these three case studies will be drawn out to reveal the underlying mechanism for socially responsible innovation: cycles of actualization. Finally, the cycles of actualization mechanism will be applied to a current problem in medicine that could benefit from socially responsible innovation: medical waste management.

1.2 Organizational Learning Theories and Cycles of Actualization

In the past twenty years, many scholars have researched a variety of healthcare systems, with the hope a new method of organizational learning could improve hospital practices [7, 8, 9]. Researchers have not only proposed new organizational learning theories but have also analyzed many past theories including: incrementalism and positive applied theory, design problem solving, individual second-order problem solving, and high reliability organizations. One new insight is that using multiple approaches could have a positive or negative effect, depending on the phase of improvement [10]. However, using reflection to determine the best method of

organizational learning is important, instead of trying to employ multiple methods without forethought.

A large portion of research on organizational learning has focused on the theory of incrementalism, proposed by Lindblom [11]. Lindblom proposed incrementalism as a way for decision makers to make more efficient policy decisions by comparing similar policies to each other, using trial and error, and moving forward in appropriately sized steps. A key aspect of incrementalism is successive limited comparisons among alternative policies. This method of comparing is more practical than comprehensive decision making because no administrator can fully understand any one policy, especially if it is on a topic unfamiliar to him or her [11, 12]. Another important aspect of incrementalism involves depicting problems through negative applied theory and positive applied theory. Positive applied theory explains why a certain solution will work, whereas negative applied theory simply offers a diagnosis to a problem [13].

Recently, there has been a discussion over whether to continue studying incrementalism and comparing it with comprehensive decision making. Incrementalism is not optimal in many situations, confusing to teach, and does not have a strong following [13, 14]. Incrementalism is mainly useful in stable environments, unlike comprehensive decision making, which is useful in unstable environments [14]. For example, incrementalism would be more suited for situations in which there is no impending crisis or changing environment, like a financial firm, whereas comprehensive decision making would be more useful in situations that are frequently changing, as in high-reliability organizations. Comprehensive decision making differs from incrementalism as it entails considering all the possible options and outcomes. A major critique of comprehensive

decision making though is that it is infeasible, due to the countless options combined with the bound rationality of policy makers [14].

Incrementalism has frequently been studied in the context of health care systems as a way of more effectively choosing policies. The method of successive limited comparisons helps expedite the policy-choosing process, while not sacrificing quality, meaning acceptable policies can be chosen in a much smaller timeframe [13]. Speeding up the policy-choosing process will help hospitals gain further efficiency at an overall administrative level.

In the last ten years, various researchers have also studied the differences between incrementalism and design problem solving. Design problem solving means involves creative problem solving and data analysis to design a new mechanism of organizational learning instead of picking a mechanism based off previously existing theories. One conclusion was that the type of decision-making affects the amount of information overload in an organization [14, 15]. When using design problem solving, information overload often occurs, as there are no limitations to what information may be used. This broad approach to problem solving often leads to innovative results but may be less efficient.

In contrast to the above organizational learning theories that describe collective decision-making, other research evaluates individual decision-making and its implications for understanding problems in the organization. A recent investigation of problem solving examines the difference between first-order problem solving and second-order problem solving for individual decision-making within an organization. First-order problem solving involves workers compensating for a problem by getting the

supplies or information necessary for completing the task but does not solve the underlying problem. Second-order problem solving occurs when the worker initiates actions that ultimately address the underlying causes, instead of just patching the problem [7]. Second order problem solving requires a supportive organizational context to include managers, modeling, cooperative work, and psychological safety. In order for second order problem solving to be completely successful, all individuals in an organization must be participating; effects can still be felt though if one individual makes the choice to use second order problem solving.

Psysychological safety is crucial for organizations to adapt because its presence ensures that people are more likely to report incidents of inefficiency. Psychological safety is the ability to question practices and admit mistakes without being punished [8]. It is also the cornerstone of a no-blame system and is extremely crucial in high-reliability organizations, where even small errors can seriously hinder a firm's existence and the safety of employees and customers [9]. In order for organizations to adapt and improve, critiques must be openly accepted in order to recognize all faults of the system and make improvements.

Organizations in healthcare, for example, and clinics and hospitals, are often described as high reliability organizations. According to Scott Sagan, HROs include four characteristics: "safety is a primary objective held by those in command, redundancy is necessary, not wasteful, personnel are ordered in a common organizational culture of reliability, yet remain flexible, and they must have a strong capability to learn" (Sagan 1993). Looking at this definition, one can easily see how air traffic control systems at airports, nuclear power plants are classic examples of HROs and where parallels exist

between the theory around high reliability organizations and socially responsible innovation.

Although entire hospitals cannot be considered high-reliability organizations, wards like Intensive Care Units (ICUs) or Neonatal Intensive Care Units (NICUs) can. In hospitals as in HROs, safety is crucial, as ensuring the care of patients is one of the highest priorities. Everyday work practices are highly redundant in order to maintain quality of care, but hospital staff must also remain flexible to meet unique patient needs. Personnel within hospitals are highly ordered and frequently stratified in a hierarchy, yet every individual remains accountable. This is especially seen in the demand on nurses. Finally, hospitals must constantly be adapting to better meet patient needs and incorporate new science and technology. Socially responsible innovation helps hospitals continue to learn and remain flexible, and thus our conceptualization of socially responsible innovation has this strong commonality with Sagan's conceptualization of HROs. However, socially responsible innovation is not only focused on safety but additionally focuses on patient-centeredness, multi-disciplined teams and supporting organizations that are self-sustaining and independent.

While past research emphasizes the various types of organizational learning theories already existing, a question still lingers: how do organizations apply the necessary theories and achieve satisfactory levels of success in their endeavors? There are few model cases where a health care organization effectively chooses, or creates, the mechanism of organizational learning best suited for their situation and for the proper care of patients. Especially in hospitals, first-order problem solving occurs much too often and leads to wasted time and resources [7]. Hospitals are not running at their full

efficiency, unnecessary waste is created, and patients may fall between the cracks and not receive the best care. In hospital based HROs, such as ICUs' and NICUs', the checklist of procedures must be scrutinized very closely, as small errors can cost lives.

Previous research has not focused on how organizations determine that they are using the best fitting mechanism of organizational learning. The highest performing hospitals are engaged in learning with a "rethinking orientation", similar to trial and error methods [16]. This suggests that successful hospitals must be able to look back at the decisions they make, analyze the outcomes, and possibly make changes. A lack of psychological safety for workers in organizations (i.e., nurses in the case of hospitals) may lead to undue shaming associated with gaps in care in the short term, and furthermore, may negatively impact patient safety in the long-term, as small problems are solved [16]. While there is a large focus on explaining and analyzing different theories, there is still a lack of analysis on the differences in application and outcome of these policies in healthcare.

Specifically, one gap in current research is the relationship between the implementation of organizational learning theories and patient outcomes. Socially responsible innovation might fill this gap, as it helps doctors consider their choices in their patient's best interests. Similar to incrementalism, socially responsible innovation uses a form of trial and error to help doctors reflect on the choices made. The process of trial-and-error is constant, as one change can lead to different outcomes and requires new analysis. This philosophy of learning and reflection helps ensure better patient care.

Socially responsible innovation's approach to patient health care also mirrors comprehensive decision making, as in order to meet patients' unique needs, many aspects

of care and the patient must be considered holistically. Cultural competency is crucial in improving overall patient wellbeing, as practitioners must work with culture and communities to provide the best care. In order to be culturally competent means to be inclusive and sensitive to how people's culture influences behavior. For example, many Indians are vegetarians and do not receive much fat naturally in their diet. Due to this lack of fat, it is often more challenging for these vegetarian Indians to heal after surgery. Being culturally competent and aware of this diet difference, many ophthalmologists tell their patients to make an effort to eat something high in fat after surgery in order to speed up the healing process within the eye.

Socially responsible innovation uses trial and error, and cultural competency to take incrementalism and comprehensive decision making to the next step, by also considering a specific work-based mission and ideology. In this case of healthcare systems, socially responsible innovation involves a mission of improving patient care and ideology of medicine's social mission. Socially responsible innovation also strives to be efficient, including the elimination of unnecessary waste, in all forms. Lower overall waste can also lower the cost of patient health, so it becomes more patient-oriented, an overall goal of socially responsible innovation when implemented in healthcare systems. Organizations using socially responsible innovation have seen increased patient care results and lowered costs.

Cycles of actualization is what we call the mechanism by which socially responsible innovation is enacted and helps practitioners constantly consider the best interests of the patient. This mechanism involves utilizing trial and error and second-order problem solving within an organizational culture that ensures psychological safety.

By examining cases of innovation within a hospital setting, it may become clearer that such a systematized mechanism of reflection may improve hospital practices, hospital technologies, and hospital sciences, thereby resulting in better patient outcomes. Previous organizational learning theories focused on how to make systems more efficient, but often failed to see how to best serve the patient at all levels. Infusing the philosophy of socially responsible innovation into medicine could help create a culture where medical professionals continue to frame their choices in the best interests of the patient. Socially responsible innovation will help reframe what it means to create better patient wellness and may lower costs.

2. Three Cases of Socially Responsible Innovation in Health Care

Three exemplary cases of socially responsible innovation illuminate larger thematic connections in a content analysis. The first exemplary case is drawn from data from an ethnographic study of India's Aravind Eye Care System, in order to highlight the role of design problem solving in improving health care quality. Even though it is not set in the US, this case helps to contextualize our use of socially responsible innovation and cycles of actualization. This case also demonstrates how self-reliability and economic sustainability challenges traditional post-colonial dependency, as mentioned in the earlier definition. The next two exemplary cases are the Chronic Care Model and Lean Management ™ in health care. Through these two cases, we reframe socially responsible innovation through a domestic context. These cases them challenge previous beliefs and dependency by showcasing how hospitals are self-sustaining and disrupting previous norms on innovation and decision making. Later in this paper, the insights gained from comparing the exemplary three cases will be used to illuminate the potential for socially

responsible innovation in medical waste management transforming it into green medicine.

2.1 Case 1: Design Problem Solving at Aravind Eye Care System in India

The first model of socially responsible innovation, Aravind Eye Care System, used design problem solving to improve post-operative patient care after cataract surgery. Aravind Eye Care System is located in Tamil Nadu, India; it is known as the largest specialty care system for eye health care in the world. However, the evidence-based practices for which it is known have been established over time. In the early 1980s, Aravind was systematically analyzing the reasons for late patient discharge following cataract surgery. At the time, an older cataract surgical technique was used that required suturing of the surgical wound, considered the standard of care for cataracts in the developing world [17, 18, 19].

After collecting and analyzing the data systematically, they noticed that the immediate postoperative complications were higher in patients who had received three sutures compared to five or more sutures. At the three month and six month checkups, patients who received three sutures were more likely to return with infections and other postoperative complications than those who received five sutures. With the availability of the evidence, there was a directive for all the surgeons to use five sutures instead of three sutures. They noticed that this improved the aggregate surgical outcomes for the patients. However, the senior surgeons resisted this change and continued to use three sutures, citing their higher levels of skill in performing the surgical procedure. Finally, both the junior and senior surgeons were convinced by the data to always use five sutures instead of three sutures to close the surgical incision. Once the five suture solution was implemented systematically, there was a greater improvement in the aggregate surgical

outcomes for the patients who had undergone the cataract procedure. Having proved through the systematic collection of data that this was the best practice, they made it a standard or required practice at Aravind Eye Care System for this type of procedure across all of Aravind's cataract surgical units [17, 18, 19].

Another study conducted by Aravind showed how using design problem solving not only increased patient wellness, but also decreased cost. One of the most serious consequences of cataract surgery because of the high possibility of vision loss is endophthalmitis, an infection of the inner eye. Gentamycin injection inside the eye during cataract surgery helped prevent endophthalmitis and thus reduced cases three and a half to four times compared with patients that did not receive the injection. Doctors at Aravind have been using a version of these injections since the 1970s, but it was not recognized worldwide as a practical means of preventing endophthalmitis until 2006. At that time, the efficacy of gentamycin injection was established, but was still widely underutilized and mostly unavailable outside of Europe [20, 21]. Inspired by these studies, Aravind first implemented the injections at a Madurai hospital and then expanded to all ten surgical centers. Not only was it found to decrease endophthalmitis in normal patients, but also helped to reduce endophthalmitis in eyes with complications, an especially at risk group [20, 21]. This has helped decrease costs by reducing the amount of patients that have to come in for post-op care. By reducing the amount of returning patients, Aravind was also able to serve more patients with less financial strain [20, 21].

2.2 Case 2: The US Chronic Care Model using Positive Applied Theory and Reflection

A second model of socially responsible innovation exists in the United States: the design and implementation of the Chronic Care Model that centered around patients' visit

to the doctor's office and improving proactive tactics. The first article on the Chronic Care Model took interest in "efforts to either design new care systems for patients with chronic illness or systematically to reorganize existing care systems" [22, pg. 511]. The team who imagined the Chronic Care Model saw a problem with the structure of medicine that was directly impacting patient outcomes, specifically chronically ill patient outcomes. Chronic Care was organized around the visit to the doctor's office and how little effort was being channeled into empowering patients because there was no incentive to do so. The system for scheduling patient-doctor visits left doctors too rushed to conduct patient education. These doctors were not able to inspire self-management in their patients and were left to be reactive rather than proactive. The team found that patients needed ample time with providers, ready access to professionals within the team, and regular assessments [22].

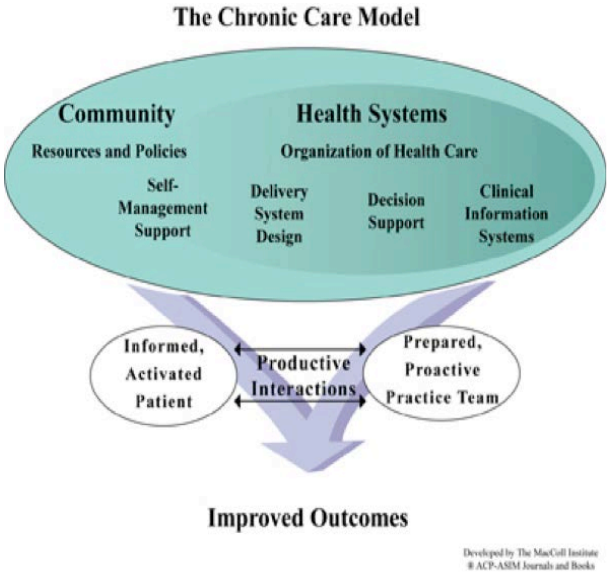

Figure 1: Chronic Care Model

To address these issues in care, the Chronic Care Model was designed (Figure 1) [23]. High quality chronic illness care elements identified were expertise, patient education, practice redesign, and information systems [22]. These areas of chronic care were studied in other settings in order to lay the groundwork for this ideal model of chronic illness care. The Chronic Care Model has changed over time incorporating concepts like cultural competency in delivery system design and care coordination in clinical information systems. This serves as evidence that ideal models are changing entities that grow with patient needs [23].

Later, the Assessment of Chronic Illness Care (ACIC) practical quality assessment tool was developed by drawing upon themes derived from the Chronic Care Model. The tool was different from most other quality assessment tools because it was not rooted in accreditation, but rather in reflection and improvement. Encompassing health care facilities across the nation, 108 teams of multi-disciplinary professionals participated in a 13-month collaborative, implementing the tool with cycles of "plan-do-study-act". The tool was used to assess the quality of the facility in health care delivery for a specified chronic illness. The teams were advised by an expert in the Chronic Care Model and served to enact systems changes within the six identified areas of chronic care: community linkages, self-management support, decision support, delivery systems design, information systems, and organization of care. The systems changes were not drastic, but small changes in practice that led to larger improvements. The teams used the ACIC tool to rate the quality of the six areas at the beginning and end of a 13-month collaborative, with many facilities seeing a positive change over time. When comparing the ratings of the teams to the Chronic Care Model experts who served to calibrate the

teams' ratings, there was agreement in five of the six areas [24]. The tool allowed professionals to reflect on their practice; this reflection, along with a strong knowledge base, allowed for improvements to be made in their practice. An example of this tool in practice would be with diabetes patients using enhanced information systems to remain engaged in making informed decisions for healthier outcomes. This use of informed decision making to garner improvements embodies the idea of socially responsible innovation. In the next exemplary case study about Lean Management in health care, one can also see the importance of reflection in knowledge creation and improvement.

2.3 Case 3: Lean Management in US Health Care through Incremental Improvement

The third model of socially responsible innovation is also in the US and called ThedaCare, a multi-hospital, for-profit, community health system in northeastern Wisconsin. ThedaCare uses Toyota's Lean Manufacturing ™ principles to reduce waste and entails an attitude of continuous improvement.

The implementation of socially responsible innovation in U.S. health care will require a cultural shift in medical practice that challenges traditional ideas of quality medical care. Such a cultural shift in medical practice will involve redistributing power from traditional hierarchies in ways that place patient-centered innovation in the hands of those on the front lines of providing care. ThedaCare is an example of this emergent cultural shift in medical practice. Toyota's Lean Manufacturing ™ values striving "to see waste in all its manifestations, eliminate it, create one-piece flow, and improve continuously" [25, pg. 1344]. Applying this philosophy to health care management, Lean Management ™ is an attitude of continuous improvement that unifies purpose, creates value, and practices transparency and flexibility while maintaining respect for those who

are doing the work [25]. These essential principles and the emphasis on a reflective culture are what make medical and allied health professionals at ThedaCare socially responsible innovators. ThedaCare innovation involves attention to detail, measurement, experimentation, and restructuring of social, operational task sequences and physical entities in ways that challenged staff to look inward while working to achieve high quality patient-centered care.

In one example from ThedaCare, teams improved patient care, eventually decreasing mortality rates and increase quality of life. Some tools utilized by ThedaCare innovation practices were value stream maps and "Plan-Do-Study-Act" practices. With the patient as the first priority at ThedaCare, the organization had to define what value meant to the patient: "benefits received for burdens endured" [26, pg.76]. When working on an improvement project, teams drew out maps revealing the patient experience from admission to discharge, step by step. These maps allowed them to visualize and reflect on their practices, looking at how certain steps might help or harm the patient. By focusing on steps valuable to the patient and restructuring tasks to be of greater value to the patient, innovation teams eliminate wasted time and resources that take value out of patient care. The teams then develop an ideal practice stream that is in the patient's best interest. This practice challenges the notion of externally comparative metrics as the sole measure of quality in medicine. In addition to looking outward, the staff at ThedaCare utilize to look inward to push towards a culture of aspiration and optimal patient care. It is a philosophical shift in using metrics as tools of aspiration and growth rather than just as measures of comparison to other facilities.

With such aspirational goals, staff at ThedaCare recognized large improvements,

especially in cases of acute care such as heart attacks and strokes, where repercussions can be serious. After the implementation of Lean Management principles through standardized checklists, mortality rates decreased and patients had higher quality of life after the hospital intervention. It is when this purpose of metrics is realized that facilities will begin to enact patient-centered care, rather than comparative care.

2.4 Analyzing Three Cases:

There are many similarities between the cases studied and the organizational learning theories previously discussed. Each case study discussed earlier uses a slightly different theory of organizational learning within socially responsible innovation to ensure excellent outcomes for patients; these outcomes are defined differently for each disease, timescale, etc. Similar between each case is the sense of psychological safety; the medical institutions that implemented these changes in patient-centered care were places where medical and allied health professionals felt safe in pointing out errors because instead of emphasizing personal blame, the institutions focused on systemic changes.

Aravind Eye Care uses design problem solving to think creatively of a solution to improve overall patient well-being, which includes physical and fiscal outcomes. Design problem solving at Aravind entails creative thinking to think of a new process, instead of relying on past processes. Requiring surgeons to put in more sutures was not originally proposed as a way to improve patient care. In order to solve a problem, Aravind staff discovered through new research and creative thinking that more sutures would make a large impact on patient recovery. Additionally, using gentamycin injections was not recognized as an efficient means of reducing endophthalmitis in post-operative patients, but the long-term results from Aravind have shown a large increase in patient wellness and a decrease in cost. These instances of creative thinking at Aravind refocused

innovation onto the patient wellness. Aravind is an international case, but provides a great example of how the core concepts of socially responsible innovation help provide better patient care. Firstly, this innovation was multi-faceted involving both organizational and technological changes to track patient outcomes with real-time data accessible by any hospital administrator. Secondly, Aravind staff utilized what they called "systems thinking", which was a form of design problem solving that worked backwards from a poor patient outcome (post-operative complications after cataract surgery) and implemented a solution using a form of incremental trial and error, but at a large scale. By utilizing their own local philosophy for problem-solving, staff at Aravind Eye Care System have built-up confidence in their abilities to produce organizational innovations through constant reflection, and responsiveness to large-scale data. Meanwhile, over time, Aravind has developed an excellent reputation inside and outside of India, which challenges the implicit privilege that Western medicine has over Indian medicine. These ideas can then be applied to domestic cases of problems in United States healthcare.

In the second case, the Chronic Care Model used positive applied theory to determine which system is best suited for patients, in order to ensure proper individualized patient care. Instead of simply diagnosing the problem, they built a better solution and demonstrated how it would efficiently operate. First, they determined that the best system included more patient education, more patient self-management of health, and better quality information exchange between the patient and his or her health care provider. Next, the experts implemented large overall system changes to move swiftly over to the new system. However, this multi-faceted innovation did not end with

organizational and technological changes. The cross-functional expert teams also developed an assessment tool and iterated between making small changes in their organizations and reflecting on the benefits and disadvantages resulting from these changes using the assessment tool. This new tool uses the theory of incrementalism in how changes are made and reflection is constantly performed. To the one-hundred and eight teams across the US who used it, the assessment of chronic illness care tool represented a shared philosophy that was not grounded in any one institution's goals or values, but instead in these medical and allied health professionals' shared and emergent philosophy towards patient-centered care. It too challenged postcolonial dependency because instead of relying upon copying the best practices of a high-status medical institution, each of the teams could implement their own carefully iterated, implemented, and tailored best practices driven by local goals and local data. The example of the Chronic Care Model can specifically help improve high-reliability organizations within medical institutions, such as e.g., Neonatal Intensive Care Units, etc. In HROs, systems must be must matched to patients' needs, as imperfection and inefficiency can lead to increased patient harm and possible death. The Chronic Care Model allows practitioners within HROs to effectively adapt and make appropriately sized steps to enact change. Smaller steps are more appropriate for HROs as incorrect changes, just like inefficiency, can lead to more harm.

The flexible nature present in Lean Manufacturing ™ that ThedaCare uses closely mirrors the trial and error present in incrementalism. As seen in ThedaCare, this allows practitioners to more easily adapt to new information and changing situations. This reflection encourages practitioners to look inward, instead of focusing on outwardly

portrayed information. When done properly, the system of reflection should improve advertised statistics about patient outcomes after hospital interventions.

Similar to the other two models of socially responsible innovation, staff at ThedaCare utilized multi-disciplinary teams that worked to improve organizational practices and accountability measures for the medical institution. Their approach utilized an extant philosophy from manufacturing and applied it to medical care. The resultant changes in organizational practices significantly improved patient care and mortality statistics for common acute conditions such as heart attack and stroke. ThedaCare's position as a mid-western, community-based health system challenged postcolonial dependency because it challenged the privilege that urban (and usually coastal) hospitals have over rural and suburban hospitals in Western medicine. ThedaCare was also strategic in its use of setting goals, collecting data, reflecting upon data, and acting upon data. Like the Chronic Care Model, ThedaCare also uses aspects of incrementalism, with reflection and action. ThedaCare also addresses the root cause of the issue with second-order problem solving, instead of just patching up the problem.

3. Cycles of Actualization: A New Mechanism

Even though ideal models for patient-centered innovation exist, many medical institutions and practitioners have been slow to alter their practices and often lack a mode of doing so. A recent article asserts the importance of using metrics to inform purpose, performance, and aspiration. The article also challenges primary health care providers to see the interconnectedness of the many care aspects through a whole-person approach [27]. While we believe these cultural changes are vital to the process of socially responsible innovation, we also believe that such large-scale cultural changes require a

mechanism by which to operate. Cycles of actualization provides the reflection and action mechanism that socially responsible innovation requires.

As previously mentioned, innovation does not solely occur in the laboratory, but must extend to practitioners as well with locally generated, evidence-based practice. Donald Schön defines the relationships between researchers and practitioners as disconnected [28]. Challenging the traditional epistemology of medical knowledge, hospitals need to think critically about the ways that they operate within their communities and strive toward ideal models of practice through the production of locally generated, evidence-based practice. Locally generated, evidence-based practice is apparent in all of the case studies in this paper; it allows practitioners to create a body of knowledge made up of local contributions. Those contributing and applying that knowledge take ownership of that data, and ultimately use it to enhance patient care. Reliance on local knowledge and evidence (while still being responsible to patient care quality) negates the need for dependency on universal Western norms of good medical practice, but does not obviate the utility of such norms as a benchmark.

While these case studies are diverse in their settings and purposes, when assessed in parallel, one can see that 1) small changes in practice combatting a defined problem were made and 2) actionable data on those changes were recorded to inform further practice. In other words, the three cases demonstrate the use of trial-and-error, second-order problem solving, positive applied theory, and constant learning in an organization that promotes psychological safety. In all of the case studies, the key was to produce actionable data professionals could use to see whether their practice changes were making an impact and combatting the defined problem. If it was helpful in combatting

the defined problem, professionals continued to implement that small change in practice because it was based on patient-generated knowledge. These actions contribute to an underlying mechanism for socially responsible innovation called cycles of actualization, seen in figure 2.

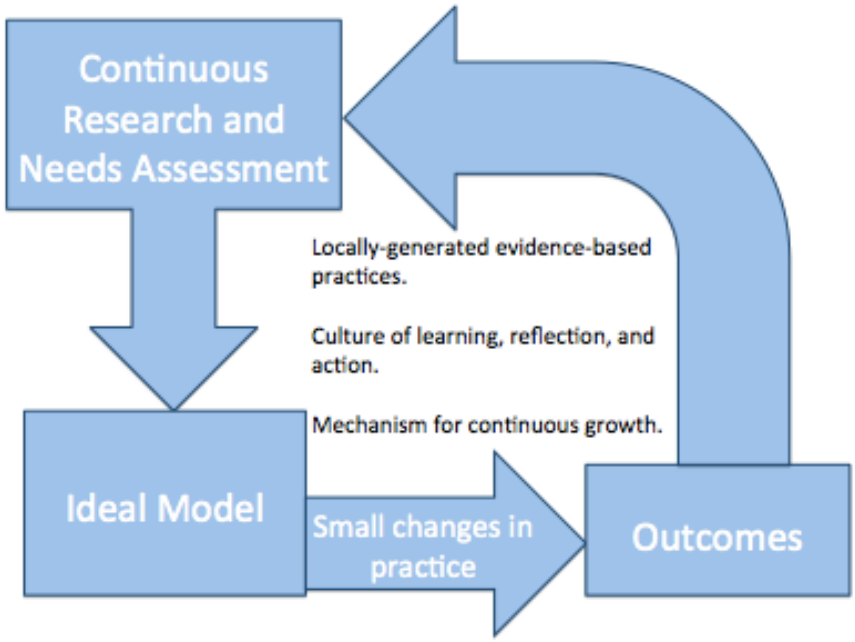

Figure 2: Cycles of actualization

Cycles of actualization challenges practitioners to take ownership of medicine by naming problems, making small changes, and reflecting on those changes in order to pursue an ideal model for practice. First, the practitioner defines a problem in medicine through continuous research and needs assessment. From this problem, an ideal model is imagined. Once an ideal model has been created, practical quality improvement tools that are informed by the ideal model are generated. Professionals collect patient-generated data in order to better inform the practice and utilize this tool. The practical quality improvement tools allow health care professionals to collectively reflect on their practice

and where they stand in relation to the ideal model. From this patient-generated knowledge, practitioners make small changes to move toward their ideal model of practice. The outcomes retrieved from these small changes are measured, fueling the ideation of a new ideal model through a virtuous cycle of learning, reflection, and action. ThedaCare, Case 2, shows this cycle of learning, reflection, and action.

Incrementalism is the organizational learning theory based on reflection and steps based on comparison between marginally different policy choices in order to make a larger change. This cycle of thoughtful changes seen in cycles of actualization is an extension of a basic trial and error method found in incrementalism [11], by going a step further by naming problems and solving them via second-order problem solving [7]. Positive applied theory, a component of incrementalism, is also used in cycles of actualization as the model suggests which actions will work the best.

Similar to comprehensive decision-making, cycles of actualization uses many forms of data to consider the problem holistically in many contexts. However, cycles of actualization differs from comprehensive decision making as policy decisions are limited to comparing to previous existing policies, instead of comparing all possible options and outcomes.

As previously mentioned, cycles of actualization is similar to the basic trial and error found in incrementalism, but is improved as it includes second order problem solving, an aspect of design problem solving. Design problem solving encompasses creativity and original thought to help solve problems [15]. Although it creates innovative solutions, design problem solving may lead to information overload, as there are no limits to what information is considered [14]. Second order problem solving addresses the root

of problems and helps enact substantial positive change in the operation of hospitals. In this problem-solving process, the individual is making decisions, thus allowing practitioners the power to enact changes themselves. In order to ensure this, though, managers must ensure psychological safety, so workers are able to express faults of the policy enacted.

These cycles of actualization may mobilize medicine to fulfill its ideal practice within the context of their communities. The processes' frequent comparisons to an ideal is similar to the method of successive limited comparisons mentioned earlier [11]. Successive limited comparisons is improved and streamlined, though, because the comparisons are being made to a single policy, instead of multiple. Cycles of actualization forces professionals to think critically as a team and compare their practices to an ideal model. This trial-and-error based comparative process is not done as a means of penalization, but as a means of aspiration. Routine reflection allows hospitals to restate their purpose and consider what they want to become. Socially responsible innovation is a practical extension of incrementalism and, through cycles of actualization, it can be adjusted to become optimal in a variety of situations and firms.

A limitation of this paper is that cycles of actualization, as shown in the three cases described above, does not offer an opportunity for incorporating how patients themselves perceive the new healthcare system into the feedback cycles. If patients do not feel that they are adequately cared for, then this new mechanism of organizational learning may not be as effective. How comfortable patients feel and the quality of patient care is the beating heart of socially responsible innovation enacted in a healthcare system. More research will be needed to assess patient attitudes to further support socially

responsible innovation. This new data could be gathered through surveys (pre- and post-innovation intervention) conducted in the facilities that use socially responsible innovation that measure how patient attitudes towards the treatment and care they are receiving.

4. Conclusion:

In conclusion, the implementation of socially responsible innovation is vital to medicine fulfilling its social mission. It calls for a cultural shift toward holistic ideas of patient wellness and aspirational metrics that are not solely based on external comparison as a measure of quality. The case studies presented in this paper illustrate several methods of socially responsible innovation with the same underlying principles of innovating in ways that place the patient first. Although all case studies illustrate methods of socially responsible innovation, they each emphasize components of different theories of organizational learning. This paper has provided a mechanism by which this change can be made, cycles of actualization. It was derived from the thematic principles that underlie the case studies and is flexible to operate in different contexts, making it much more practical than previous theories of organizational learning. Socially responsible innovation is about producing locally generated evidence-based care that adjusts to the changing needs of patients and treating the entire patient.

This paper is a call to action to leaders in health care. Innovation is not bound to the bench of a laboratory or the passing of a law, but can begin with those who are doing the work and know what patients need. Health care innovators can work within existing laws and regulations in order to provide optimal care for patients and the world beyond the clinic. As social movements call for community organizers, so does this cultural shift

in medicine. There may not always be tangible incentives for good practice; some rewards for good practice may be innate or might lead back to the patient. Innovating health care in socially responsible ways can help to treat the patient holistically and do justice to the social mission of medicine. A cultural shift toward learning, reflection, and action, as seen with our cycles of actualization, in addition to a reframing of the use of metrics, is needed in order to develop and actualize ideal models of practice in health care. With patients being so multi-dimensional, it is essential that the U.S. health care system strives to treat this patient beyond physiology. As patients are multi-dimensional, so is the US health care system. If medicine is ever to heal its own ails in ways that encompass a holistic systems approach, socially responsible innovation should be adopted and practiced.

4.1 Epilogue: Transforming Medical Waste Management into Green Medicine

Medical waste management is an often-overlooked area of health care delivery that holds immense potential for socially responsible innovation. Conducting a needs assessment, one can see the generation of medical waste in the United States is disconcerting in both rate and magnitude. The magnitude of waste generation and management practices has led to increased costs associated with medical waste management, and consequently patient care. In comparison to other industrialized nations, the United States produces the largest amount of medical waste. Each day on average, 5-7 kg of medical waste are produced per patient bed [29]. Multiplying that by every bed within every hospital and clinic reveals that the United States generates nearly 7000 tons of medical waste per day costing the health care industry $10 billion annually. Roughly 85% of waste generated by hospitals is non-regulated or non-hazardous waste, 60% of which can be recycled or composted [30].

To understand the problem with medical waste management in the United States, it is important to assess it within a global context. In developing nations, practices such as open dumping and burning contribute to unsafe environments in areas surrounding medical disposal [31]. In comparison, the United States has adopted safe measures of medical waste management such as incineration and sterilization that have kept people safe from exposure air-borne pollutants [29]. While this is a large accomplishment when considering human health from the exposure-based mindset, the implementation of socially responsible innovation could potentially lead to greater health for humans and their environment.

A conversation between Author 3, an American ophthalmologist and an African ophthalmologist at lunch during their training at Aravind Eye Care Systems in India highlights the difference in waste management perceptions between highly-resourced hospitals and under-resourced hospitals [3]

American ophthalmology fellow: ...everything is automated. ...

...

Author 3: But maybe that's not how it should be

American ophthalmology fellow: That's not how it should be if you want to save money, which supposedly, the US government wants to do. But in reality no one wants to save money. We also throw away everything.

African ophthalmologist: Yeah?

American ophthalmology fellow: Yeah everything goes into the dumpster, so we are not saving money, we are not saving energy and we are making a huge amount of trash.

African ophthalmologist: What do you throw away?

American ophthalmology fellow: Everything. [4, pg. 211-249]

Within this conversation, one can see the cross-cultural differences in approaches to using, re-using, and recycling high technology in the surgical ward. The American ophthalmologist is later confronted by the high quality visual outcomes and low infection rates in a surgical ward at Aravind whose patterns of re-use and recycling is strategically less wasteful (and therefore less costly) than those she has experienced previously in her surgical practice in the U.S. This interaction speaks volumes about how much room waste management has to improve in the U.S.

While sterile disposal practices of biomedical waste should continue in order to protect human health, medical waste management should strive for more stringent methods of hazardous waste determination and seek opportunities to recycle where possible. Medical waste management should reduce overall waste output, the costs associated with waste management, and health care costs for patients. Medical waste management is usually an afterthought of patient treatment, as it is seen as a consequence of treatment rather than a part of it. Moving beyond traditional ideas of patient wellness that are typically biological is essential in pursuing optimal health systems and protecting patient health holistically. The ideal model for medical waste management should encompass a perspective of waste that incorporates sustainability, eco-friendliness, and cost-effectiveness- a sort of green medicine.

Adopting the ideal model of green medicine will allow health care facilities to impact the world of patients beyond the clinical setting. It will not only be environmentally friendly, but cost effective for both providers and eventually patients.

This practice will have some costs associated with hiring people to sort waste, investing in onsite methods of medical waste management, and teams dedicated to finding new ways to reduce waste. However, these costs will pay off as the amount of medical waste produced decreases and less money is spent on disposing waste, we believe eventually lowering the costs associated with health care. This newfound wealth can then be passed onto the patients that the doctors took a Hippocratic Oath to treat holistically. By adopting the principles of green medicine, doctors can better uphold their oath not only to "do no harm" to the patients, but the surrounding environment. A change in these organizational processes must be considered for the betterment of human and environmental health.

In this proposed green medicine socially responsible innovation, traditional notions of patient wellness are challenged by looking at the fiscal health of the patient and the environment in which the individual lives. In this proposed area of innovation, waste output measurements will be consistently organized by teams of individuals who are dedicated to lessening the environmental burden of hospital waste generation. These teams would create and then utilize metrics to identify key sources of waste generation; they would then work to minimize waste output in ways that are fiscally, medically and environmentally healthy for the patient, health care professionals, and the public. Applying socially responsible innovation through these cycles of actualization could greater improve patient care and local health.

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