



## Merging Participatory Action Research and System Dynamics as a Locus for Transformation in a Large Scale Hospital Setting

MMF Ansermeah

Department of Orthopaedic Surgery, Addington Hospital, Durban, South Africa

E-mail: [Maseeha.Ansermeah@kznhealth.gov.za](mailto:Maseeha.Ansermeah@kznhealth.gov.za)

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### **Abstract**

In this paper, we report on the utility of merging Participatory Action Research (PAR) with System Dynamics (SD) as a locus for stimulating transformation in a large-scale hospital academic setting. This is significant because it provides points of cross fertilisation whereby the two frameworks act synergistically with each other to create high leverage interventions for change, which may otherwise not have been apparent. Coupled within a SD auspice, there was a synergistic blend of uncovering an overall ecological view of the public health care system. The PAR methodology is located within the epistemological realm of critical theory and constructivism, whereby facilitating positive social change is viewed to be the key outcome of such research. This outcome has been confirmed by the researchers prioritizing the necessity for a departure from the traditional expert-led health system, evolving into one which supports the empowerment of patients and health-care workers as a necessity. However, the implementation of the improvements has not been as straightforward as initially projected. Some of the challenges included the slow assimilation of proposed solutions for planned care and paucity of key engagement from upstream stakeholders. The value of this paper can potentially serve to encourage key stakeholders in public health care systems to consider viewing health care complexity through the lens of PAR and SD.

**Keywords:** *Participatory Action Research (PAR); System Dynamics (SD); Public Health*

### **Introduction**

The researcher has sought to understand the rigors of public health care delivery in South Africa from the purview underlying dynamic complexity which governs service delivery. This was from a context of a research practitioner working within an Orthopaedic Surgery department in a public hospital in South Africa. Escalating rates of litigation contributed to the search for more robust, scientific approaches to identify blind spots and design high leverage interventions whereby variables which

influence patient care will be influenced. Variables such as the average length of stay, number of days awaiting theater appointment and resource constraints were analysed to generate a System Dynamics framework. The interconnected elements were structured according to System Dynamics heuristics; thus challenging reductionist approaches currently in operation. An overall ecological view of the system was sought to further shed light on inherent systemic challenges plaguing the public health care system in South Africa.

This process was augmented by a mixed methodological approach which embraced the use of Participatory Action Research (PAR) to analyse the relevant heterogeneous factors. The cyclical learning nature of PAR as a methodological tool has catalysed a gradual process of developing, implementing, and reflecting on action taken at each stage of the learning cycle, as part of the research process.

PAR was selected as the driving methodological, pedagogical and epistemological framework underpinning a study undertaken at the hospital. The iterative characteristic of the action research cycles necessitated continuous reflection and reviewal of research undertaken (Norton, 2009; Goessling, 2020). In a large scale hospital setting, the researcher wishes to engage with the value of PAR below; appreciating the critical intersections of pluralistic dialogue around systems critique.

### SD and PAR Synergetic Interactions

PAR is a liberating research modality that departs from conventional prescriptive methods (Zimmerman, 2016). The researcher has been interested in the PAR methodology and has found it to be congruent with SD Thinking on the following planes of epistemology. There is much synergy and synchronicity between the two frameworks as illustrated in Table 1. One of the key influential links between the two paradigms, tabulated is that of emphasising ownership in improving one's own working environment rather than providing generalisations around issues concerning health care (Loewenson, 2014). This resonates with systems-as-cause-thinking whereby an active role in taking responsibility is stressed upon instead of seeking to allocate blame to other sources (Stroh, 2015). The above was considered by the researcher to be one of the main impactful cross linkages between SD and PAR. The researcher has particularly considered the empowering stance of exploring the merging of PAR with SD. This collaboration has served to be a locus for innovation, since both perspectives provide an evolutionary niche creating room for learning; in an ever changing context such as a large health care setting (Goessling, 2020). Further areas of similarities are highlighted in Table 1 related to non-linear patterns of analysis as well as cyclical feedback.

Table 1: Isomorphic linkages between PAR and SD

PAR PARADIGM	SD FRAMEWORK
<ul style="list-style-type: none"> <li>A shift in analysing social challenges from a linear cause and effect framework, to one of a participatory perspective that places special emphasis on the contexts of people's lives (Kelly, 2005).</li> </ul>	<ul style="list-style-type: none"> <li>Non-linear relationships between variables in SD Thinking (Wolstenholme, 2007).</li> <li>Non-linear interface recognises delays in cause and effect which are in constant flux whilst being self-organising and responsive to change (Sterman, 2018).</li> </ul>
<ul style="list-style-type: none"> <li>Cyclical nature of research, reflection, and action with reflection serving as a springboard for transformational interventions (Marshall, 2015).</li> </ul>	<ul style="list-style-type: none"> <li>Commensurate with the characteristics of CLDs and systems archetypes which are found in the realm of SD Thinking (Clancy, 2018).</li> <li>Systemic variables are tightly coupled revealing</li> </ul>

PAR PARADIGM	SD FRAMEWORK
	<p>interaction of the factors with each other and with extrinsic factors.</p> <ul style="list-style-type: none"> <li>• Feedback is thus a core characteristic feature of systems thinking where minor alterations in the system can cascade and be amplified (Maani, 2006).</li> </ul>
<ul style="list-style-type: none"> <li>• Ownership in improving one's own services rather than providing generalisations around issues concerning health care (Loewenson, 2014).</li> </ul>	<ul style="list-style-type: none"> <li>• Linked to systems-as-cause-thinking whereby an active role in taking responsibility is stressed upon instead of seeking to allocate blame to other sources (Stroh, 2015).</li> </ul>
<ul style="list-style-type: none"> <li>• Engaging a nuanced method to generating knowledge in its repertoire to be a self-reflective process for the purpose of transformation (Loewenson, 2014).</li> <li>• Empowering and liberating for participants, as it facilitates both a critical appreciation and reflection (McDonald, 2012; Marchildon, 2016).</li> </ul>	<ul style="list-style-type: none"> <li>• Reframing of mental models and dissolution of cultural barriers to change (Meadows, 2008; Stroh, 2015).</li> </ul>
<ul style="list-style-type: none"> <li>• Advances applications of participatory paradigms, emancipation of participants and empowerment of citizens, thus integrating the bottom-up and top-down processes (Wright, 2020).</li> </ul>	<ul style="list-style-type: none"> <li>• Lateralises the concept of innovation due to its multi-agent approach, sharp focus on complexities of human systems and emphasis on the simultaneous development of organisations, technologies, communities and relationships (Maatta, 2014).</li> </ul>

### Principles and Characteristics of PAR

Qualitative research synthesis initially began by adopting a clear interpretivist stance; however this has evolved in the latter years to take on more of a social-constructionist position (Loewenson, 2014). Traditional interpretivist study approaches have been criticised within the literature for attempting to develop an in-depth understanding of a theme whilst utilising what is sometimes considered to be tentative findings of qualitative research (Wimpenny, 2012; Goessling, 2020).

PAR, however posits the generation of knowledge as a by-product of social determinants hence this epistemological method is located within post-positivist, critical theory and constructivism. Knowledge is derived from the comparative experiences of reality by individuals who are directly impacted by the challenges being studied (Loewenson, 2014). PAR differs from interpretivist stances by making a contribution of building greater meaningful insights through an approach that relegates a broader unpacking of the data. This epistemological perspective enhances the thematic areas of concern in a manner that yields new fresh perspectives (Kjellström, 2019).

Positivist paradigms often sideline values whilst in PAR, values are considered to be inherently important. The positivist researcher is an objective observer, who considers subjective experiences to be those of bias and establishes impetus to generate neutral subject-object relationships. However in PAR, the undertaker of the research also actively participates, formulating a pedagogical outlook from sources of common experiences, placing emphasis on self-reflective action to spur on avenues of radical change

(Loewenson, 2014; Wright; 2020). Practitioners focus less on theoretical frameworks to reflect upon and process the results; instead they are seeking a practical manner in which to comprehensively understand their working contexts (Carter, 2021). It operates around the framework of allowing the organisation to be the central tenet in the research process. It also secures colleague participation to be actively engaged in the research (Hilton, 2017). Colleagues of the researcher actively participated by giving voice to their perspectives relative to challenges they were experiencing first-hand.

This approach resonates with a trajectory of professional practice and continuous professional development. Change and development are integral to both research and practice with practitioner researchers being present in the field and engaging with an extension of Kolb's (1984) experiential learning cycle as depicted in Figure 3.1 (Young, 2006). Research does not thus become reduced and deconstructed as a highly specialised field; rather it is viewed as part and parcel of the practitioner's area of knowledge itself (Loewenson, 2014).

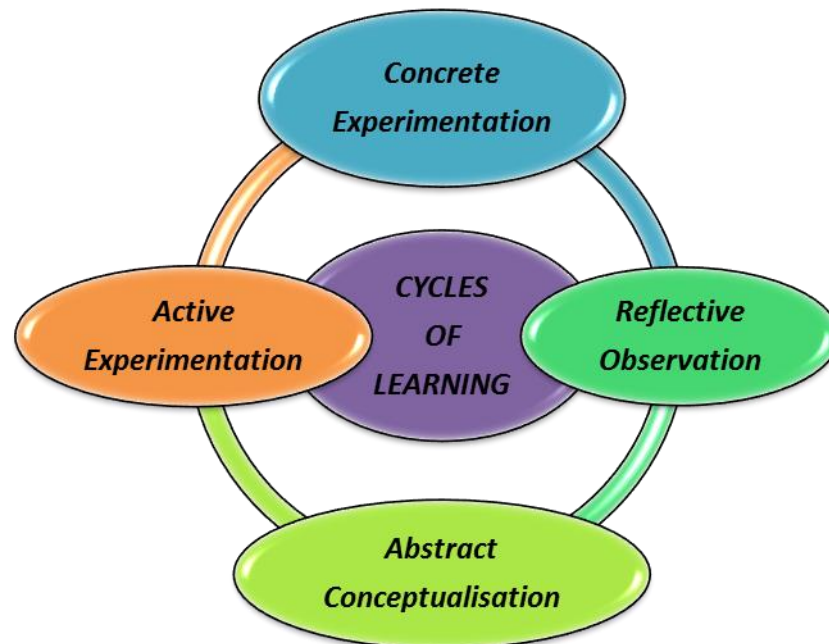


Figure 1: Kolb's Cycles of learning

Source: Constructed by Researcher adapted from Loewenson (2014)

Figure 1 illustrates the manner by which Kolb's central tenet demonstrates that experience evolves into one of a pedagogical nature when the researcher extracts meaning from the experience through action or reflection (Wright, 2020). Kolb's cycles of learning thus posits around four phases of learning; concrete experience, reflective observation, abstract conceptualisation and active experimentation. These phases were found to be empirical by the researcher in order to be fully immersed in finding solutions for the challenges facing the Department of Orthopaedic Surgery. For instance, concrete experience refers to the researcher's daily interaction with the complexity of the challenges being faced, whilst observing the nature of the cross-linkages between variables gave rise to the researcher participating in active experimentation followed by reflective observation on the changes implemented.

## The Strengths of PAR

### *Control*

The central pillar of PAR is the cross linkages of collaborative work amongst influential role players. Practitioners have direct agency and control in the research process (McNiff, 2006; De Jong, 2019). Nakamura (2014) emphasises that the key feature of PAR revolves around those stakeholders who will be directly affected by planned changes to bear the primary responsibility on deciding which critically informed pathways to follow, leading to overall potential success of the organisation. They will also be better informed in evaluating the techniques on a pragmatic basis (Macdonald, 2012). In PAR, the researcher moves beyond their role by actively being a process facilitator. This begins with laying down a foundation of trust within their respective groups or research teams. To initiate this process, a perspective of shared meaning is to be entered upon (Cusack, 2018).

These approaches allows participants to traverse beyond being mere subjects of research, but rather, are empowered to evolve into active participants of research (Chandler, 2003; Kelly, 2005). The vision of PAR translates into recreating an individuals' capacity to creatively participate in meaningful decision-making protocols (Kjellström, 2019). Collective inquiry constructs room for ownership, and subsequently the research process becomes detangled, enabling bonds of trust to be nurtured (McTaggart, 1991; Macdonald, 2012).

### *Professional Development*

PAR provides a medium for practitioners to study their practice and challenge foundational assumptions upon which the practice is constructed. Practitioner research facilitates a pathway to professional growth which redirects autonomy, granting agency to those who might historically be perceived as the recipients of that service (Nakamura, 2014; Carter, 2021). Pervading dominant notions of expertise and skills ownership are disrupted, re-centring focus on marginalised groups who are in the frontline of being affected by challenges directly affecting them eg. health care staff at the hospital (Wright, 2020).

The pedagogical advantages extend into the educational realm of individuals who learn by practicing (Kirshner, 2021). The cornerstone of action research is to methodically improve one's own practice, with the binary objective of strengthening the organisation and contributing to a theoretical database to be of value to the organisation concerned (Sales, 2020).

### *Societal Transformation*

PAR places emphasis on values underlying the social, political, and economic contexts related to disempowered individuals (Andersson, 2018). Broader ecological perspectives are also investigated (Kirshner, 2021). The methodology thus facilitated uncovering a deeper ecological perspective of patient flow in the Department of Orthopaedic Surgery.

PAR is based on an epistemological framework, pedagogical approach, research methodology, and process which facilitate collaborative social action. The processes of research, education and action are merged with the objective of being aligned with societal transformation (Wright, 2020). The pinnacle goal of PAR lies ultimately in the emancipation of individuals to join in social transformation, which motivates professional maturation and agency empowerment of all the participants (Loewenson, 2014; Goessling, 2020).

## **The Challenges of PAR**

Whilst having a strong foundational basis displaying many intrinsic advantageous qualities, the PAR scope of practice does not remain unblemished from a few controversies.

### **Nomenclature**

One of the primary challenges experienced by the researcher during this study relates to difficulties surrounding nomenclature. This can be ascribed to the various different definitions available for terms such as 'PAR' and 'Participatory research' which are used interchangeably for 'Action Research'. This has potential to make the field opaque for first time researchers assessing this modality. De Jong (2019) explains that in this field there is no agreed upon consensus surrounding the diverse points of origin, theoretical frameworks and methods associated with PAR.

### **Community Associated Challenges**

PAR also presented pitfalls due to its mandate to include members of the community as part of the research team. At the hospital where the research practitioner works at, staff members, patients and colleagues comprised the 'hospital community'. This study demonstrated congruency with concerns in the literature whereby participants encountered difficulties in upholding their dedication to the research project over a period of time (Goessling, 2020; Carter, 2021). The researcher was able to understand and contextualise the reasons of some participants not being actively involved at every stage of the study in line with PAR principles. Some participants were less involved due to a general sense of being overworked and understaffed.

At the beginning of this study participants were educated that PAR is a lengthy process and relies on the dedication of the research team. The researcher attests to this process requiring extensive pedagogical strengthening in terms of explaining to PAR participants what the research process entailed. Sufficient time had to be allotted accordingly to create settings amenable for comprehensive community participation. Importantly, the community of interest should be receptive towards the researcher, which is sometimes challenging especially in the context of a researcher not belonging to the same cultural milieu (Nakamura, 2014).

### **Scientific Critique**

There are some concerns from a scientific perspective that PAR is a 'soft' method of research (Cusack, 2018). A level of discord has also been voiced regarding the paucity of theoretical groundwork related to practitioner research (Roxå, 2008). In response, contemporary frameworks of practitioner research allocate equal gravitas to both the theory and the associated practice of the research process. Hence the legitimacy of PAR methodology undergoes scrutiny by researchers who are not well versed with the rigour of PAR as a research tool. While some researchers regard the heuristics which emerge from participatory methods as lacking a scientifically firm foundation, it must be stressed that robustness of research forms and validity are considered to be as critical in PAR as in any other (Loewensen, 2014).

### **Positive Engagement with PAR**

The researcher can attest to the catalysis of the PAR journey in lieu of being familiar with the working environment at the hospital over 15 years. The knowledge and experience gleaned, was a major contributory factor to PAR activation. This is consistent with what other authors have described. Some authors (Wimpenny, 2013; Wright, 2020) assert that the PAR route is initialised by the unique experiences individuals import into the process, which takes into account their intimate knowledge of the working environment and their insight into seeing the system from their vantage point.



This process was deepened by having an attitude of reflection, awareness and openness to the world-view of others. All of the above have added value towards reframing the themes generated from the data analysis into one of greater discernment of the research questions and objectives (Lowenson, 2014). The numerous PAR areas of intervention implemented during the course of this research have been found to have made a difference to the health care experience of both patients and colleagues. This ranged from simply introducing a more vibrant organically aesthetically pleasing work environment with plants and paintings, to more concretised measures making essential Orthopaedic equipment e.g. ripple mattresses available as part of PAR cyclical reflection points.

The overall journey can be described as positive despite the limitations. The researcher can attest to experiential learning providing a latticed framework for dissecting through the conjoined processes and the net output of PAR. The experiential learning cycles played an intrinsically valuable role in building on the process of personal and professional development (Rosala, 2018). This was mediated via practitioner research due to the assimilation of abstract concepts interwoven into the pedagogical process, such as the researcher's personal reflections, or by ontologically participating in change by filtering through mental models and values as a health care practitioner (Carter, 2021).

## **Challenges of PAR**

### *As an Epistemic Concept*

Kolb's experiential cycle of learning formulates the frameworks upon which PAR Reflection points epistemically originate (Carter, 2021). In addressing the research questions of the study undertaken, the researcher maintains that practitioner-led research is a modality of experiential learning to which Kolb's cycles of learning certainly offered a path of elevated discernment of the processes related to practitioner research (Zimmerman, 2016).

However, reflecting on the outcomes, post implementation of the various stages of the cycles, the researcher is inclined to think that Kolb's model (Figure.1) is extrinsically potentially misleading in terms of elucidating a premise of flawless transitions in between each stage of the learning cycle. Rather there are divergent points at each stage of learning, creating a marbled appearance of experience, reflection and experimentation. It is not a compact and tidy undertaking; rather it brings about an inhomogeneous method of experimentation by traversing through stage by stage assimilation to achieve learning and development (Macdonald, 2012; Wright, 2020).

It can thus be surmised from the experience of the researcher that the PAR process does not always dissolve into a smooth transition between the different stages; rather it requires sustained persistence and active involvement from all stakeholders in order to successfully meet its objectives. Results and findings presented in Chapter Four display the complexities of uncovering new insights, along with the dynamic interplay and overlap of cross fertilisation points. This takes into account reflexive accounts from diverse participants and then filtering through stages of data analysis and synthesis. Maintaining the integrity of the data at every stage was paramount in generating key insights within the contexts of wider supporting literature (Lane, 2018).

### *Practical Application in Terms of Engaging Medical Managers*

Moving beyond the initial learning cycle, the research practitioner has developed acute insight into the challenges of incorporating a strong sense of integration of both the bottom-up and top-down processes of innovative policy introduction and implementation (Goessling, 2020). This was one of the core learning objectives of the study completed.

PAR interventions which were instituted at the hospital level fall within the ambit of bottom-up grassroots structural change, which have long been considered to be a driving force in social re-engineering and innovation (Zimmerman, 2016). Whilst this process has been found to be empowering as co-facilitators of change, there is recognition of critical need for support from upstream hierarchical structures in the form of top-down acknowledgement (Maatta, 2014). As evidenced by the literature, it has also been the researcher's experience that key managerial input is necessary to augment and actualise grass roots bottom-up processes (Loewenson, 2014; Kirshner, 2021).

In the hospital setting, given to acknowledge that there have been some breakthrough inflection points, there remains a degree of uncertainty whether there will be long term sustainability unless senior managerial support is garnered and maintained. Currently the PAR interventions are in activation from local, bottom up contributions which may fluctuate as different staff members rotate through the department. The researcher does thus consider it a weakness and limitation in settings of PAR interventions that are not organically linked to upstream validation and support. The digression points between practitioner research and public health care is a rather complex one fraught with many challenges. As a result, a number of potential interventions did not have an impact at the institutional level e.g. the critical need for a dedicated Orthopaedic Theatre.

Throughout the course of this research, meaningful dialogue was undertaken integrating transparency and participatory decision making. As a caveat, the researcher has found that openness and trust require longer time frames and commitment in order to be solidified and should thus not be underestimated. There have sometimes been differences of opinion which have clouded matters related to the dominant discourse at hand. This has been experienced in specific sub groupings whereby there have been encounters with upstream managerial policy developers brought out under the 'shadow side of the institution.

Endeavours to incorporate PAR findings into a platform of policy-making levels has also drawn attention for being limited in terms of its context-specificity, and subjectivity. These issues may give rise to logistical hindrances for health policy developers due to longer than anticipated trajectories and ambivalent outcomes, which do not adhere to stringent deadline oriented policy directed undertakings (Loewenson, 2014; Kirshner, 2021). Thus it can be postulated that the epistemological grounding utilised during this research can be considered to be a potential barrier to its utility in terms of policy implementation (Rifkin, 2009). PAR as an alternate paradigm is sometimes poorly appreciated and its underlying heuristics are either reduced to those that succeed or do not. This approach does not take into account the nature of the knowledge generation outcomes in harnessing change in institutions (Rifkin, 2009).

### *Personal Practical Pitfalls*

Reflecting upon the implementation of PAR initiatives has brought upon new levels of discernment. The cases demonstrate the expediency of the researcher in selecting routes that were perceived as 'easier' to implement over those which the research practitioner had no agency over (Wolstenholme, 2019). Sometimes these changes by the researcher amplified non-systemic approaches. This was due to the realities of added complexity associated with exploring the long term more perilous route of a systems overhaul.

A recurrent voice of concern generated in the realm of the PAR paradigm was one of acknowledging that tackling the deeper aetiology of the malaise required more fiscal muscle, involved considerable delay prior to implementation as well as being linked to much uncertainty and risks (Marchildon, 2016). The PAR process has enabled the researcher to focus on the balancing loops which sought to restore equilibrium to decrease the perceived distance between current realities of the system



and preferred objectives. These balancing processes hence unmasked reasons why the system was prevented in reaching successful outcomes. This involved critical appraisal by the researcher of the inclination to halt efforts in tackling a challenge once it appeared to have been remediated. Wolstenholme (2019) describes these phenomena as that of declining interest which leads to a resurfacing of the initial impediment to the system.

## **SD Thinking**

### **Advantages of SD Thinking**

The SD framework has enabled a closer inspection of the complex causal linkages between the variables and the value of feedback in order to implement multiple changes which strengthened each other. A fundamental principle of SD is that the behaviour of a system is predicated upon its structural outline (Sterman, 2006; Zimmerman, 2016). These structures were expressed in the form of various SD tools presented throughout this dissertation. Being cognisant of the critical junctures that generated either “a vicious or a virtuous cycle” in health care processes (Hirsch, 2020), and examining them relative to their interconnected variables, has bolstered the raising of awareness and facilitated opportunities for transformation at the hospital.

The use of systems thinking builds upon frameworks of expanding a scientific basis of knowledge described by Epstein (1996) as a “militant ignorance” i.e. an affirmation that one does not fully understand the inner unfolding and subtleties of a system. Taking this into account, the researcher valued the concept of emergent new insights produced by SD tools which enhanced the analysis of the health care setting from a ‘never seen before’ perspective. At the same time, it has created a paradigm niche for leverage points to be identified and for subsequent interventions to be continuously evaluated and revised. These would have otherwise been missed opportunities by the researcher to fail to appreciate the associated blind-spots (Wolstenholme, 1999; Diaz, 2015).

One of the more compelling advantages of engaging with systems thinking paradigms has been that of inspiring not only a rigorous scientific habit of mind, but also an internal recognition that adopting systems frameworks exacts more than just a proliferation of discursive discourses. It advanced the boundaries of emotional intelligence together with the necessity in developing practical skills to engage individuals, on the spectre of taking a hard long look at the realities of the system. This has displaced many a mindset from a comfort zone of allocating blame to others instead of taking responsibility for situations which they themselves unintentionally contributed to. These processes occurred in tandem with that of deepening professional growth as an individual in the realm of valuing humility, curiosity, courage, and patience (Stroh, 2015; Amisshah, 2020).

### **Challenges of SD Implementation**

Upon addressing the initial research objective of identifying leverage points of intervention, the researcher found that such areas posed challenges in implementation. The researcher has brought to light several systems archetypes e.g. Fixes that Fail and Unintended Dependencies (Clancy, 2018). Reflecting on the sequence of events above, the researcher has obtained a previously unappreciated newfound consideration of the unintended sequelae of non-systemic-centric solutions. Wolstenholme (2019) advises practitioners to be prudent about “what needs to be undone” prior to instituting “what should be done”.

The appeal of short term temporary quick fixes had distracted the researcher from investing in longer lasting, robust solutions. Systemic directed changes were tackled initially with courageous steps to debride and excise identifiable necrotic systemic pathology; however some of these proved to be emergency quick fix coping strategies. This unfortunately led to the initial disease still being present and to go on infecting the system (Wolstehnholme, 2019; Schoenenberger, 2021).

In order to meaningfully identify and implement solution based archetypes, the realities of associated time delays and organisational boundary limitations should have first been appreciated (Mandl, 2019). These would have then served as a framework for the agent of change, to have a greater understanding of conditions which veiled the unintended side effects. A huge influential factor was that of not respecting long time delays to combat the urgency of the challenges which presented themselves. Wolstenholme (2019) cautions that in the UK, collaborative work at political level takes up to fifteen years to be drawn out and actualised.

The researcher has established that up-stream issues revolving around policy development and implementation are marred with bureaucratic challenges whilst reviewing the challenges associated with PAR activation. It has been the recurrent confirmatory finding of this dissertation that health systems display a multi-layered nature of dynamic complexity and are hence vulnerable to counter-intuitive features and policy resistance (Bala, 2017; Wolstenholme, 2019). This exemplifies why breaking away from preconceived notions of fiscal indicators being the ultimate measure of how well a health system will perform was important for the researcher to identify with.

It can be surmised that there are no simplistic downstream solutions to the problem of an underperforming and economically burdened health care system. It has been demonstrated throughout this study that funding is not the only prerequisite for such breakthrough initiatives. Credence should also be allocated to the enthusiasm of the individuals involved to roll up their sleeves and earnestly seek out practical, durable solutions (Leerapan, 2021).

During this study, the researcher has had many opportunities to engage fellow staff members and colleagues on the various different challenges being faced by the Department of Orthopaedic Surgery. From the textured milieu of different accounts, there was an understanding of the extreme time pressure faced by hospital staff and progressively rising fiscal duress faced by the hospital. The researcher can thus conclude that by reframing perceived notions of failures from avenues of frustration to sources of learning, colleagues can be engaged to appreciate the value in the visionary principles of systems thinking.

### **Critique in Literature**

Whilst SD was generally acknowledged as being important to the field of health reformation, it remains underutilised. In particular, systems thinking have been perceived as predominantly conceptual in nature (Kwamie, 2021). Another often raised misconception of systems thinking is one of being attributed to a paucity of scientific rigour (Reid, 2002; Paley, 2007) and acquires labels of being viewed as a ‘soft’ modality of analysing complex challenges.

The literature refutes this claim on several levels. Years ago, Von Bertalanffy (1972) argued that systems epistemology “shares the same scientific attitude” with scientific thinking. Systems thinkers have demonstrated a unified, interconnected perspective of complex phenomenology by framing the analysis of relationships as a legitimate modality of inquiry. This has been reinforced utilising techniques rooted in mathematics as well as consideration for the physical, biological, and social science components to undertake rigorous systems modelling (Brailsford, 2008; Alvarado, 2017; Lin, 2020; Cabrera, 2021).

### **SD and Ecological Factors of Health Care**

Analysis of the associated ecosystem related to Orthopaedic patients, has yielded interesting insights into tackling efficacious risk control, by reducing the flow of people from risk to pathology (Randolph, 2015) i.e. high rate of pedestrian vehicle accidents. These processes have been crucial in terms of researching and answering questions that were important to an Orthopaedic health care context aiding to better appreciate the social determinants of injury. This included the manner by which social

structures or the lack thereof influenced the performance of health systems (Marchildon, 2016). There has also been a direct strengthening of communication and mutual respect amongst participants in the hospital setting, including those in disempowered communities e.g. homeless patients and those afflicted with substance abuse. Potential has been demonstrated to improve health systems, for example, by detecting areas which render patients susceptible to being readmitted with the same mechanism of injury and acting on them. This involved calling into question the social accountability of public health care. This is congruent with the PAR methodology which is located within the epistemological realm of critical theory and constructivism, whereby facilitating positive social change is viewed as the key outcome of such a research.

### **Conclusion**

Amidst a background of initially feeling a sense of despair by the overwhelming multilayered complexity of the challenges being faced at a large scale hospital academic setting, the premise of interventions was facilitated by the following processes. The PAR methodology presented a conduit of exploring change by means of action, reflection and learning cycles. By merging this with SD archetypes, the researcher was able to systemically view challenges from more novel vantage points of instituting seeds of transformation. These have contributed towards addressing resource constraints, strengthening relationship between variables as well as to ameliorate the overall Orthopaedic Service at the hospital. There was a direct sense of involvement by the researcher who is a medical doctor at the department, instead of a mere detached academic write up about proposed interventions. First hand, experiential feedback of changes implemented was taken into account and altered accordingly. Post the undertaking of this research, there is a sense of tangible changes having been implemented.

However, the implementation of the improvements has not been as straightforward as initially projected. Some of the challenges included the slow assimilation of proposed solutions for planned care and paucity of key engagement from upstream stakeholders. Future recommendations to overcome such challenges include research on the pragmatic aspects of applying SD and PAR in the context of real world application especially in poorer income countries. This will bridge the hiatus between knowledge and practice by embedding problem solving merged with action research methods.

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