HEALTHCARE QUALITY SOCIETY OF SINGAPORE

Executive Committee 2022 / 2023

President
Dr. Alvin Chang Shang Ming

Secretary
Dr. Sandhya Mujumdar

Treasurer
Ms. Tabitha Low

Member
A/Prof. Ling Moi Lin

Auditors

Mr. Rexford Del Rosario
Ms. Elisabeth Angelina
# TABLE OF CONTENTS

| Editorial |
|-----------------|-----------------|
| Patient Safety & Healthcare Quality in Asia-Pacific | Tan KH | 77 - 78 |

| Commentaries |
|-----------------|-----------------|
| Enhancing Patient Safety: From Paternalistic Care to Person-Centred Care and Patient-Partnered Care | Tan KH | 79 - 84 |

| Articles |
|-----------------|-----------------|
| Improve the Process for Draining Effluent Fluid from Continuous Renal Replacement Therapy Machines | Lee J, Koh HH, Low HL, Lee A, Ong C, Duan S, Dhabitah S, Wong D, Ee A, Lim A, Ng LC | 89 - 100 |


| Remote Project-based Design Thinking Workshop | Heng K, Lim YK, Tang XY, Foo Z, Tan KH | 110 - 119 |

| Improving Vitamin D Screening in Patients with Systemic Lupus Erythematosus | Fong W, Yeo SI, Ng SA, Tan LK, Lustestica IE, Poh YJ | 120 - 126 |

| Near Fatal Chemotherapy Overdose Incident - Patient Safety Lessons and Impetus for Organisational Culture Change | Tan KH, Quay I, Pang NL | 127 - 140 |

| Building a Patient Advocacy Network in an Asian Healthcare System to Enhance Patient Experience and Patient Safety | Sim-Devadas AL, Lakshmanan EM, Foo Z, Chang SM | 141 - 154 |
The Journal of Patient Safety and Healthcare Quality is published twice a year.
Patient Safety & Healthcare Quality in Asia-Pacific

Kok Hian Tan
Editorial Board, JPSHQ

The Journal of Patient Safety & Healthcare Quality (JPSHQ), a peer reviewed journal started since early 2022, is dedicated to presenting innovation advances, field applications & improvement projects in every area of patient safety and healthcare quality. This journal accepts manuscripts for the following - original articles, commentaries, case studies, improvement projects, reviews and report articles in patient safety and healthcare quality.

'It takes a village to raise a child' and definitely, it takes a community to nurture a journal. Strong support from healthcare leaders as well as patient safety and quality improvement champions in our global community, is crucial for the development of this journal. For its second issue, we warmly welcome our Editorial Board International Members to JPSHQ. Our journal will certainly benefit from our inaugural batch of international members who have been expert participants of GALLOPS (Global Action for Leaders and Learning Organizations on Patient Safety) programme in 2021 & 2022, with their unique perspectives and insights of patient safety in their countries.

We hope to make this journal a global platform for sharing of best practices, especially for Asia, translated into academic publications for better dissemination, education and sharing [1]. We are determined to encourage and nurture many patient safety and quality improvement activists to share their project experiences and insights through academic publications in the JPSHQ.

For this second issue, we have a focus on patient partnership culture. In my commentary for this issue, 'Enhancing Patient Safety - From Paternalistic Care to Person-Centred Care and Patient-Partnered Care', I emphasize that a strong patient partnership culture is important for a strong patient safety and quality ecosystem. The patient partnership culture is a crucial piece of this ecosystem which together with other contributing constituent cultures, including speak-up culture, teamwork culture, learning culture, support culture and just culture, are needed for strengthening patient safety and healthcare quality in any healthcare organisation [2].

Also in this issue article, ‘Building a Patient Advocacy Network in an Asian Healthcare System to Enhance Patient Experience and Patient Safety’, Sim-Devadas et al reflect and distil the key factors for enabling the successful development of patient partnership and patient advocacy, in Singapore, a country where the culture of active patient engagement is new. The authors demonstrate that patient engagement & partnership to improve healthcare and elevate the patient experience, can work very well in a community in Asia, using the development of SingHealth Patient Advocacy Network (SPAN) as the case study and a roadmap for building a successful patient advocacy network. Even then, SPAN secretariat, together with the SPAN leaders, continues to seek further directions. SPAN is expanding its work to elevate the patient experience, to improve patient safety, to amplify patient voices and to grow the body of knowledge on patient engagement and patient advocacy for the Asian community. This certainly augurs well for patient safety and healthcare quality in Asia-Pacific.
REFERENCES


INTRODUCTION

Meaningful partnerships between doctors/healthcare professionals and patients are created when healthcare providers and patients as healthcare receivers, work together as partners to achieve common goals together. This relationship is based on mutual respect for each other’s skills and competencies and recognition of the advantages of combining these resources to achieve beneficial outcomes. Successful partnerships are nonhierarchical and the partners share decision making and responsibility. The key to successful doctor(clinician) patient partnerships is to recognise that patients are equal partners with useful knowledge, skills and expertise to enhance their care [1–3].

In healthcare, the paternalistic model is one where a physician or other healthcare professional makes decisions for a patient without the explicit consent of the patient. The professional believes the decisions are in the patient's best interests. Paternalistic models have now been increasing replaced by models in which more emphasis is placed on respecting patient freedom and sharing decision making. We are currently evolving toward models in which patients and clinicians work in a partnership toward improving clinical care safety and outcomes. In these new models, clinicians aspire to be responsive to individual patient preferences, needs, and values and ensure that patient values guide all clinical decisions. At the same time, patients can play a key role in preventing errors during clinical care delivery by being engaged in their own care especially in safety efforts.

HOW PATIENTS CAN BE AN EFFECTIVE PARTNER IN HEALTHCARE

Patients can play a key role in safety by preventing errors during clinical care delivery and eliminating avoidable harm. They can be rightful partners for improving health care in community. Many patient partners have extensive experience either as a patient, family member or caregiver in community care, transition of care, referrals & handovers and primary care. Patient and family engagement & co-creation in clinical care processes can improve safety culture and reduce adverse event rates. There are three ways in which patient can be involved.

Firstly, they can help in detecting and reporting near miss and adverse events. Patients can report errors that were not detected through traditional mechanisms such as case reviews or clinical reporting system. It is important for patients to be empowered & comfortable in asking questions & voicing concerns to healthcare professionals.

Secondly, patients can participate in programs that educate patients about safety hazards. They can be made more aware of good safety behaviours and to speak up respectfully to healthcare staff if needed to clarify or prevent errors. Active engagement by patients helps improve adherence to safety practices.

Thirdly, patients can be encouraged take an active role in patient safety and be involved in driving efforts to improve the culture of safety. We recognize the crucial role of patients’ perspectives in establishing a culture of safety. Patients can be active representatives in the design and nurturing of safety efforts, including promoting transparency in reporting errors and solving care problems. Active patient involvement in healthcare quality improvement projects/committees, research and programmes to co-create initiatives and solutions to improve care is key to safer care. Patients become active partners in healthcare quality improvement projects. Patient can also share success stories and best practices at conferences, healthcare staff orientation programmes, bulletins, and publications.
**PATIENT SUPPORT GROUPS, PERSON-CENTRED CARE AND PATIENT-PARTNERED CARE ENTITIES**

Patients, communities and healthcare staff can be involved in Patient Support Groups, Patient Centred Care and Patient Partnered Care Entities to improve the safety and quality of care.

**Patient Support Groups**
Support groups are an important source of emotional, social and psychological support for patients, family members, loved ones and care givers. By encouraging active participation in discussion groups and through meeting others with similar experiences, people find they are not alone in their battles. A good example is Singapore General Hospital (SGH) Breast Cancer Support Group formed by former patients, who volunteer to provide counselling and psychological support for breast cancer patients and their family members and caregivers. Members work closely with the Reach to Recovery Mastectomy Support Group of the Singapore Cancer Society to plan and facilitate programmes [4].

**Person/Patient Centred Care Entities**
Patient-centredness or person-centredness encompasses dimensions relating to biopsychosocial concept of care, patient-as-person, sharing power and responsibility, therapeutic alliance and coordinated care [5].

Patient-centred care is a person receiving healthcare with dignity and respect and involving them in all decisions about their health. An excellent example is ESTHER Network Singapore which was launched in 2016, and aims to promote the philosophy of person-centred care and to train a pipeline of ESTHER Coaches to drive improvement work to better serve our patients and their caregivers. As of September 2021, 271 health and social care professionals from 72 institutions have undergone the ESTHER Coach training programme to lead and facilitate person-centred improvement work. Patients are involved in improving care by giving feedback and participation in improvement programs [6].

**Patient Partnered Care Entities**
Patient-partnered care is defined as an authentic collaboration between decision makers; patients, healthcare providers and informal caregivers, built upon four foundational team-based pillars including collaborative leadership, communication, situation monitoring, and shared decision making and mutual support [7].

Patient and Family Advisory Councils (PFAC) are examples in healthcare system where patients and families as partners in care are emphasized. A patient and family advisory council is an organization of current and former patients, family members and caregivers that works together to advance best practices at a hospital or healthcare organization. Volunteer patients and families collaborate with employees (clinical, administrative and support) to provide guidance on how to improve the patient and family experience [8].

As a PFAC, the SingHealth Patient Advocacy Network (SPAN) is a self-driven network of patients and caregivers that represents the collective voice of patients as partners in care. As Patient Advocates, they are committed to making a positive impact on healthcare and work in close partnership with the healthcare team to provide important patient and family perspectives to enhance the patient experience and quality of care [9].

Established in March 2017 by the SingHealth Duke-NUS Institute for Patient Safety and Quality (IPSQ), SPAN is strategically guided by the Patient and Caregiver Engagement Framework for the SingHealth cluster, and works in close partnership with IPSQ, SingHealth Group Nursing and the SingHealth Group Office of Patient Experience. SPAN is a reflection of SingHealth’s commitment to designing a healthcare system that is truly for patients, by patients.

Patient Advocates of varied backgrounds, ages and medical conditions, lend insightful perspectives of the patient and family experience, in areas such as (but not limited to):

1. Consultation and/or participation in projects for quality improvement, process design, patient experience, facility design, implementation of healthcare services and more. Depending on the scope of the project, patient advocates may be roped in for one-time consultations or co-opted as a member of the project team.

2. Sharing of experience through talks, skits and more.

3. Patient, caregiver and staff education initiatives.

4. Engagement as judges of staff and patient awards (including national-level awards like the Singapore Health Quality Service Awards and the Singapore Health Inspirational Patient & Caregiver Awards).
5. Healthcare improvement initiatives – these deep insights are welcomed by the healthcare community in meeting the need of understanding what matters to patients and caregivers.


**Patient Safety and Quality Ecosystem**

Having a strong patient partnership culture is important for a strong patient safety and quality ecosystem. The strengthening of patient safety and quality culture requires a virtuous patient safety and quality ecosystem that takes time and constant efforts to develop. We believe while building this ecosystem, that it is necessary to concomitantly promote and synergize relevant contributing constituent cultures, including speak-up culture, teamwork culture, learning culture, support culture, just culture and patient partnership culture (Figure 1) [10].

Creating a virtuous ecosystem is challenging for all healthcare organizations as there are prevailing counter cultures such as the blame culture, paternalistic culture and hierarchical culture to contend with. To prevent counter cultures from festering further, the desired cultures of this virtuous ecosystem must be strongly inculcated, embedded, sustained and continually renewed in the healthcare institution for optimal safety and quality of care. This requires the leaders to invest in resources and infrastructure to build the ecosystem. Training programs for staff and teams to create awareness, promote and change individual and team behaviors congruent with the relevant cultures are important. In promoting a patient-partnership culture, training and development are key in supporting patient advocates in their exciting and crucial role as partners-in-healthcare. They attend compulsory Patient Advocates Communication Training, as well as other training sessions on Quality Improvement, Design Thinking and Story-telling [9].

**Global Action for Patient Partnership in Healthcare**

There is now an increasing global push towards more patient engagement in healthcare [12]. In support of this push, a Patient and Family Engagement Consensus Workshop on Global Patient Safety Action Plan (GPSAP) was held at the 3rd Asia-Pacific Patients Congress (APPC) on 17 November 2021. A total of 52 patient/care provider participants and 18 facilitators involved, under the auspices of the SingHealth Duke-NUS Institute for Patient Safety & Quality (IPSQ), International Alliance of Patients’ Organizations (IAPO), Philippine Alliance of Patient Organization (PAPO) and Patient Academy for Innovation & Research (PAIR) [13].

In supporting GPSAP, five Asia-Pacific Patient Advocacy Consensus Statements for Patient Safety were reached. They were as follows:

i. [Engage] Partner and Engage patients, families and civil society organizations in co-development of policies, plans, strategies, programmes and guidelines to make health care safer.

ii. [Learn] Learn from the experience of patients and families exposed to unsafe care to improve understanding of the nature of harm and foster the development of more effective solutions.

iii. [Capacity Building] Build the capacity of patient advocates and champions in patient safety.

iv. [Transparency] Establish the principle and practice of openness and transparency throughout health care, including through patient safety disclosure to patients (and families when permitted).

v. [Education & Empowerment] Provide information and education to patients and families for their involvement in self-care and empower them for shared decision-making in relation to patient safety.

**Resilience in Adverse Situations including COVID-19 Pandemic**

During COVID-19 pandemic, interaction between patients and families and health workers was severely constrained [11]. Many health services became virtual, potentially compromising the quality of patient and family engagement and patient safety in certain circumstances. Moreover, families were unable to provide support to their family members because of social distancing restrictions and visitation policies, with diminished safety net for prevention of errors and avoidable harm.

COVID-19 global pandemic brought increased recognition of risks to patients and staff. And drive impetus to efforts that promote safer care at every level & to make health care systems more resilient to the impact of harm than ever before. COVID-19 pandemic showed patient partnership is even more pertinent. It is important for all stakeholders including patients, families and caregivers to work collaboratively and mutually support each other as partners in safe care during normal times or in situation of extreme adversity.
This consensus serves as a guide for patient advocates, patient organizations and healthcare organizations in Asia Pacific region to strengthen patient and family engagement in eliminating avoidable harm in healthcare.

**CONCLUSION**

Patient partnership, engagement and voices are important to ensure the safety of the clinical processes and enhance learning from errors. We need to actively promote patient partnership and co-creation to eliminate avoidable harm in care. Person-centred care and patient-partnered care are keys towards safer and higher quality healthcare.
Figure 1. Patient Safety and Quality Ecosystem and its Cross Cutting Constituent Cultures vs. Counter Cultures

Patient Safety & Quality Ecosystem
with A Strong Patient Partnership Culture
REFERENCES


Value-based Healthcare: Implementation in SingHealth

Eng Kok Lim
Group Director, Value-Driven Care and Future Workforce, Singapore Health Services

The concept of Value in healthcare was first introduced by Michael Porter in his book: “Redefining HealthCare”, published in 2006 [1]. The underlying impetus for Value-based Healthcare (also known as Value-Driven Care (VDC) in the local context) is to deliver the best possible outcomes at the lowest possible cost for our patients.

**VDC AND SUSTAINABILITY OF OUR HEALTHCARE SYSTEM**

As Value is the ratio of ‘outcomes over cost’, actions can be taken to improve Value by addressing the numerator (improving care outcomes) or denominator (reducing costs). A fundamental principle in our implementation to date is to always focus on optimising Clinical Outcomes, with the Cost component remaining as a secondary objective to address. This ensures that quality of care is minimally at a ‘Good’ level or better (and being delivered at an optimised cost), as opposed to ending up with low cost care that is associated with compromised quality. A focus on the ‘Value equation’ therefore provides a powerful motivating force to engage in discussions about improving the outcomes delivered based on a given amount of healthcare resources, rather than being a solely cost-cutting approach. By leveraging on transparency of both clinical outcome and cost data, the VDC methodology is a means to keep our healthcare system sustainable.

**A KEY SUCCESS FACTOR FOR VDC**

The key underpinning success factor for VDC is for clinicians and administrators to work collaboratively, capitalising each other’s strengths. The VDC methodology focuses on using data to facilitate ‘like-for-like’ Value performance benchmarking (Figure 1). This allows for analysis over time, between subgroups, clinicians or institutions, thereby enabling data-driven discussions to identify possible opportunities for improvement and guide actionable steps towards gap closure.

To implement this successfully, clinicians embarking on VDC projects need to be well-supported by administrators to navigate the wealth of clinical outcomes and cost data in a nimble and timely manner; and subsequently to work on the Value Improvement journey. These administrative teams would not be new to VDC but are in fact, existing current teams within each institution i.e., comprising teams from Clinical Quality / Governance or equivalent; Finance; Data Analytics; and Quality Improvement. The VDC methodology provides a common goal which synergises efforts from all parties to achieve quantifiable and impactful Value improvement outcomes for our patients.

**VDC CAPABILITY IN SINGHEALTH**

Following the launch of the national VDC initiative by the Ministry of Health (MOH) in 2017, Singapore Health Services (also known as SingHealth) has progressively worked to implement VDC as a Cluster. Our VDC capability has grown significantly, expanding beyond the initial 17 MOH VDC conditions to the current 45 conditions with all new conditions initiated beyond the initial 17 MOH VDC conditions to the current 45 conditions with all new conditions initiated by SingHealth institutions. At present, SingHealth’s VDC conditions span primary care, acute and community hospitals; with efforts supported by 17 Institution Value Leads (who lead VDC efforts within each SingHealth institution), 169 clinical champions (i.e. Clinician Leads overseeing each VDC condition within our institutions), and over 450 other supporting colleagues, both clinicians and administrators. Their collective efforts and dedication have brought about commendable gains in the Value of care that is
being delivered to our patients. This includes but is not limited to the better clinical outcomes for over 1,000 patients for the MOH VDC conditions alone (based on 2021 data).

**NEW OPPORTUNITIES FOR VDC**

As we consider the next steps in our VDC journey, the shift to population health and capitation-based subvention opens up new opportunities to review Value of care delivery more holistically along the entire care continuum. In alignment with the transition to population health, the scope of VDC is being expanded from the current setting-based focus (e.g. primary care, acute hospitals, etc.) towards a cross-setting (i.e. across the continuum of care provision, from primary care to acute hospitals to step-down care), system-level and increasingly patient-focused approach. This is facilitated by the shift towards a capitation-based approach to subvention (i.e. MOH funding of public healthcare providers) which further incentivises the provision of care of the right type (as far ‘upstream’ towards prevention as possible); at the right-site (as close to the patients’ home as possible) and at the right level (i.e. not too much, nor too little).

**NEXT STEPS**

Building on the current setting-based VDC projects, the next steps in our journey call for a broader lens to be adopted to consider the strategy for clinical service delivery across the care continuum, and working further together as a Cluster to optimise care delivery to our Patients. We will also need to work with external, non-SingHealth stakeholders who provide care to our Patients (including private sector GPs and community providers); and increasingly also on activating Patients and their Caregivers to ensure that they too play a role in optimising their own care. To implement the VDC methodology successfully, all stakeholders must be committed to share their performance data openly, and be guided by that data to continually work towards the best value care possible.

It will certainly be an exciting journey ahead as we continue to work together to refine and redesign our care processes, and also with other stakeholders within the national healthcare system (including Patients), with the continued pursuit of Value improvement for our Patients acting as a ‘North Star’ to guide us going forward.

**ACKNOWLEDGEMENT**

I would like to thank Prof Ng Wai Hoe (Deputy Group Chief Executive Officer, Strategy and Planning, Singapore Health Services), Institution Value Leads, Clinicians Leads and Value-Driven Care (VDC) teams from across SingHealth institutions for their support and dedication in SingHealth’s VDC journey.
Figure 1. The VDC methodology focuses on using data to facilitate ‘like-for-like’ Value performance benchmarking

Start here...

**Target Specific Condition, and Define it**
- Single episode
- Multiple episodes
- Complex “RHS” episodes

**Define Value Measures**
- Clinical Outcomes
- Cost
- Patient Reported Outcomes
- Appropriateness of Care

**Value Data Analysis**
- Clinical and Finance data integration
- Data visualization
- Drill-down

**Drive Value Optimisation**
- Value Improvement plans
- Data-driven monitoring
- Aligning incentives

Clinicians, Clinical Quality, Finance, Casemix

Always approach from a Clinical Outcome viewpoint first
- Start with identifying how to derive the best Clinical Outcomes for our patients
- The Cost component comes (almost) as a secondary objective to derive Value for patients and sustainability for the system
REFERENCES

ABSTRACT

Introduction: Continuous Renal Replacement Therapy (CRRT) is a common dialysis in the Intensive Care Unit (ICU) due to its precise volume control, electrolyte correction and achievement of hemodynamic stability. During hemofiltration, uremic toxins are removed and drained into effluent bags. Changing effluent bag is laborious and under strict infection control guidelines, effluent fluid cannot be discharged into the sink in ICU rooms or inbuilt dialysis pipe. The quality improvement project described in this paper aimed to improve infection control practices and workplace safety for ICU nurses.

Methods: Using Plan-Do-Study-Act (PDSA) structured improvement cycle, the team tested their innovation on a small scale before updating work practices.

Results: Inbuilt dialysis pipes were modified to align with latest infection control recommendations. An ergonomic trolley was designed and built for effluent drainage inside ICU rooms. The customized dialysis cover has a unique lock that is suitable for the polymerization of different types of dialysis. The trolley also enables safe transfer of effluent bags and outlive the pressure of keeping up with rapidly evolving CRRT machines with its variable heights.

Conclusion: The new innovation supports optimal infection control measures and prevented work related hazards. It is also scalable in all ICU settings and has resulted in considerable economical savings. The benefits of the customised trolley is not just limited for CRRT dialysis, it has potential for most types of fluid drainage procedures such as liver or peritoneal dialysis.

Keywords: CRRT, effluent drainage, infection control, dialysis, workplace safety

1. Nursing Department, National Heart Centre Singapore
2. Support Services, National Heart Centre Singapore
3. Specialty Nursing, Singapore General Hospital

Address correspondence to:
Jasmine Lee, Department of Nursing, National Heart Centre Singapore, 5 Hospital Drive, Singapore 169609
Email: jasmine.lee.m.b@nhcs.com.sg
**INTRODUCTION**

Acute kidney injury (AKI) is associated with high morbidity and mortality [1-3]. Other than dialysis, no therapeutic interventions reliably improve survival rates [4-5]. Continuous Renal Replacement Therapy (CRRT) is a leading form of dialysis in the Intensive Care Unit (ICU) due to its precise volume control, electrolyte correction and achievement of hemodynamic stability [5]. It runs continuously and removes water and waste at a consistent pace to that of native renal function. CRRT not only plays a principal role in the treatment of patients with renal failure but has also spread its field to the treatment of many other diseases such as septic shock, myasthenia gravis, acute on chronic liver failure [6-7].

Despite its advantages, CRRT has some limitations. These include the risk of infection, decreased organ perfusion, inadequacy of anticoagulation and prolonged bed confinement [5]. Therefore, the delivery and performance of CRRT requires well-trained medical and nursing staff. Other important goals include achieving an acceptable circuit life and prevention of healthcare-acquired infections (HAIs), which can lead to sepsis and eventually death. Transmission of potential pathogens inside the hospital is complex. They can be caused by viral, bacterial or fungal pathogens. Such infections can be transmitted through contact, droplet or airborne transmission, or through contaminated equipment. The healthcare environment can also act as an amplifier of HAIs during outbreaks.

CRRT comprises of an integrated system of machine, haemofilter, lines and solutions. Dialysate solutions are used to facilitate the removal of toxins. The waste products are extracted from the extracorporeal circuit and drained into an effluent bag. Once filled to the 5-10 litre capacity, the effluent bag is disconnected from the machine and drained inside the disposal room (Table 1). Changing effluent bags is labour intensive and time consuming. On average, ICU nurses spend approximately 10.5 minutes to change and drain each effluent bag. The repeated heavy lifting of bags in an awkward position increases the nurses’ risk of musculoskeletal injuries [8].

Intermittent dialysis like haemodialysis and sustained low-efficiency dialysis (SLED) are also performed in the ICUs. These machines discharge waste products into inbuilt sewage pipes via 3 tubing, and the sheer pressure of fluid discharging into the sewage produces water droplets. The bigger droplets contaminate the surrounding environment, while smaller droplets generate into aerosols [9]. This promotes the spread of infectious agents to the healthcare workers, patients and visitors. Thus, putting the entire community at an unnecessarily heightened risk of infection.

Tighter margins and competitive pressures within healthcare are driving many hospitals to re-evaluate their operations. These opportunities plead for innovative solutions which offer ways to augment the healthcare workforce, improve safety and enhance a hospital’s ability to deliver excellent patient experience. The quality improvement project described in this paper aimed to improve work safety and infection control measures for patients undergoing dialysis in an 8 bedded Coronary Care Unit (CCU) at National Heart Centre Singapore (NHCS). A multidisciplinary team was formed with members from NHCS and Singapore General Hospital (SGH) renal department.

**METHODOLOGY**

The project was implemented with the Plan-Do-Study-Act (PDSA) structured improvement cycle. Ideas were generated to tighten infection control during dialysis and prevention of work injuries. Top concepts were discussed and translated into mock-ups to test for feasibility and prototyping. The final solution consists of a customised dialysis cover and a trolley. Both products were designed to be used simultaneously for patients undergoing CRRT in the ICUs, whereas dialysis cover can be used as a standalone during intermittent dialysis.

**Dialysis cover**

A proposal was developed to merge dialysis machines’ tubing into the design of the dialysis cover. The diameter of waste water tubing from diverse brands of dialysis machines were measured. A universal disposable tubing was tested and its fitting was compatible to the outflow drainage ports for both 5 and 10 litre effluent bag. The customised cover acts as a barrier between the waste products and the drainage system. This simple mechanism shields and prevents the surroundings from contamination. Three modified inlets enable each tubing to be securely attached onto the sewage pipes when pressurized waste water are discharged. The cover has an unique lock that is suitable for the polymerization of different types of dialysis, such as intermittent dialysis and CRRT (Table 2). It performs in the manner similar to a pressure cooker, whereby once the lid is closed, potential spillage and dislodgement can be prevented. While the inner adjustable shell helps to seal the
entire cover when not in use and therefore, prevents pests from crawling out from sewage pipes. Lastly, a stopper was used to block the disposable tubing’s inflow port, effectively preventing the backflow of contaminated water into the environment. The pilot trial validated the feasibility of the cover. A hook was later added to the design; it helps to hold the tubing when it is not connected to any effluent bag.

**Trolley**

Trolleys are regarded as one of the most affordable and practical pieces of warehouse equipment. They increase efficiency by allowing employees to safely load and transport items. The importance of implementing an efficient transfer procedure lies with the trolley’s features and specification. Research has proven the force of pushing is preferable to pulling as most people can safely apply a greater force [10]. To have a better view, interactions between the users and trolley were mapped out. A customised made trolley was prototyped after few deliberations (Table 3). The spring-loaded trolley utilizes a trapeze base to support the weight of effluent bags. There are 2 vertically adjustable heights for transferring and draining effluent bags. Wheels are fixed with castors and the spacious table top eases transfer of effluent bags. Using the prescribed four steps in the PDSA cycle, the team tested the design, evaluated the outcome, improving on and testing it again.

In the first PDSA cycle, the 5-litre effluent bag was easily transferred onto the trolley and pushed next to the sewage pipe. In contrast, the table top was small for the 10-litre filled bag and the movement of the trolley made it wobblier. The size of the table top was expanded for the second PDSA cycle. Unexpectedly, both 5 and 10 litre bags were unable to drain completely into the sewage pipe due to insufficient water pressure. Water pressure is described as the force that is used to push water through pipes and it is created by altitude. There were approximately 100ml of fluid left in each bag. The challenge could be overcome if the height of the trolley is elevated. However, it would inevitably incur more cost. In the final PDSA cycle, the team decided to make 2 customized cutting on the table top for draining residual effluent fluid. The installed hooks below the table top secures the nearly emptied bags, it allows the residual fluid to hang below the table, thereby creating a gradient for draining the fluid entirely by gravity.

**RESULTS**

With the new workflow, nurses spend 4.5 minutes to change and drain each effluent bag. Based on 2 daily CRRT cases in CCU, the new initiatives saved 1022 hours (Table 4 & Appendix 1). This is only a conservative estimation. CCU rooms are set up for intensive monitoring and when patients deteriorate, more life supporting treatment are initiated such as Extra-Corporeal Membrane Oxygenation (ECMO). The room becomes more clutter and risk of dislodging dialysis tubing is high especially during peak activities. Contaminated water from the tubing and sewage is known to cause a variety of environmental and health problems. The dialysis cover met Infection Prevention and Control (IPC) standards by minimising the spread of pathogens during dialysis. It consists of engineered parts designed to provide secure leak proof protection which is capable of withstanding high-water pressure, vibration and pulling forces. By ensuring the hospital environment is as safe as possible for both patients and healthcare workers, quality healthcare delivery is achieved.

Per shift, nurses have to drain effluent fluid at least 4 times in the disposal room. To change each effluent bag, nurses have to squat besides the CRRT machine, disconnect the filled bag from the CRRT circuit and connect a new effluent bag. Nurses who squat inappropriately may experience knee pain and squatting with weights increases the risk of injury, including damage to the knees and lower back. The trolley allows the nurses to use minimal energy to transfer the bag onto the trolley while maintaining a closed CRRT circuit. It also eliminated the need to carry effluent bags to the disposal room as fluid can be safely discharged into the sewage via the dialysis cover inside the ICU room.

**DISCUSSION**

Medical supplies and equipment account for the biggest healthcare expenditure and hospitals are spending $93 billion per year on medical equipment lifecycle costs [11]. The improvement initiatives constitute a cost-effective solution, thus, moving the ultimate goal of achieving efficiency and cost effectiveness desperately needed in healthcare industry. Dialysis machines empty effluent fluid into exposed piping that led to a branch drain and onward to the main drain. The diameter of the pipes provides adequate flow capacity with sufficient gradient to convey sewage by gravity. The size, length and gradient of sewage pipes are similarly
constructed in SGH campus and this added to the convenience of installing the covers. In term of cost effectiveness, the cover is more economic than purchasing and maintaining fluid transfer pumps. Fluid transfer pump is an electrical device that creates a pressure difference to move fluid from effluent bags to sewage pipes. It costs SGD $5000, excluding annual preventive maintenance fees and consumables. While, the stainless-steel cover, inclusive of installation fees and trolley costs SGD $430 and $3000 respectively.

The demand for ICU care is driven by a greying population, chronic illnesses and the prevalence of kidney related diseases [12]. This is mirrored in the increasing age of ICU patients. In addition, climbing number of children with corrected congenital disorders are growing into adulthood. More ICU beds are needed and this is expected to propel the growth of CRRT market as evidenced in Appendix 2. Healthcare cost will continue to rise. Singapore will spend $27 billion or around 3.5% of Gross Domestic Product (GDP) on healthcare by Year 2030 [13]. Aging population and medical advancement are behind some of the increase. As Singapore move into capitation funding model, the 3 public healthcare clusters must take a lean approach in developing hyper-effective processes and profitable business models. Lean model emphasizes the elimination of waste such as time and labour. A zero waste approach conserves financial resources and savings can be invested in other potential revenue generating areas. The challenge of becoming a value-based organization should not be underestimated, given the rooted practices of many decades.

The entire process for changing and draining an effluent bag consumed 10.5 minutes of nurses’ time (Table 5). This is inclusive of the time taken to wear Personal Protective Equipment (PPE) and walking to the disposal room. With the new workflow, 6 minutes are saved for every cycle of bag changing. The accumulated time saving enables ICU nurses to make key difference in the clinical outcomes and delivery of safe patient care. Efficient processes are important because they require less time, effort and resources. Another common process hitch is unnecessary movement, such as leaving the patient’s room to look for equipment or draining effluent fluid in the disposal room. Utilizing dialysis covers and trolley across all the ICUs will reduce movement wastage. With the right system in place, the ICU nursing team is more efficient. Besides, evidence from various studies indicates that the growing COVID-19 effect could potentially exacerbate nurse shortages globally [14].

Global nursing shortage was a well-recognized issue prior to the COVID-19 pandemic. In Year 2020, the first State of the World’s Nursing report estimated a global shortage of 5.9 million nurses [15]. With ageing nursing workforce, 17% of the nurses globally are expected to retire within the next 10 years, and 4.7 million additional nurses will need to be educated and employed just to maintain the current workforce, let alone address the shortages [15]. In total, 10.6 million additional nurses will be needed by Year 2030. Nursing turnover is costly and it jeopardises patient care. Nursing leaders must transform nursing practice through re-examination of nursing work and to maximize the potential of the nursing workforce by supporting nurses to truly practice at the top of their license.

The project prioritizes the safety of nurses while examining opportunities to cut cost. Addressing health and safety should not be seen as a regulatory burden. Human capital within the healthcare is an important factor to attract and engage a highly skilled workforce. The ageing population in Singapore also suggests that an increasing number of older persons are working and needs special considerations. With age, employees become more susceptible to injury and the majority of these injuries come from muscle straining through over exertion. The International Labour Organization estimated that there are around 340 million occupational accidents and 160 million victims of work-related illnesses annually [16]. It is equivalent to 4% of the annual global GDP, or USD 2.8 trillion being lost to direct or indirect costs of accidents and diseases [17]. This does not take into account pain, suffering and permanent disability.

Injuries sustained by the ICU nurses can be devastating. With fewer nurses available to take on specialized roles, the nursing department will have to absorb cost associated with reduced productivity and overtime. The best way to minimise the hidden costs of workplace injury and related insurance costs is prevention of work accidents. The use of the trolley eliminated manual carrying of 5 to 10 litres of effluent bags outside of the ICU room for drainage. This translates into better economic viability and productivity for healthcare institutions when the numbers for work related injuries are kept low. The prominent advantage of the customised trolley is the ability to cater to the requirements across a spectrum of CRRT machines. It also enables safe transfer of effluent bags and outlive the pressure of keeping up with rapidly evolving CRRT machines with its variable heights. Blending in users’ needs and department goals, the trolley addresses staff safety issues. The team optimized the user experience and make the product

Improve the process for draining effluent fluid from Continuous Renal Replacement Therapy machines
sustainable for long term use. It creates ripple effect of employee engagement, motivation and meaningful job satisfaction.

The use of stainless steel and strong surface material enhances the durability of the trolley. It can withstand strong disinfectant cleaning and its stability is supported by the trolley’s wide base to prevent it from toppling. This enables it to withstand various weight of effluent bags. The trolley is fixed with wheels to ease transfer of effluent bags from machines to drainage pipes. The benefits of the customised trolley are not just limited for CRRT dialysis, it has potential for most types of fluid drainage procedures such as liver or peritoneal dialysis. The project showed promising results in terms of improving work safety, manpower utilization and working postures compared with the traditional handling method.

Another highlight of the cover is its critical role in preventing waste water spillage into the surroundings. Environmental contamination has a major responsibility in HAIs and the spread of antimicrobial-resistant microorganisms (ARM). Several pathogens can remain in the environment for extended periods of time, which serve as vehicles of transmission and dissemination in the hospital setting [17]. Manual environment cleaning is not sufficient to eliminate cross contamination to a safe level for patients and staff. Thus, there is a need for a more diverse approach to control the spread of infectious diseases by specialists outside the clinical settings. They include engineers with expertise in building design and facilities management [18]. Annually, approximately 2 million patients suffer from HAIs in the USA, and nearly 90,000 are at risk of dying [19]. The overall direct cost of HAIs to hospitals ranges from US$28 billion to 45 billion [19]. In addition, most HAIs are widely regarded as expensive complications of healthcare delivery, mainly associated with substantial increase in length of stay [20]. This has detrimental downstream effect as other sick patients are deprived of timely medical care in the hospital.

Both HAIs and ARM have highlighted the urgency to review infection control practices in the clinical settings. Failure to identify potential lapse in infection control practices can paralyze hospitals and the entire healthcare system. On the other hand, the risk of the Emerging Infectious Diseases (EIDs) has increased significantly in the past years [21-22]. Specific factors precipitating disease emergence include ecological and demographic factors such as extensive deforestation, exposure to a previously unfamiliar microbe and overcrowded spaces [23]. At least 60% of EIDs are zoonotic, the pathogen is most likely an RNA virus, emerging from an area where the right mix of risk factors favourably promotes the risk for sustained transmission [24-25]. Similarly, there is the potential for diseases to emerge as a result of bioterrorism. These risk factors are growing in prevalence. Together with transport connectivity, population growth, drug resistance, intensive farming practices, tradition of live animal trading and under-resource healthcare systems, EIDs will continue to pose serious public health threats [26]. Preparedness is essential to mitigate the impact of EIDs. It comprises of a range of activities to monitor, prevent and control high impact EID events, in which the benefits of countering the impact of event far outweigh the investment required in such activities [27-28]. Therefore, improving existing healthcare facilities will reduce disease transmission and support infection prevention. Healthcare institutions must understand where their gaps lie in order to address them and reduce the likelihood of an outbreak spreading. Without leadership accompanied by institutional reforms, any future pandemic will come with high human and economic costs.

**CONCLUSION**

High quality supportive care remains the foundation for ensuring patients have high chance of survival. Dialysis related outbreaks and event serves as a reminder of the serious consequences that can result when basic principles of infection control are not adhered closely. To make further progress in health and meet new challenges, resources must be deployed effectively. This requires knowledge on interventions, information on cost, and experience with their implementation and delivery.

**DECLARATION OF INTEREST**

The author has no conflicting interest. The team members’ involvement in the project are summarized in Appendix 3.
**FUNDING**

The team has received funding from Fresenius Medical Care for the making of the customized trolley

**ACKNOWLEDGEMENT**

The author would like to thank Ms Tay Ai Liu, Chief Nurse, National Heart Centre Singapore for her comment on the manuscript.
**TABLES AND FIGURES**

**Table I: Process to drain effluent bags**

<table>
<thead>
<tr>
<th>STEP 1</th>
<th>STEP 2</th>
<th>STEP 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU nurse removing effluent bag from CRRT machine</td>
<td>ICU nurse carrying 5L effluent bag to disposal room</td>
<td>ICU nurse hanging effluent bag on customised hook</td>
</tr>
</tbody>
</table>

Step 1: Removing effluent bag from CRRT machine  
Step 2: Carrying effluent bag to the disposal room for drainage  
Step 3: Draining effluent fluid into a sluice and disposing the empty bag into a trash bin

**Table 2: Customized dialysis cover for inbuilt dialysis pipe in the ICU**

<table>
<thead>
<tr>
<th>INITIAL DESIGN</th>
<th>DESIGN #1</th>
<th>DESIGN #2</th>
<th>DESIGN #3</th>
</tr>
</thead>
</table>

- Design #1 - Stainless steel cover with a unique lock. The cover prevents aerolisation and accidental spillage of effluent fluid into the environment.

- Design #2 - During intermittent dialysis, 3 dialysis tubing are lodged into the inbuilt sewage pipe. Often, the tubing is easily dislodged due to accidental tripping. The special inlets secure tubing when waste water is discharged into the sewage.

- Design #3 - Inner adjustable shell to “close” (refer red arrow) 3 outlets. This prevents pests from crawling out.
Table 3: Customized trolley for effluent drainage in the ICU

<table>
<thead>
<tr>
<th>INITIAL DESIGN</th>
<th>DESIGN #4</th>
<th>DESIGN #5</th>
<th>DESIGN #6</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="initial_design.png" alt="Image" /></td>
<td><img src="design_4.png" alt="Image" /></td>
<td><img src="design_5.png" alt="Image" /></td>
<td><img src="design_6.png" alt="Image" /></td>
</tr>
</tbody>
</table>

- Design #4 - A trapeze base to support the weight of effluent bags. It has 2 vertically adjustable heights and the wheels are fixed with castors.
- Design #5 - Minimal strength is required to transfer the bag onto the trolley
- Design #6 - The table top has 2 customized cutting to facilitate the draining of residual effluent fluid from a 5 and 10 litre effluent bag.

Table 4: New work process for effluent drainage in the ICU room

- Step 1: Transfer effluent bag onto trolley
- Step 2: Push trolley next to sewage pipe for drainage in the ICU room
- Step 3: Apply stopper onto disposable plastic tubing once drainage complete

Table 5: Before-After implementation

<table>
<thead>
<tr>
<th>BEFORE</th>
<th>AFTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple trips to the Disposal Room</td>
<td>Eliminated trips to the Disposal Room</td>
</tr>
<tr>
<td>Avg. 4 trips per shift x 3 shifts = 12 trips per day</td>
<td>Zero (0) trips per day</td>
</tr>
<tr>
<td>Low efficiency of effluent drainage</td>
<td>High efficiency effluent drainage</td>
</tr>
<tr>
<td>Time spent waiting for drainage of effluent bag</td>
<td>Total elimination of time spent waiting for the effluent to drain completely</td>
</tr>
<tr>
<td>→ 4 mins per bag x 4 bags/shift x 3 shifts = 48 mins per day</td>
<td>48 mins/day eliminated time spent draining effluent bags</td>
</tr>
<tr>
<td>Long process time</td>
<td>Average 16.5 mins total time spent on changing and draining one effluent bag</td>
</tr>
<tr>
<td>Average 16.5 mins</td>
<td>Improved process time</td>
</tr>
<tr>
<td>60% improvement</td>
<td>Time spent on changing one effluent bag</td>
</tr>
</tbody>
</table>

RESULTS

- 36 mins/day eliminated time spent on trips to disposal room
  - 13,140 min or 219 hours savings per annum!
- 48 mins/day eliminated time spent draining effluent bags
  - $7,220 min or 120 hours savings per annum!
- Total Annual Manpower Savings: 511 Hours
  - Cost avoidance $13,286!
REFERENCES


Improve the process for draining effluent fluid from Continuous Renal Replacement Therapy machines
APPENDIX

Appendix 1: Calculation on cost saving

<table>
<thead>
<tr>
<th>Innovation</th>
<th>Calculation</th>
<th>Total savings</th>
</tr>
</thead>
</table>
| Trolley             | **Based on 1 CRRT Case / day**  
▪ Average 4 trips per shift to the disposal room. Per trip takes 3 minutes.  
▪ 12 trips per day  
**Time spent:**  
▪ 36 minutes per day / CRRT case  
▪ 219 hours per annum  
**Manpower cost avoidance:**  
▪ $4380 per annum* | **Based on 1 CRRT case / day**  
▪ 511 hours additional hours spent on patient care per annum based on old workflow  
▪ $13286 manpower cost avoidance per annum* |
| Dialysis cover      | • Average 4 minutes to drain an effluent bag  
• 48 minutes to drain bags for 3 shifts  
**Time spent:**  
• 48 minutes per day  
• 292 hours per annum  
**Manpower cost avoidance:**  
• $5,840 per annum* | **On average, there are 2 CRRT cases in one ICU**  
**Total time savings / annum:**  
• 1022 hours/annum  
**Total manpower cost avoidance:**  
$26572  
* Estimated hourly manpower cost - $26 |

Appendix 2: Usage of effluent bags in NHCS ICUs

![Usage of effluent bags in NHCS ICUs*](image)

* Coronary Care Unit (CCU) and Cardiothoracic Intensive Care Unit (CTICU)
Appendix 3: Role of team members

Team Members Involvement

Jasmine Lee
Koh Hwee Hong
Low Hui Ling
Delvin Wong

- Supervise & monitor and lead discussion
- Conduct & lead cause & effect analysis discussion
- Guide team in brainstorming design for trolley and drainage cover

Ng Li Choo
Amy Lee
Anne Lee
Alina Ee

- Conduct teaching and provide demonstration
- Assist in usage of equipment and provide technical support

Sharifah Nur Dhabitah
Charmaine Ong
Duan Shuya

- Collect feedback from staff and vendor
- Plot & Analyse the Cause & Effect, Pareto Analysis & prioritization of the root causes

Improve the process for draining effluent fluid from Continuous Renal Replacement Therapy machines
ABSTRACT

Introduction: Continuous wound infusion of local anaesthetic could provide effective analgesia and reduce opioid utilisation. In this quality improvement study, we evaluate the analgesic efficacy and opioid-sparing effects of the ON-Q* Pain Relief System (PRS) in gynaecologic oncology patients after lower midline laparotomy.

Methods: Our retrospective observational study included patients who underwent a laparotomy for ovarian cancer between 2016-2018. Data collection included mode of postoperative analgesia, pain scores, total 72 hour morphine consumption and occurrence of postoperative opioid adverse effects.

Results: A total of 137 patients were identified, of which 27 were managed with the ON-Q* PRS and patient controlled analgesia (PCA) morphine while 110 patients used only PCA morphine for postoperative analgesia. There were no significant differences in oral or intravenous (IV) morphine consumption and pain scores between groups, although there is a trend towards lower pain scores in the ON-Q*PRS/PCA group on postoperative day (POD) 1. A significantly higher proportion of patients experienced severe postoperative nausea and vomiting (PONV) on POD 3 in the PCA morphine group, compared to the ON-Q*PRS/PCA morphine group (7.3% vs 0%, p=0.003). Among patients with sedation score ≥2, a significantly higher proportion of patients were managed with PCA morphine alone (27% vs 0%, p=0.042).

Conclusion: Postoperative co-administration of the ON-Q*PRS with PCA morphine vs PCA morphine alone are associated with comparable analgesic effectiveness. However, ON-Q*PRS with PCA morphine demonstrates a trend towards opioid-sparing effect for severe PONV and sedation after lower midline laparotomy in ovarian cancer patients.

Keywords: Enhanced recovery after surgery/standards, perioperative care/methods, pain, postoperative/therapy, hysterectomy
INTRODUCTION

Enhanced Recovery After Surgery (ERAS) is now firmly established as a global surgical quality improvement initiative that results in both clinical improvements and cost benefits to the healthcare system (1). Benefits of ERAS pathways include shorter length of stay, decreased postoperative pain and need for analgesia, more rapid return of bowel function, decreased complication and readmission rates, and increased patient satisfaction (2). The ERAS® Society guidelines for perioperative care in gynaecologic oncology surgery advocates opioid-sparing multimodal analgesia to reduce adverse effects of opioids (1). Opioid use is associated with postoperative pruritus, nausea and vomiting, impairment of bowel function, delayed mobilisation, and increased pulmonary morbidity due to depression of the respiratory drive, all of which can delay recovery and negatively affect patients’ perception of the surgical experience (2-4).

Historically, patient controlled analgesia (PCA) with intravenous opioid has played an integral role in pain control after abdominal hysterectomy for gynaecologic oncology patients (5). Due to its side-effect profile, patients on postoperative opioids need to be closely monitored (6). More recently, studies suggest that continuous infusion of local anaesthetics (LA) at the surgical incision site could provide effective analgesia and reduce the utilisation of opioids (i.e. opioid-sparing effect) after orthopaedic and abdominal surgeries (3,7). In addition, the use of continuous regional analgesia has been shown to reduce costs associated with hospital length of stay (LOS), complications, and opioid-related side effects (8). Direct application of LA agents to wounds provide analgesia via at least two mechanisms: LA agents directly block the transmission of pain from nociceptive afferents and also inhibit the local inflammatory response to injury, thereby reducing the sensitisation of nociceptive receptors which contribute to pain and hyperalgesia (8,9).

Since January 2016, as part of the ERAS protocol for gynaecologic oncology surgeries, our institution has implemented the ON-Q® Pain Relief System (PRS) fixed flow rate pump (Avanos Medical, Inc., Georgia, USA) for postoperative analgesia in gynaec-oncology patients after abdominal surgery, in combination with PCA morphine. The ON-Q® PRS fixed rate pump consists of dual catheters connected to an elastomeric pump infusor which acts as the LA reservoir (Figure 1). At the end of the surgery, each catheter is placed on either side of the midline incision and tunnelled in the pre-peritoneal layer throughout the whole length of the incision. A bolus of 20mls 0.25% Bupivacaine is typically given through each catheter before they are connected to the elastomeric pump filled with 400 ml of 0.25% plain bupivacaine which subsequently dispenses LA at a fixed rate of 4 mL/hr over the next 3 to 4 days postoperatively.

There is a paucity of studies evaluating the efficacy of continuous LA wound infusion via the ON-Q* PRS in gynaecologic oncology patients after a lower midline incision. This quality improvement study seeks to compare the advantages of the ON-Q* PRS in combination with PCA morphine versus PCA morphine alone in ovarian cancer patients after lower midline laparotomy, with regard to analgesic effectiveness, total morphine consumption and occurrence of side effects.

METHODS

This project was conducted at the KK Women’s and Children’s Hospital which provides tertiary care for women and children in Singapore. Institutional Review Board was not attained as this was a quality improvement project in which patients’ identifiers were not collected.

Inclusion criteria consist of gynaecological patients with a confirmed diagnosis of ovarian carcinoma who underwent a lower midline laparotomy between January 2016 to December 2018. They were identified by the relevant surgical codes from the hospital database. Surgeries were limited to staging laparotomy, total hysterectomy, bilateral salpingo-oophorectomy with or without lymphadenectomy and omentectomy. All ovarian carcinoma patients undergoing lower midline laparotomy managed by one specific senior surgeon received an ON-Q PRS* pump except if they had advanced peritoneal disease, the incision was transverse (as opposed to midline) or patient refusal. All patients managed by five other surgeons received PCA morphine postoperatively due to limited experience in insertion of ON-Q PRS* pump. Once identified, selected patients were administered the ON-Q* PRS fixed flow rate pump for postoperative analgesia via dual catheters at wound closure.

All patients, regardless whether an ON-Q* PRS was prescribed, were given PCA morphine via the CADD-Legacy® pump (Smiths Medical, Minnesota, USA) with the following settings: demand bolus of 1 mg, lockout time of 5 minutes, maximum dose limit of 6mg, 8mg or 10mg in an hour and no background infusion. All patients received preoperative education on its use and PCA was initiated in the postoperative
recovery area once patients were awake from the anaesthesia. All patients were also prescribed IV ondansetron 4 mg every 8 hours P.R.N. for postoperative nausea and vomiting (PONV). Patients who could tolerate oral feeds or soft diet also had the option to convert their PCA morphine to oral tramadol 50mg every 8 hours P.R.N.

As per institutional protocol, all patients on parenteral opioids received hourly monitoring of non-invasive blood pressure, heart rate, respiratory rate and sedation score (Table 1) for 24 hours and subsequently, at four-hourly intervals. Pulse oximetry (SpO2) was monitored hourly till PCA morphine was discontinued.

Data was captured without patient identifiers from the department pain database using the relevant surgical codes and included age, ethnic group, postoperative analgesia prescribed (ON-Q* PRS, PCA morphine and/or oral tramadol), total 72-hour morphine consumption (IV and oral morphine equivalent doses, where a conversion factor for oral tramadol to oral morphine of 0.2 was applied), visual analogue scale (VAS) pain score at rest and on movement at 24 hours, 48 hours and 72 hours postoperatively, presence of postoperative nausea and/or vomiting (PONV), pruritus, sedation (defined as score > 1 and not sleeping) and respiratory depression (defined as respiratory rate < 8/min) and total length of hospital stay. To compare the side effects, the number of episodes of vomiting, pruritus and sedation recorded for each patient in the 72 hours after surgery were noted and the proportion of patients affected by each side effect was compared between groups.

Continuous data is expressed as mean (SD) or median [range] depending on data distribution. Categorical data is expressed as number (percentage). Independent t-test was used to examine mean differences for continuous, normally-distributed variables between the groups and non-parametric test was utilized to examine median differences between groups. Fisher’s exact chi-square test was utilized to examine differences of proportion in categorical variables between groups for pain scores. As the sample sizes of the subgroups with vomiting and sedation score ≥ 2 were very small, independent samples proportion z-test was applied to test if the outcomes occurred equally in the subgroups. P value less than 0.05 was considered statistically significant. Statistical analyses were performed with IBM SPSS version 28.

RESULTS

A total of 137 patients were identified to fulfill inclusion criteria, of which 110 were prescribed PCA morphine while 27 patients received both PCA morphine and the ON-Q* PRS for postoperative analgesia (Table 2). The ethnic distribution of the patients follows that of the population, with a predominance of Chinese patients in both groups. Mean age was comparable between groups and representative of the age of ovarian cancer diagnosis at our institution. Average length of stay in the ON-Q* PRS/PCA group was slightly shorter than that of the PCA group, but this was not statistically significant [6.07 (3.2) vs 6.72 (4.4), p = 0.399].

Table 3 shows a comparison of opioid consumption and pain scores between groups at different time points. In terms of total opioid usage (considering IV and oral equivalents of morphine), there was no significant difference in the mean 72-hour IV and oral morphine consumption between groups. There was also no significant difference in pain scores at rest and on movement on postoperative day (POD) 0, 1, 2, 3, although we observe a trend towards lower pain scores on movement on POD 1 for patients in the ON-Q* PRS/PCA group. A smaller proportion of patients in the ON-Q* PRS/PCA group experienced pain score ≥ 3 on POD 1, compared with patients in the PCA morphine group (44.4% vs 61.8%, p=0.078).

Table 4 compares the occurrence of side effects in the postoperative 72 hours between groups. Among patients with severe PONV (≥3x episodes), a significantly higher proportion of patients were managed with PCA morphine alone (7.3% vs 0%, p= 0.003). Similarly, in patients who experienced 2 episodes of sedation, a higher proportion were managed with only PCA morphine (27% vs 0%, p=0.042).

DISCUSSION

Our quality improvement project showed that postoperative administration of ON-Q* PRS was associated with reduced occurrence of severe PONV and sedation, as well as a trend towards lower pain score on POD 1 in ovarian cancer patients after lower midline laparotomy.

Despite the scarcity of literature exploring the analgesic efficacy of the ON-Q* PRS after abdominal surgery in gynaecological patients, current evidence suggests that the ON-Q* PRS combined with PCA provides
good pain relief after major gynaecological surgery and may be superior to conventional PCA opioid administration. In a study in which twenty gynaecologic oncology patients were randomised to receive either postoperative ON-Q* PRS or IV PCA fentanyl, significantly lower pain scores were reported by patients in the ON-Q* PRS group at 24 hours [2.6(0.7) vs 3.9(1.4); p=0.023] and 48 hours [1.9(0.6) vs 4.7(1.6); p<0.001] (3).

It is interesting to note that we did not demonstrate an opioid-sparing effect with the ON-Q* PRS. In one study in which 40 elective abdominal hysterectomy patients were randomised to postoperative wound infusion with either 0.25% levobupivacaine at 5 ml/h or normal saline (placebo), the wound infusion group consumed significantly less PCA ketobemidone (a potent opioid) in the 4-24 hours postoperatively, suggesting an opioid-sparing effect (10). We hypothesise that the difference in observation could be related to the heterogenous patients included in that trial, with inclusion of benign pathologies for hysterectomy. Hence, not all patients would have been subjected to extensive cancer surgeries and a high degree of tissue damage that increases analgesic requirement. Furthermore, pain after hysterectomy is multifactorial, with contribution from visceral and somatic components (7). Visceral pain arises from autonomic innervation of the parametrium, the upper vagina and the visceral peritoneum, while the somatic component is from the muscle, skin, fascia and other subcutaneous soft tissue (7). Even though LA from the ON-Q*PRS pump eliminates the somatic pain, the visceral component may remain significant, thereby accounting for no observed opioid-sparing effects observed.

The present study showed a significant reduction in the occurrence of severe PONV (defined as >3 episodes) and sedation (sedation score >1) with the ON-Q* PRS. This could be due to the opioid-sparing effect with the ON-Q* PRS even though our study did not demonstrate it as it was underpowered. PONV are common complications after surgery and anaesthesia, but poses a substantial economic burden due to prolonged hospital stay, unanticipated re-admission and health care resource utilisation (11). As opioids are the primary cause of PONV, reducing opioids by adoption of a multimodal analgesic regime is the cornerstone of ERAS (12). Continuous infusion of LA at the surgical wound is an effective method of managing postoperative pain, as LA agents exert their effect locally and results in reduced utilisation of opioids and their side effects. Moreover, by relieving pain in the surgical wound area, the ON-Q* PRS helps prevent pulmonary complications, such as atelectasis, and aids in early ambulation and early recovery of bowel movements after gynaecologic oncologic surgeries (3). Consequently, the ON-Q* PRS is recognised as highly beneficial to cancer patients who desire a quick recovery from surgery to commence on postoperative adjuvant anti-cancer therapy (3). Some potential catheter-related concerns have been highlighted, but remain mostly theoretical. A meta-analysis on the efficacy of continuous wound LA catheters showed a low incidence of technical failure (1%) and LA toxicity (0%) (8). Despite concerns of wound infections related to catheters, reported rates of wound infection did not differ between patients with and without wound catheters (8).

As hospital LOS is an important index of efficiency, ERAS programmes are designed to reduce the length of hospital stay by shortening the postoperative period (1). In this study, the use of the ON-Q* PRS was associated with a slight, albeit non-significant reduction in the averaged hospital length of stay. Factors, other than medical reasons, could influence hospital discharges after major surgery. A study that aims to evaluate the impact of an ERAS programme on hospital discharges in surgical patients found that hospital LOS could be influenced by two major factors – medical interventions to accelerate recovery and the organisation of post-discharge care (13). While surgical recovery could be enhanced by compliance with protocols, clinical guidelines and care pathways, pre-emptive discharge planning is critical to ease the transition of patients to other care facilities. Due to the design of this quality improvement project, we did not consider the social factors that could influence timeliness of discharge and hence, hospital LOS.

There are limitations in this study. As this was a retrospective study, data may not have been accurately, completely recorded and this could introduce bias in our analysis. We note the PCA morphine group had predominantly Chinese patients which could result in biases. As patients were not randomised, we could not control for confounding factors that could influence the results. We also note that the two study groups were unequal in size as this was determined by the prevailing surgical practice.

There are also strengths in the study. The patients were relatively homogenous, with regard to diagnosis and nature of surgery. All the ON-Q* catheter insertions and related oncological surgery were performed by a single surgeon. Future research should seek to further delineate the role of the ON-Q* PRS as an ERAS initiative through more robust methodology.
In conclusion, postoperative co-administration of the ON-Q®PRS with PCA morphine vs PCA morphine are associated with comparable analgesic effectiveness. However, ON-Q® PRS with PCA morphine demonstrates a trend towards opioid-sparing effect for severe PONV and sedation after lower midline laparotomy in ovarian cancer patients and should be incorporated into the ERAS protocol.

ACKNOWLEDGEMENTS

We would like to thank Dr Wong Wai Loong, Head of the Gynaecologic Oncology Department, for his support in the study.

DECLARATION OF INTEREST

None

FUNDING

None

AUTHOR’S CONTRIBUTIONS

PC was involved in the data collection and writing of the manuscript. RNH was involved in data analysis and constitution of the manuscript. JE and EL helped in the data collection. EL conceptualised the study and contributed to the constitution of the manuscript.
REFERENCES


Tables and Figures

Figure 1: ON-Q* PRS fixed flow rate pump with LA reservoir and duo catheters.

Table 1. Sedation scoring system

<table>
<thead>
<tr>
<th>Score</th>
<th>State of patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Patient is awake and alert</td>
</tr>
<tr>
<td>1</td>
<td>Patient is sometimes drowsy</td>
</tr>
<tr>
<td>2</td>
<td>Patient is often drowsy but easily arousable</td>
</tr>
<tr>
<td>3</td>
<td>Patient is unarousable</td>
</tr>
<tr>
<td>S</td>
<td>Patient is asleep and easily arousable</td>
</tr>
</tbody>
</table>

Table 2. Patient demographic characteristics and LOS

Data is expressed as mean (SD) or number (percentage).

<table>
<thead>
<tr>
<th></th>
<th>ON-Q* PRS/PCA</th>
<th>PCA alone</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of patients</td>
<td>27</td>
<td>110</td>
<td>137</td>
</tr>
<tr>
<td>Chinese n (%)</td>
<td>20 (74.1)</td>
<td>110 (100)</td>
<td>130</td>
</tr>
<tr>
<td>Malay n (%)</td>
<td>6 (22.2)</td>
<td>0 (0)</td>
<td>6</td>
</tr>
<tr>
<td>Others n (%)</td>
<td>1 (3.7)</td>
<td>0 (0)</td>
<td>1</td>
</tr>
<tr>
<td>Age on operation day (years)</td>
<td>52.1 (12.8)</td>
<td>53.8 (11.9)</td>
<td>------</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>6.07 (3.2)</td>
<td>6.72 (4.4)</td>
<td>-------</td>
</tr>
</tbody>
</table>
Table 3. Comparison of pain variables between groups.

Data is expressed as mean (SD), median [range] or number (percentage).

<table>
<thead>
<tr>
<th></th>
<th>ON-Q* PRS/PCA</th>
<th>PCA alone</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean 72h IV PCA morphine (mg)</td>
<td>39.9 (28.5)</td>
<td>44.0 (32.8)</td>
<td>0.531</td>
</tr>
<tr>
<td>Median 72h total oral morphine</td>
<td>0 [0 – 60]</td>
<td>0 [0 – 40]</td>
<td>0.109</td>
</tr>
<tr>
<td>Equivalent dose (mg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of oral opioids, n(%)</td>
<td></td>
<td></td>
<td>0.092</td>
</tr>
<tr>
<td>Yes</td>
<td>9 (33.3)</td>
<td>21 (19.1)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>18 (66.7)</td>
<td>89 (80.9)</td>
<td></td>
</tr>
<tr>
<td>Pain score on movement on</td>
<td></td>
<td></td>
<td>0.281</td>
</tr>
<tr>
<td>POD 0, n(%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3</td>
<td>18 (66.7)</td>
<td>64 (58.2)</td>
<td></td>
</tr>
<tr>
<td>≥3</td>
<td>9 (33.3)</td>
<td>46 (41.8)</td>
<td></td>
</tr>
<tr>
<td>Pain score on movement on</td>
<td></td>
<td></td>
<td>0.078</td>
</tr>
<tr>
<td>POD 1, n(%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3</td>
<td>15 (55.6)</td>
<td>42 (38.2)</td>
<td></td>
</tr>
<tr>
<td>≥3</td>
<td>12 (44.4)</td>
<td>68 (61.8)</td>
<td></td>
</tr>
<tr>
<td>Pain score on movement on</td>
<td></td>
<td></td>
<td>0.383</td>
</tr>
<tr>
<td>POD 2, n(%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3</td>
<td>15 (55.6)</td>
<td>67 (60.9)</td>
<td></td>
</tr>
<tr>
<td>≥3</td>
<td>12 (44.4)</td>
<td>43 (39.1)</td>
<td></td>
</tr>
<tr>
<td>Pain score on movement on</td>
<td></td>
<td></td>
<td>0.207</td>
</tr>
<tr>
<td>POD 3, n(%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3</td>
<td>27 (100)</td>
<td>103 (93.6)</td>
<td></td>
</tr>
<tr>
<td>≥3</td>
<td>0</td>
<td>7 (6.4)</td>
<td></td>
</tr>
<tr>
<td>Pain score at rest on POD 0, n(%)</td>
<td></td>
<td></td>
<td>0.508</td>
</tr>
<tr>
<td>&lt;3</td>
<td>24 (88.9)</td>
<td>95 (86.4)</td>
<td></td>
</tr>
<tr>
<td>≥3</td>
<td>3 (11.1)</td>
<td>15 (13.6)</td>
<td></td>
</tr>
<tr>
<td>Pain score at rest on POD 1</td>
<td></td>
<td></td>
<td>0.420</td>
</tr>
<tr>
<td>&lt;3</td>
<td>23 (85.2)</td>
<td>89 (80.9)</td>
<td></td>
</tr>
<tr>
<td>≥3</td>
<td>4 (14.8)</td>
<td>21 (19.1)</td>
<td></td>
</tr>
<tr>
<td>Pain score at rest on POD 2</td>
<td></td>
<td></td>
<td>0.589</td>
</tr>
<tr>
<td>&lt;3</td>
<td>26 (96.3)</td>
<td>107 (97.3)</td>
<td></td>
</tr>
<tr>
<td>≥3</td>
<td>1 (3.7)</td>
<td>3 (2.7)</td>
<td></td>
</tr>
<tr>
<td>Pain score at rest on POD 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3</td>
<td>27 (100)</td>
<td>110 (100)</td>
<td></td>
</tr>
</tbody>
</table>
Table 4. Comparison of side effects in the postoperative 72 hours

<table>
<thead>
<tr>
<th></th>
<th>ON-Q* PRS/PCA</th>
<th>PCA alone</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of patients with PONV:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 episode, n(%)</td>
<td>22 (81.5)</td>
<td>87 (79.1)</td>
<td>0.777</td>
</tr>
<tr>
<td>1 episode, n(%)</td>
<td>3 (11.1)</td>
<td>9 (8.2)</td>
<td>0.657</td>
</tr>
<tr>
<td>2 episodes, n(%)</td>
<td>2 (7.4)</td>
<td>6 (5.5)</td>
<td>0.722</td>
</tr>
<tr>
<td>≥3 episodes, n(%)</td>
<td>0 (0)</td>
<td>8 (7.3)</td>
<td>0.003</td>
</tr>
<tr>
<td>No of patients with pruritus, n(%)</td>
<td>0 (0)</td>
<td>5 (4.6)</td>
<td>0.325</td>
</tr>
<tr>
<td>No of patients with sedation score ≥2 from POD 0 to 3, n(%)</td>
<td>4 (14.8)</td>
<td>11 (10)</td>
<td>0.337</td>
</tr>
<tr>
<td>Among patients with sedation score ≥2, no of patients with:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 occurrence of sedation, n(%)</td>
<td>3 (75)</td>
<td>5 (45.5)</td>
<td>0.262</td>
</tr>
<tr>
<td>2 occurrences, n(%)</td>
<td>0 (0)</td>
<td>3 (27.3)</td>
<td>0.042</td>
</tr>
<tr>
<td>3 occurrences, n(%)</td>
<td>1 (25)</td>
<td>3 (27.3)</td>
<td>0.929</td>
</tr>
<tr>
<td>No of patients with RR&lt;8, n(%)</td>
<td>0 (0)</td>
<td>1 (0.9)</td>
<td>0.801</td>
</tr>
</tbody>
</table>
Remote Project-based Design Thinking Workshop

Keith Heng1, Yong Kang Lim1, Xin Yan Tang1, Zann Foo1, Kok Hian Tan1

ABSTRACT

Introduction: The project-based Design Thinking (DT) Workshop is a programme designed to equip healthcare professionals with the knowledge and skills to drive improvement projects using DT methodology. With the ongoing COVID-19 pandemic and safe distancing measures, remote DT project facilitation had been adopted to ensure the continuity of improvement efforts in our healthcare setting.

Objective: The objective was to develop an effective remote project-based DT Workshop via video conferencing.

Methods: The workshop was conducted virtually via a video conferencing platform, Zoom, with the incorporation of videos and role-plays. A secondary platform, Miro, an online tool which allowed participants to view and contribute content in real-time, was selected to foster participation from all team members to collaborate and contribute findings for observation and ideation activities. A total of 12 learners attended the two pilot runs that took place on 11 June 2021 and 25 June 2021. A pre-and post-workshop quiz that consisted of 10 questions was administered to the learners to assess the effectiveness of the workshops. In addition, an evaluation survey was conducted to assess the experiences of learners after attending the workshops.

Results: The overall average scores of the pre-and post-workshop quizzes for the 12 learners increased from 75.8% to 89.2% (p < 0.05). Based on the evaluation survey results collected from 6 of the learners, 50% (n = 3) felt that the workshop could substitute the face-to-face approach for project training during the pandemic, and 33% (n = 2) felt that the workshop could be a supplement to the face-to-face approach.

Conclusion: The improvement in overall average scores of the pre-and post-workshop quiz demonstrated that the remote project-based DT Workshop was effective in enhancing the knowledge of the participants after attending the workshop. The remote workshop was a good alternative to the face-to-face approach during the COVID-19 pandemic.

Keywords: Design Thinking, remote workshop, video conferencing, project, facilitation, online workshops

1. SingHealth Duke-NUS Institute for Patient Safety & Quality (IPSQ), Singapore

Corresponding Author:
Keith Heng
Assistant Manager
SingHealth Duke-NUS Institute for Patient Safety & Quality (IPSQ), Singapore
Email: keith.heng.s.k@singhealth.com.sg
INTRODUCTION

The COVID-19 pandemic has impacted the world significantly. The upheavals caused by the pandemic have resulted in major disruptions to businesses and operations. With movement restrictions in our institutions, group size limitations, and split-team work arrangements as safety measures, various improvement projects had been put on hold. This propelled us to review how we could facilitate and conduct collaborative project-based Design Thinking (DT) workshops remotely, to ensure the continuity of improvement efforts in our healthcare setting.

DT provides a human-centred approach to problem solving with an emphasis on empathy, open-mindedness and collaboration with users to gain insights, identify opportunities, and generate ideas to prototype solutions for testing, and gathering feedback for continuous improvement.

Project-based DT workshops had always been conducted in a physical setting, where participants could be on-site to gather insights through user observations and interviews. They would then reconvene in their groups to discuss their findings, identify user needs, ideate by sketching their ideas on paper and create physical prototypes for users to assess and provide feedback.

However, this physical approach could not be delivered due to the safe distancing measures during the COVID-19 pandemic, which led to the development of our re-designed remote project-based DT workshop. This paper will examine the benefits, challenges and effectiveness of the re-designed workshop conducted via a video conferencing platform.

METHODS

We piloted two full-day remote project-based DT workshops from 8.30am to 5.30pm (eight hours, excluding lunch and break time) for a total of 12 participants from the SingHealth Patient Advocacy Network (SPAN) using Zoom video conferencing platform. Zoom was chosen as the platform mainly due to its security controls, functionality and ease of use. Pre-reading materials were provided to the participants prior to the workshops. Hence, the workshops focused primarily on the application of DT tools and simulation of actual project scenarios to provide high-quality learning content.

Structure of remote project-based DT workshop

The structure of the remote project-based DT workshop was developed by adopting the Technological Pedagogical Content Knowledge (TPACK) framework shown in Figure 1. TPACK is the basis of effective teaching with technology, and understanding the interactions among content, pedagogy, and technology knowledge [1]. The structure of the workshop is summarized in Figure 2, and the detailed outline can be found in Annex A.

For the two pilot workshops, we had a main trainer and a facilitator with 6 participants in each workshop. A small class size was considered to be more suitable for more guided and interactive sessions. The facilitator to learner ratio was set at 1 facilitator to 3 learners to increase individual attention, participation and more effective communication between the facilitators and learners, which could be challenging to achieve on an online platform [2], as well as to create a sense of social presence so that the student feels part of the learning community [1]. The first author led the first phase of the DT methodology and the second author led the second and third phases.

The workshops incorporated a three-part activity using video recordings and role-plays to demonstrate the application of a particular situation that mimics the project setting of the learners. The three-part activity allowed learners to practise the following tools set out in the curriculum:

- User Observations, User Interviews, Persona Creation, Insights writing and crafting of How Might We statements
- Ideation using Silent Brain-writing, Improvement, Absurd Ideas, Idea Interlude and Idea Selection
- Prototyping and Gathering of Feedback

Supporting tools and activities

Zoom breakout rooms were used to facilitate the activities, and the learners were briefed on each activity as well as instructions on how to use the Zoom breakout room function. Learners were instructed to keep their cameras and microphones on during the breakout sessions. The learners were split into 2 breakout rooms during the activities in each workshop which involved interviews, sharing of ideas and gathering feedback. Both trainers went into each of the breakout rooms to facilitate the activities. A technical support staff was on stand-by to provide assistance should the learners experience technical difficulties or had trouble re-joining the session if they got disconnected.

Miro and WhatsApp were used as sharing tools for the workshop. Miro, an online project collaboration platform, allowed all to view and contribute content in real time, while WhatsApp was widely used for...
daily communication. The first team activity in the Understand Phase involved learners reviewing the curated video on the life of a dementia patient and their caregiver. Video documentaries that bore similarities to the project challenge statement, were edited to fit the duration and topic of interest of the learners. After reviewing the video, learners were required to type out their observations onto the Miro platform. For the next activity in the Explore Phase, learners were encouraged to present their ideas as sketches and instructed to take photographs of their sketches and share them in the WhatsApp group chat. The facilitator then downloaded the sketches and imported them onto the Miro platform for discussion.

The last activity in the Test Phase involved collaborative prototyping. Prototyping is an integral part of DT as it allows for the testing and validation of ideas, design assumptions and other aspects of conceptualisation so that the team can make appropriate refinements or changes. There are many forms of prototyping, and the most commonly used in face-to-face DT workshops are storyboarding and tangible 3D prototypes. However, due to the nature of the virtual platform, it was not possible to collaboratively create and test 3D prototypes. Hence, the team focused on getting the learners to use storyboarding as the prototyping narrative tool to focus on people and their actions, thoughts, emotions and goals. The storyboard would help learners to communicate their ideas through visual stories and showcase how their solutions address the problem statement. A facilitator was assigned to each breakout room to help the learners translate their story into a comic strip and upload it to Miro, where learners would narrate the comic with speech, action and thought bubbles using the Miro text function.

**Workshop Evaluation**
A pre-and post-workshop quiz that consisted of 10 questions, was administered to the learners to assess the effectiveness of the workshops in meeting the learning objectives. A list of the quiz questions can be found in Annex B. In addition, an evaluation survey was conducted to gather feedback and assess the experiences of learners after attending the workshops.

**RESULTS**

**Pre- and post-workshop quiz scores**
Knowledge was assessed with a pre-and post-workshop online quiz via Zoom polling function. All 12 learners who attended the remote project-based DT workshops attempted the pre-and post-workshop quiz successfully. A sample of the quiz can be found in Annex B. The responses to the quiz were anonymous.

The overall average scores of the pre-and post-workshop quiz increased from 75.8% to 89.2%, after learners attended the remote project-based DT Workshop. The difference between pre- and post-workshop quiz scores was statistically significant (p < 0.05), as summarised in Table 1 using the Wilcoxon Rank-Sum Test in IBM SPSS Statistics version 28.0.1.0.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
<th>Z</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-workshop</td>
<td>12</td>
<td>9.58</td>
<td>115.00</td>
<td>-2.098</td>
<td>0.045</td>
</tr>
<tr>
<td>Post-workshop</td>
<td>12</td>
<td>15.42</td>
<td>185.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Evaluation survey results**
Evaluations to assess the attitudes and experiences of the learners were collected using FormSG online survey immediately after the workshop. The attitudes measured include engagement, enjoyment, and the views of the participants on virtual interactive learning. Interactivity and engagement were analysed by asking participants to share their opinions of the workshop across each dimension using the Likert scale.

The team managed to collect feedback from 6 of the learners for the evaluation survey. The low feedback rate could be attributed to allowing participants to exit the workshop before completing the evaluation survey. Although follow-up emails were sent to remind participants to complete the evaluation survey, the team was unable to identify participants who did not complete the survey as it was anonymous. Based on the survey results, 50% (n = 3) of the learners felt that the workshop could substitute the face-to-face approach for project training during the pandemic, and 33% (n = 2) felt that the workshop could be a supplement to the face-to-face approach. This is summarised in Table 2.

Informal feedback gathered from the workshops were generally positive. While most learners preferred face-to-face interaction where possible, the virtual approach using video conferencing was a strong substitute to achieve effective discussions. The learners felt that remote project-based training was necessary, as social responsibility and safety take priority under pandemic circumstances.

Some limitations of remote learning shared by the learners include the inability to replicate certain activities within a virtual platform, as well as having
insufficient technological skills. The result of training learners to pick up technological skills during the workshop had led to shorter time allocated for group discussions.

Though these were some of the challenges raised by the participants, the results collected from the pre-and post-workshop quiz as well as the evaluation survey showed that the workshop was generally well-received, and that the participants demonstrated an increased understanding of Design Thinking concepts and its applications.

**DISCUSSION**

In this section, we assess the benefits and challenges of conducting our first remote project-based DT workshop, as well as provide recommendations for future remote project facilitation workshops.

Some of the benefits of adopting technologies in conducting training and project facilitation are discussed below.

**Lower cost of implementation**

The technology-based solutions discussed in this paper incurred lower costs compared to face-to-face sessions. Logistics costs, such as venue rental and refreshments, were not incurred for video conferencing workshops. Soft copies of workshop materials were provided to the participants before and after the workshop via email, without incurring any printing costs. Hence, the overall logistics costs in planning a face-to-face workshop was greatly reduced with the workshop conducted virtually via Zoom.

**Enhancing connectivity amid cross-institution travel restrictions**

The online platform provided more flexibility and allowed colleagues from various sites to register and attend the video conferencing workshop, while adhering to cross-institutional travel restrictions in a pandemic.

**Continuation of project facilitation**

Even during the pandemic, facilitators were still able to continue supporting DT projects using the video conferencing platform. Meetings with project teams could be held virtually, and sharing of information was still possible even when team members were in remote workplaces. Built-in recordings and transcripts of meetings could also allow teams to stay updated if they are unable to attend meetings.

**Challenges & Recommendations**

Some of the challenges and recommendations responding to these challenges are as follows:

**Adapting to New Technologies**

The unfamiliarity of a new platform tends to pose adoption challenges. When designing remote workshops, we noticed that a lack of familiarity with software user interface posed a significant obstacle with the workshop experience. While these affordances have the potential to improve how workshops could be conducted over remote settings, having participants to pick up on the training content and learn a new medium posed a significant challenge in this fast-paced DT workshop. Though we allocated time for participants to familiarise with the new platform, the inability to address multiple queries or issues faced by the participants resulted in frustration. Hence, it is important to include a step-by-step guide to help all users navigate the platform used. In addition, it would be helpful to have a technical support staff available to assist with technical queries from the participants, to enable the trainer to focus on content delivery.

**Group discussions**

To increase time allocated for group discussions, it may be helpful to limit the number of Miro tools that learners should know. During the workshop, the learners were taught to practise 4 Miro tools, namely “Text”, “Sticky Note”, “Draw line” and “Shape” tool. However, we observed that most learners mainly used the “Text” tool for the activities during the session. This could be due to familiarity with the “Text” tool, as well as the ease of identifying and using the tool. Reducing the number of tools would likely decrease the time required for participants to practise using them, as well as the time needed to resolve questions pertaining to the tools, allowing trainers to allocate more time for effective group discussions.

**Issues arising from the use of personal devices**

Participants of our workshop had to use their personal computers or internet devices, as the computers provided by our organization had no internet access due to security reasons. A few issues may arise when participants use their personal devices, such as a lack of privacy on personal data, especially when the screen-sharing function is used.

It would be helpful if the organization could provide the resources for digital learning to be effective, such as a standardised laptop or tablet with the same specifications. In addition to increased privacy, this
would be favourable as facilitators can expect the type of functions available for each participant. Moreover, a timely update on digital learning software can be ensured if hardware devices are monitored by the organization.

**Insights gathering**

The main challenge in designing our workshop was not being able to be on-site to conduct qualitative research, which includes observations and face-to-face interviews with the user. On-site observations enable participants to observe the subject matter in their daily lives and activities to facilitate a better understanding of them. Regardless of the type of problem statement, the use of pre-recorded videos could not replace direct on-site observations. Several factors contribute to the reduced effectiveness of data gathered from video recordings, such as the field of view, clarity of the video stream via the internet, and the lack of directly understanding how the user interacts with the environment. It is also particularly important for participants to have a first-hand experience of what their user is going through. We cannot exclude that an interactive video may still be able to achieve reliable insights on the user, for example allowing participants to self-navigate and focus on objects of interest. Video recordings used as an alternative to direct observations are still useful and practical. These systems can be successfully adopted for studying user daily behaviours which participants may not be able to observe while being on-site, such as periods of activity and their key touch points.

While the use of videos to completely replace on-site observations may not allow participants to yield quality insights, augmented reality and virtual reality could play an increased and diversified role in insights gathering.

**CONCLUSION**

The impact of the COVID-19 situation has affected the way we work and may continue to do so in years to come. As a result, digital learning and project facilitation will remain integral and relevant in the near future. This paper presents our experience of conducting remote project-based DT workshops for SPAN members. We experimented with the use of video recordings, Zoom and Miro as platforms for insights gathering, ideation and collaborative prototyping.

Below is a summary of our recommendations for conducting similar future remote project-based DT workshops:

- Use familiar technology. If introducing new technologies, provide adequate time and practice sessions.
- Use a video conferencing tool that eliminates the need for users to switch between tools to reduce confusion.
- Standardise hardware to eliminate unforeseen technical issues.

We hope that the lessons presented can help trainers explore and gather more perspectives in conducting remote project-based DT workshops. Furthermore, it is noteworthy that research on similar workshops and trends should be explored to ensure that continuous learning and improvements can be achieved in the healthcare setting regardless of the situation.

**MANUSCRIPT INFORMATION**

**Author contributions**

K.H. and Y.K.L. conceived the study and wrote the first draft of the manuscript. X.Y.T. edited the manuscript and performed the data analysis for the Wilcoxon Rank-Sum Test. All authors reviewed the manuscript, made amendments and approved the manuscript.

**Declaration of interests**

The authors declare that there are no competing interests in the publication of this paper.

**Ethical approval**

This study was exempted from SingHealth Centralised Institutional Review Board (CIRB) based on Category 2 – Anonymous Educational Tests, Surveys, Interviews, or Observation. CIRB Reference number: 2022/2076.

**Funding**

The authors received no funding for conducting the study and publishing this paper.
## TABLES AND FIGURES

**Figure 1:** The Technological Pedagogical Content Knowledge (TPACK) framework.

**Figure 2:** Brief structure of the remote project-based DT workshop.

**Table 2:** Results of the evaluation survey for the remote project-based DT workshop.

<table>
<thead>
<tr>
<th>Disease Outbreak Situation</th>
<th>Situations</th>
<th>Response (% and count)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>As a substitute</td>
<td>As a supplement</td>
</tr>
<tr>
<td>Outbreak</td>
<td>50% (3 out of 6)</td>
<td>33% (2 out of 6)</td>
</tr>
<tr>
<td>Non-outbreak</td>
<td>17% (1 out of 6)</td>
<td>50% (3 out of 6)</td>
</tr>
</tbody>
</table>
REFERENCES

1. Davey B, Elliott K, Bora M. Negotiating pedagogical challenges in the shift from face-to-face to fully online learning: A case study of collaborative design solutions by learning designers and subject matter experts. Journal of University Teaching & Learning Practice. 2019;16(1). Doi: 10.14453/jutlp.v16i1.3


### ANNEX

**Annex A:**

**Detailed Remote Project-based DT workshop Outline**

| Welcome | - Welcoming participants  
|         | - Introduction of the team  
|         | - Sharing of objectives for Introduction to Design Thinking Workshop  
|         | - Helpful tips on using Zoom platform  
| Introduction | - Introduction to Design Thinking  
|             | - Sharing of 3-phase AM-EPIC Design Thinking Process  
|             | - Relevance of Design Thinking in Healthcare  
|             | - Principles of Design Thinking and Designing for Users  
| Understand | - What is Understand Phase  
|            | - Importance of Empathy  
|           | - Commonly-used Understand Tools  
|           |   - User Interviews  
|           |   - User Observations  
|           |   - Being in the Shoes of  
|           | - Power of Reframing  
|           | - Writing good Insights  
|           | - How-Might-We statement  
| Explore  | - What is Explore Phase  
|         | - Brainstorming Rules  
|         | - Commonly-used Explore Tools  
|         |   - Silent Brain writing  
|         |   - Improvement  
|         |   - Absurd Ideas  
|         |   - Round Robin  
|         | - Concept Refinement  
| Test    | - What is Test Phase  
|         | - Prototyping principles  
|         | - Commonly-used Test Tools  
|         |   - Paper Prototyping  
|         |   - Storyboarding  
|         |   - Tangible/3D Prototypes  
| Conclusion | - Summary of Design Thinking in Healthcare  
|           | - Introduction to 1-day face-to-face Design Thinking Workshop  
|           | - Q&A and AOB  
|           | - Post-workshop Assessment and Survey  

### Annex B:

#### List of Questions for the Pre-and Post-Workshop Quiz

<table>
<thead>
<tr>
<th>Questions</th>
<th>Options (Correct answer in <strong>bold</strong>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What does it mean for Design Thinking to be focused on user outcomes?</td>
<td>○ Innovating a product once and not ever returning to it</td>
</tr>
<tr>
<td></td>
<td>○ <strong>Working to solve user’s problems as the first design priority</strong></td>
</tr>
<tr>
<td></td>
<td>○ Making products more feasible for business operations</td>
</tr>
<tr>
<td></td>
<td>○ Creating solutions that are perfect for users without refinement</td>
</tr>
<tr>
<td>2. Design Thinking is used to</td>
<td>○ Improve aesthetics to existing products</td>
</tr>
<tr>
<td></td>
<td>○ <strong>Impact people in a positive manner</strong></td>
</tr>
<tr>
<td></td>
<td>○ Only resolve personal problem</td>
</tr>
<tr>
<td>3. Who is Design Thinking suitable for?</td>
<td>○ Designers</td>
</tr>
<tr>
<td></td>
<td>○ Engineers</td>
</tr>
<tr>
<td></td>
<td>○ Healthcare Professions</td>
</tr>
<tr>
<td></td>
<td>○ <strong>Everyone</strong></td>
</tr>
<tr>
<td>4. When is it NOT suitable to use Design Thinking?</td>
<td>○ When the problem at hand is complex or unclear</td>
</tr>
<tr>
<td></td>
<td>○ When we are facing a human-centred problem</td>
</tr>
<tr>
<td></td>
<td>○ <strong>When the problem at hand is well-defined and straightforward</strong></td>
</tr>
<tr>
<td></td>
<td>○ When a holistic view of users and stakeholder needs are required</td>
</tr>
<tr>
<td>5. Design Thinking starts with</td>
<td>○ Prototyping where problem-solvers fall fast and cheaply</td>
</tr>
<tr>
<td></td>
<td>○ <strong>Understanding the user with empathy</strong></td>
</tr>
<tr>
<td></td>
<td>○ Exploring and coming up with many new ideas</td>
</tr>
<tr>
<td>6. To understand users with empathy through Design Thinking, all options should be done EXCEPT</td>
<td>○ Be an active listener</td>
</tr>
<tr>
<td></td>
<td>○ Be comfortable with silence</td>
</tr>
<tr>
<td></td>
<td>○ <strong>Make assumptions</strong></td>
</tr>
<tr>
<td></td>
<td>○ Be comfortable to ask questions when unsure</td>
</tr>
</tbody>
</table>
7. Which of the following is the best insight statement written?

- Registration counters always crowded. 2 Self-registration kiosk available
- **Patients choose to crowd around the registration even though self-registration kiosk are available but are obscured by poster panels**
- Patients choose to wait for registration at counter even though self-registration kiosks are available.

8. Which of the following is NOT a principle of the “Explore” phase in Design Thinking?

- Defer judgment
- **Go for quality**
- Encourage wild ideas
- Build on the ideas of others

9. It is important to create prototypes with low fidelity as

- **DT practitioners can test concepts quickly and cheaply with users**
- Effort can be used to focus on other phases
- It can accelerate the Design Thinking process
- There is no time

10. While Design Thinking focuses on the following options, _____ is the primary focus of Design Thinking for the process to be effective.

- Creativity
- Cost savings
- **Human-centeredness**
- Innovation
Improving Vitamin D Screening in Patients with Systemic Lupus Erythematosus: A Quality Improvement Project

Warren FONG¹,²,³, Siaw Ing YEO¹, Sue-Ann NG¹, Li Khoon TAN¹, Imelda Ereno LUSTESTICA⁴, Yih Jia POH¹

ABSTRACT

Introduction: Vitamin D deficiency is prevalent in patients with systemic lupus erythematosus (SLE). Internal audit revealed suboptimal performance of vitamin D screening in patients with SLE. Our aim was to improve the screening of vitamin D levels in patients from 21% to 50% within one year.

Methods: Quality improvement methodology was utilised to design and implement the Plan-Do-Study-Act cycle. Rate of vitamin D screening was measured using run charts.

Results: Physician factors (relating to lack of time), healthcare system factors (relating to inability for allied health to order previsit blood tests) and factors of work processes (relating to long processing time of vitamin D tests) were identified to be root causes of low vitamin D screening rates. We conducted three interventions, namely setting up a co-morbidity clinic to provide patients with previsit planning, empowering nurses and pharmacists to order the screening blood tests prior to patients’ outpatient physician visits, and reminding patients to perform their blood tests earlier. The rate of screening of vitamin D increased from 21% to 60%.

Conclusion: Utilisation of a quality improvement framework is useful in improving screening of co-morbidities in an outpatient clinical setting.

Keywords: Lupus, co-morbidities, quality, osteoporosis, screening

1. Department of Rheumatology and Immunology, Singapore General Hospital, Singapore
2. Yong Loo Lin School of Medicine, National University of Singapore, Singapore
3. Duke-NUS Medical School, Singapore
4. Department of Neonatal and Developmental Medicine, Singapore General Hospital, Singapore

Corresponding Author:
Warren FONG, MBBS (Singapore), MRCP (UK), FAMS (Rheumatology)
Senior Consultant
Department of Rheumatology and Immunology
Singapore General Hospital
Academia Building, Level 4, 20 College Road
Singapore 169856
Tel no: +6563214028
Fax no: +6565348632
**INTRODUCTION**

Systemic lupus erythematosus (SLE) is a multisystem autoimmune disease that can affect vital organs and has the potential to become life-threatening if untreated [1]. It typically affects young women of childbearing age. One of the complications that contributes to increased morbidity in SLE is that of osteoporosis. Osteoporosis leads to osteoporotic fractures, and this is associated with limitation of ambulation, chronic pain and disability, and reduction in quality of life [2,3]. Osteoporosis can occur in up to two-thirds of patients with SLE [4,5]. One of the many contributing factors leading to osteoporosis in patients with SLE is that of vitamin D deficiency [6]. Numerous studies have shown that vitamin D deficiency is common in patients with SLE [7–9], and low vitamin D levels have been associated with low bone mineral density of the lumbar spine [10]. In turn, low bone mineral density is also associated with vertebral fractures [7,11,12]. In order to identify patients at risk of low vitamin D, screening needs to be performed on patients with SLE. However, internal quality audits had demonstrated that only 21% of patients with SLE had their vitamin D levels screened. Of the patients that had their vitamin D levels screened, 88% were found to have low levels of vitamin D, and this was more compared to other cohorts that reported vitamin D levels to be insufficient in 49-67% of the cohort [8,9,13].

Our project aimed to improve the screening of vitamin D levels in at-risk patients with SLE. Our mission statement was to improve the screening of vitamin D among patients with SLE who present to the Autoimmune and Rheumatology Centre in Singapore General Hospital from 21% to 50% within 1 year.

**METHODS**

This quality improvement project was conducted in Singapore General Hospital, a tertiary rheumatology centre. Patients at risk were patients who had a clinical diagnosis of SLE and they were managed in a dedicated centre, the Autoimmunity and Rheumatology Centre (ARC). Electronic medical records of patients who visited ARC with a diagnosis of SLE were reviewed from 2018 to 2019 to obtain the baseline weekly rate of screening of vitamin D levels in patients with SLE. No Institutional Review Board was needed for Quality Improvement Projects according to local guidelines.

A multidisciplinary quality improvement team was set up and consisted of six rheumatologists, an advanced practice nurse, a resident nurse and a quality improvement coach.

A cause-and-effect analysis was performed to identify root causes for the low level of vitamin D screening rates in patients with SLE.

Voting was then conducted on the root causes identified and these were then plotted on a pareto chart. Factors accounting for at least 80% of the votes were then included into a tree diagram and prioritization matrix. Data was collected after one Plan-Do-Study-Act (PDSA) cycle, which was used to assess performance improvement and impact of the interventions. Run charts were used to track the screening rate of vitamin D in patients with SLE.

**RESULTS**

The cause-and-effect analysis identified root causes of the low levels of vitamin D screening in patients with SLE (Figure 1). The factors were broadly classified into categories of work processes, healthcare system factors, patient factors and physician factors.

After two rounds of voting, according to the Pareto Principle, seven factors were identified as contributing 88% of the effect (Figure 2). The factors identified could be broadly classified under physician factors, healthcare system factors and factors of work processes. Physician factors mainly involved time related factors such as screening of vitamin D not being a priority in a busy outpatient clinic, lack of time or overlooking to trace vitamin D results if they were not available during the outpatient consultation and lack of time to check when vitamin D was last screened.

Healthcare system factors identified included inability of nurses and pharmacists to order the test and inability for the test to be performed in some polyclinics. In our clinical setting, nurses and pharmacists run outpatient monitoring clinics where they telephone patients as part of the regular follow-up of patients in the outpatient, alternating this with outpatient visits with the physician. In our local healthcare setting, some of the patients also opt to perform their blood tests in the polyclinics, instead of the hospitals, and some of the polyclinics did not allow for testing of vitamin D levels.

Work processes which were identified were that there was a long processing time for vitamin D levels, often taking up to one week for the results to be available, and abnormal results not being highlighted in the electronic results.

Based on the tree diagram and prioritization matrix (Table 1), in order to address the lack of time by
physicians in having to check if the vitamin D levels had been screened, setting up a co-morbidities clinic was deemed to be the most effective, easy to implement and sustainable solution. Nurses and pharmacists would run a virtual co-morbidities clinic and perform previsit planning. They would check for need for screening of comorbidities, in particular vitamin D levels, prior to patients’ outpatient appointments using a standardised template, and place this information in the electronic health records so that the information is easily available to the physician, nurse or pharmacist during the clinic encounter, which can occur in person or via teleconsultation. This provided an easy reminder for the physician, nurse or pharmacist to screen for co-morbidities, especially vitamin D, during the upcoming outpatient consultation.

To address healthcare system factors, nurses and pharmacists were empowered to order the tests on behalf of the physician so that the patients could perform the tests prior to the next regular outpatient follow-up clinic visit with the physician, nurse or pharmacists, which could occur either in person or via teleconsultation.

To address work processes that resulted in long turnaround time for vitamin D test results, clinic assistants were tasked to remind patients to perform their blood tests a week prior to their scheduled outpatient appointments, thus ensuring that the test results would be available in a timely manner. The interventions for the PDSA cycle are summarised in Figure 3.

From January 2019 to June 2019, 744 individual patients and 1356 patient visits were evaluated. As seen from the run chart (Figure 4), the median level of vitamin D screening in patients with SLE increased from 21% to 60%, and this exceeded our initial goal of 50%.

**DISCUSSION**

The goal of our quality improvement project was to achieve a sustainable rate of screening of vitamin D levels in patients with SLE. The interventions highlighted are practical and can be replicated in other clinical settings. A learning point of the project was that whilst physicians might be aware of the recommendations and need for screening of vitamin D levels in patients with SLE, this is often overlooked in a time-constrained consultation, a problem commonly highlighted in other studies [14,15]. There was substantial improvement in the screening rates with the implementation of the co-morbidities clinic, where nurses and pharmacists provided previsit planning. The team had earlier considered the option of implementing an automated electronic prompt for physicians, but this was costly and needed technical expertise to enhance the electronic health records. With availability of funding, this could certainly be an area for future improvement. Empowering nurses and pharmacists to order the tests also ensured that results would be available prior to patients’ outpatient visits. This intervention also resulted in upskilling of nurses and pharmacists, and is line with aims to improve patient outcomes in non-physician-led rheumatology clinics [16]. The benefit of previsit planning has also been previously highlighted by other studies that demonstrated improvement in the process of care and patient outcomes [17]. Simple measures such as reminding patients to perform their blood tests earlier can also ensure that results are readily available during patients’ outpatient visits and avoid healthcare professionals having to trace such results after the clinic visit, thus minimising human error.

A limitation was that the efforts focused mainly on improving the screening of vitamin D levels through the provider and not the patient. This could possibly explain why not all patients could be screened for vitamin D levels, as other factors such as cost of the test could be reasons why patients declined vitamin D screening. Further improvements to the quality improvement project could be looking into ways to improve patient factors affecting low vitamin D screening levels, such as patient education on the importance of vitamin D screening and looking into ways to reduce cost burden of tests to patients. Also, it is also important to note that the provision of previsit planning is resource intensive and may still be challenging to implement in resource challenged settings.

**CONCLUSION**

In summary, our team recognised that screening of vitamin D levels were not adequately performed in our institution. Low vitamin D levels can predispose patients with SLE to osteoporosis and subsequent osteoporotic fractures. After implementing improvements such as setting up of the co-morbidity clinic, empowering nurses and pharmacists to order screening blood tests and reminding patients to perform their blood tests earlier, we were able to improve the rate of screening of vitamin D levels from 21% to 60%.
DISCLOSURE

There was no external funding for this study and no authors declared conflict of interest related to the production of this manuscript.

ETHICAL DISCLOSURE

Ethics approval was not deemed to be needed as this study this is a quality improvement project and there is no interaction with patients nor animals.

FUNDING

No funding.

AUTHOR’S CONTRIBUTIONS

All listed authors have contributed significantly in all of the following: (1) substantial contributions to the conception or design of the work, or the acquisition, analysis, or interpretation of data for the work; (2) drafting the work or revising it critically for important intellectual content; (3) final approval of the version to be published; (4) agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
TABLES AND FIGURES

Figure 1. Cause-and-effect analysis of root causes of low levels of vitamin D screening in patients with systemic lupus erythematosus (SLE)

Figure 2. Pareto chart
Figure 3. Summary of Plan-Do-Study-Act (PDSA) cycle

- Virtual co-morbidities clinic (prioritizing planning)
- Patient consultation with physicians, nurses, or pharmacists in-person or via teleconsultation
- Waiting area

- Nurse or pharmacists will ensure patients are up-to-date in their co-morbidities screening and vaccinations
- Place prompt in the electronic health records

- Assess disease control
- Check laboratory results
- Check co-morbidities screening and vaccination status
- Patient communication
- Order medications and future blood tests
- Empower nurses and pharmacists to order screening tests

Figure 4. Run chart of patients screened for vitamin D levels

![Run chart of patients screened for vitamin D levels]

Baseline median = 21%

Table 1. Tree diagram and prioritization matrix

<table>
<thead>
<tr>
<th>Aim of project</th>
<th>Concepts to address root causes</th>
<th>Specific solutions</th>
<th>Criteria</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Physician (Time): screening of vitamin D not priority in busy clinic, lack of time/overlooked to trace vitamin D results when not available during consultation, lack of time to check when vitamin D was last screened</td>
<td>Place alert in electronic records when screening is due</td>
<td>Effectiveness: 4  Low cost: 1  Ease of implementation: 2  Sustainability: 5</td>
<td>12</td>
</tr>
<tr>
<td>Healthcare system (Availability of service): inability to order tests by nurses and pharmacists, unable to perform tests in the polyclinic</td>
<td>Setup comorbidities clinic to screen for vitamin D</td>
<td>5  1  5  5</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Post reminders in the clinic to screen for vitamin D</td>
<td>2  5  3  3</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process (Laboratory): long processing time of test required and abnormal results not highlighted in red</td>
<td>Empower nurses and pharmacists to order tests</td>
<td>5  3  4  5</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Send blood sample collected in polyclinic back to hospital for testing</td>
<td>5  1  2  3</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check if the laboratory is able to generate the results on the same day</td>
<td>4  1  1  5</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinic assistant to remind patients to do their blood tests a week earlier</td>
<td>2  5  5  5</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check if results can be highlighted in red</td>
<td>4  1  3  5</td>
<td>13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES


Near Fatal Chemotherapy Overdose Incident - Patient Safety Lessons and Impetus for Organisational Culture Change

Kok Hian Tan¹, Irene Quay¹, Nguk Lan Pang¹

ABSTRACT

Incident: An incident involving multiple-fold unit errors in the programming of infusion pumps affected two oncology patients in 2009. One involved the drug doxorubicin. The other involved a potentially fatal overdose of 5-flurouracil, which was fortunately promptly and successfully treated with an antidote, uridine triacetate (Vistonuridine), then an experimental drug.

Root Cause Analysis: A multidisciplinary review was conducted using Root Cause Analysis (RCA). The root causes were similar looking infusion pumps, lack of standardisation of units (ml/h & ml/24h), absence of a formal structured training in the use of infusion pumps, complacency in the independent check process and suboptimal communications.

Recommendations & Follow-up Actions: The recommendations included standardisation of infusion pumps and dosing units, introduction of formal structured training with documented competency checks, enhancement of culture of medication safety & patient safety and improved dissemination of information. The recommendations were implemented and patient safety culture and awareness were enhanced.

Discussion: There were pertinent lessons for our pharmacy department as well as an impetus towards an organization culture change in hospital for patient safety. We learnt the importance of systemic approaches for patient safety like structured training and standardisation of units and equipment. Medication safety culture and awareness was heightened considerably among our staff. Patient safety became our top priority since then. A mindset change for staff of our hospital since this sentinel event was the need to have a strong patient safety culture.

Keywords: Chemotherapy, overdose, RCA, 5-fluorouracil, medication error

1. KK Women’s and Children’s Hospital, Singapore

Corresponding Author:
Prof Tan Kok Hian
KK Women’s and Children’s Hospital
100 Bukit Timah Road
Singapore 229899
Email: tan.kok.hian@singhealth.com.sg
**INCIDENT**

In November 2009, two of our gynaecological cancer patients were inadvertently administered multi-fold overdose of chemotherapeutic drugs – one an overdose of 5-fluorouracil (5-FU) and the other doxorubicin. This was a miscalculation and erroneous programming of the ambulatory chemotherapy pumps. In 2006, a similar error involving 5-FU in Canada was reported by the Institute of Safe Medication Practices (ISMP), which resulted in a fatal outcome. The two errors occurred on the same day, during the same shift, involving two patients who were administered chemotherapy delivered via portable home infusion pumps.

**Patient A**

Patient A was administered her third course of chemotherapy. The regimen consisted of cisplatin dosed at 99 mg in 500 ml normal saline to be infused over 6 hours, after which Patient A would be discharged home with intravenous doxorubicin dosed at 100 mg via home pump to be infused over 72 hours through a Hickman’s line. For the first 2 courses, the pump used was CADD-Legacy® 1 (Smiths Medical, St Paul MN, USA), which has a fixed continuous delivery rate of milliliters per 24 hours (ml/24h).

For the third course, the pump used was a CADD-Legacy Plus, which is capable of intermittent or continuous delivery at rates of either in milliliters per hour (ml/h) or milliliters per 24 hours (ml/24h). The CADD-Legacy Plus was used because the Oncology Pharmacy did not have a CADD-Legacy 1 at that point in time. The CADD-Legacy Plus pumps were usually reserved for intermittent antibiotic infusions, though they could be reconfigured to deliver continuous infusions.

The CADD-Legacy Plus was configured and set by a senior pharmacist, and double-checked by another pharmacist. Unfortunately, the infusion rate was set erroneously to deliver 66 ml/h instead of 66 ml/24h. The configured and programmed CADD-Legacy Plus and prepared drug was then dispatched by a porter to the Women’s Day Therapy Centre and attached to Patient A’s Hickman line for continuous intravenous administration by the oncology nurse before the patient was sent home.

That same evening, Patient A discovered that the pump had completed the infusion before the scheduled time. She called the pharmacist and was advised to return to the hospital immediately. The intravenous doxorubicin, which was intended to be infused over 3 days, had been infused over 3 hours. The infusion pump was detached from Patient A’s Hickman line. She was admitted for close monitoring and was well. She was discharged 11 days later.

**Patient B**

Patient B started her third course of chemotherapy on the same day as Patient A. The chemotherapy regime consisted of cisplatin and 5-fluorouracil (5-FU). Cisplatin was dosed at 105 mg in 500 ml normal saline to be infused over 3 hours, after which Patient B would be discharged home with intravenous 5-FU 6 g (4 g/m2) via ambulatory pump to be infused over 96 hours through a Hickman’s line.

The home pump used for Patient B’s third course of chemotherapy was also the CADD-Legacy Plus pump. It was set and checked by the same pharmacists who handled Patient A’s pump on the same afternoon. The infusion rate was also erroneously set as 30 ml/h instead of 30 ml/24h. The prepared drug and infusion pump was dispatched by porter to the Women’s Day Therapy Centre and attached to Patient B’s Hickman line for intended infusion over 4 days at home. However, the drug was infused over 4 hours instead.

Upon discovering that Patient A’s chemotherapy infusion had completed much earlier than scheduled, the pharmacist called up Patient B the same evening to return to the hospital immediately to check if her pump settings were in order. However, by the time the pharmacist called Patient B, the drug had already been completely infused and Patient B had gone ahead to stop the pump at home before coming to the hospital. At the hospital, the pump was detached and Patient B was admitted for close monitoring. The intravenous 5-fluorouracil, which was intended to be infused over 4 days, was infused over 4 hours. Patient B, like Patient A was admitted immediately on the same night for observation and monitoring.

**Immediate actions of the hospital**

We were concerned for the well-being of both patients especially Patient B as previous cases of 5FU overdose cases reported overseas had resulted in fatalities. Our hospital medical oncologist noted that there might be a recently available antidote for 5-FU overdose. A literature search showed Vistunuridine, then an investigational drug in 2009, had achieved good results as an antidote for 5-FU overdose. Vistunuridine is manufactured by Wellstat...
Therapeutics Corp, Maryland, USA. Contact was immediately made and arrangements were made to have Vistonuridine delivered to Singapore immediately on the next available flight as a hand carried item.

For purposes of medication registration, the Health Sciences Authority (HSA) of Singapore has to approve any drug brought into Singapore. The office of HSA was not contactable as it was after office hours then. KKH Ethics Committee Chairperson was immediately consulted and advised that in a life-threatening situation, an investigational drug can be given without formal ethics committee approval as long as two senior doctors agreed with the plan. The two senior doctors reviewed the patient and signed the agreement for the drug to be use.

On the second day (Saturday morning), the relevant HSA officer was informed of the urgent request and the circumstances surrounding the request. HSA gave immediate approval for the hospital to proceed. On the third day, 41 hours after the discovery of incident, the antidote arrived in Singapore. The first dose of the drug was administered to Patient A an hour later after arrival in the country.

Patient B’s clinical and biochemical parameters were monitored daily. Her anemia required transfusion of a single unit of blood. Patient B had thrombocytopenia and a transient rise in liver enzymes. Prophylactic antibiotics and antifungal treatment were started. Reverse nursing barrier was practiced during the neutropenic phase. She was also given growth colony-stimulating factors (filgrastim) support. She recovered and was discharged well 19 days after the incident.

ROOT CAUSE ANALYSIS

The hospital convened a review to establish the circumstances and root causes leading to the medication errors. The review panel comprised a multidisciplinary team of doctors, nurses, allied health staff and administrative professionals. The review was to recommend improvements to prevent future occurrences of such medication errors.

The RCA chart is depicted in Fig 1. The root causes were similar looking pumps used for infusion, lack of standardisation of units (ml/h & ml/24h) for infusion pumps, absence of a formal structured training in the use of pumps, complacency in the independent check process and suboptimal communications. They are elaborated as below:

1. Similar Looking Pumps for Infusion Use in the Oncology Pharmacy

   The CADD-Legacy 1 and CADD-Legacy Plus pumps were approximately the same size and look similar. See Fig 2. The CADD-Legacy 1 was used for the ambulatory oncology patients who required continuous chemotherapy infusion over several days. It had a distinct label in front indicating “ml/24 hour”. The CADD-Legacy Plus was usually used for antibiotics infusion, but had been configured on previous occasions to deliver continuous infusion of chemotherapy drugs. It did not carry a label indicating that by default, its delivery rate was mls per hour.

   The hospital’s Oncology Pharmacy had a total of 4 CADD-Legacy-1 pumps validated for ambulatory chemotherapy use. On a yearly check in September 2009, the volumetric accuracy of three CADD-Legacy-1 pumps were found to have deviated more than 10% and were thus sent for maintenance repair in the USA. The pharmacists felt it was not necessary to request for a replacement CADD-Legacy 1 pump as they did not have any patients needing the CADD-Legacy 1 pump at that time. The usage of this pump is very low during that period. Hence Oncology Pharmacy was dependent on one remaining dedicated CADD-Legacy 1 pump and several CADD-Legacy Plus infusion pumps. Both the Biomedical Engineering and Pharmacy departments did not have a policy of staggering the servicing of the pumps. The pumps had to be outsourced to the vendor for maintenance, as special software was required for validation.

2. Lack of Standardisation of Units (ml/h & ml/24h)

   The pharmacist would set the CADD-Legacy 1 based on a checklist that records the dose, volume, duration of infusion and the rate of infusion in mls per 24 hours. The pump programming requires several steps to find the ‘continuous’ option and the rate of infusion. The pump did not contain smart capabilities to set maximum dose or rate to prevent overdosing. A second pharmacist would countercheck the first pharmacist’s setting of the infusion pump.

Checklist used on 6 Nov 2009 was meant for the CADD-Legacy 1. The checklist clearly stated it is meant for the CADD-Legacy 1. The calculation on the checklist is configured for the final infusion rate to be in mls per 24 hours. In the case of 5-FU, the absolute dose of medicine was 6 gm, the total duration of infusion was 96 hours (a), the total volume of infusion was 120 mls (b) and the continuous infusion rate was calculated based
on the checklist to be b/a x 24 hours to give a rate of 120/96 x 24 = 30 mls per 24 hours.

As the CADD-Legacy 1 was not available, the pharmacists used the CADD-Legacy Plus pumps for Patient A and Patient B. By default, the CADD-Legacy Plus pump has a delivery rate of mls per hour unless otherwise configured. The pharmacists confirmed that they were aware that the 2 pumps had different delivery rates – the CADD-Legacy 1 in mls per 24 hours and the CADD-Legacy Plus in mls per hour. However, when the pumps were set for Patient A and Patient B, they were set according to the number that the pharmacists arrived at using the checklist. For Patient A, the rate on the checklist was 30 mls per 24 hours, and so the figure 30 was set. The difference in the unit of measure for the 2 pumps were overlooked by both pharmacists. Both pharmacists confirmed that they read the settings together twice for each pump. For Patient B, although the digital read out was 30 mls per hour, it did not occur to them that it was a wrong rate – a situation of “what the mind does not think, the eyes do not see”.

3. Complacency in the Check Process – No Double Independent Checking
There was independent checking in the case of Patient A’s pump but there was no independent checking by the 2 pharmacists in the case of Patient B’s pump. Both pharmacists confirmed that they did the programming of Patient B’s pump together. There was no Pharmacy Policy and Procedure on independent checking.

The calculation check as completed on both occasions did not surface the error in the infusion rates for both patients. Both pharmacists failed to recognise that they were using the checklist and calculations of the CADD-Legacy 1 pump on the CADD-Legacy Plus pump. The calculation checks were not validated with a mental approximation as identified.

4. Absence of a Formal Structured Training of the Use of Pumps
Both pharmacists confirmed that they have undergone an induction programme that covered the use of the different pumps. There was however no formal structured training with documented competency checks in Oncology Pharmacy on the use of the different types of pumps. It was more on-the-job training that was given to pharmacists. There was no clear policy on the training for the different uses of the pumps.

The pharmacists confirmed that they had never used the CADD-Legacy Plus pump for chemotherapy before although both pharmacists have used these pumps for antibiotics administration. This was due in large part to the relatively low workload for chemotherapy for gynaecological oncology patients requiring ambulatory pumps in our hospital.

5. Suboptimal Communication
There was a lack of awareness of prevention & information on medical management of previous 5-FU overdoses. A previous vendor notice on the possibility of dosing error in these pumps was not well circulated. Information about previous management of 5-FU overdoses was not readily available in Singapore.

Fortunately, the experimental antidote Vistonuridine was recollected by hospital oncologist who had chanced upon this antidote while attending a conference a few months ago prior to the incident. The team called up the manufacturer (Wellstat Therapeutics in Maryland) for the antidote that was still an investigational drug at that time. The manufacturer was extremely helpful and was able to courier the drug to Singapore in a very short time for emergency use.

FOLLOW UP ACTIONS IMPLEMENTED BY THE HOSPITAL
The recommendations included standardisation of infusion pump equipment, standardisation of dose units, introduction of formal structured training with documented competency checks, enhancement of culture of patient & medication safety especially awareness of high risk medication; and improved communication & dissemination of information. The implemented recommendations improved patient safety. The recommendations in detail are illustrated in Fig 3.

Following the actions implemented, a Patient Safety Culture Survey was conducted for 3,876 staff of the hospital in March 2010. The response rate was 87.7% (3399 staff). There were high positive responses to the following items relating to promotion of patient safety:

- We are actively doing things to improve patient safety – 87%
- Hospital management provides a work climate that promotes patient safety – 85%
- The actions of hospital management show that patient safety is a top priority – 85%
DISCUSSION

The lessons learnt from this event are applicable to organizations offering oncology services and healthcare organisations that offer high risk medications world-wide and want to eliminate preventable harm.

5FU Toxicity & Antidote

In our patient, the use of the antidote, uridine triacetate (formerly known as Vistonuridine) on the 5-fluorouracil overdose, resulted in a good patient outcome. 5-Fluorouracil overdose cases in the past almost often resulted in serious, debilitating and life threatening outcomes for patients [1,2]. The use of uridine triacetate appeared to be a safe and effective, life-saving antidote in our experience, for the management of 5-fluorouracil overdose.

Importance of Standardisation

Human errors in medical device use were known to account for a large portion of medical errors. Most of these errors were due to inappropriate designs for user interactions, and system deficiencies or inadequate safety measures that failed to prevent error from causing harm. The Anesthesia Patient Safety Foundation (APSF) convened a multidisciplinary consensus conference in 2010 and called for a "new paradigm" for future safety efforts with standardization as one of the critical elements to improve safety [3].

Some delivery systems had inherent flaws that increased the error risk [4], as in this incident where look-alike devices were the cause of confusion to the users. Standardization is a process that can minimise users' confusion in the selection or setting. Besides standardising medical devices use, Institute of Safe Medication Practices (ISMP) had identified several drugs and drug categories that were considered 'high alert' and which were more likely to result in patient harm when involved in an administration error. Prevention methods include standardising commercially available concentrations and setting dose limits in medication-use technology [5].

Information Sharing and Dissemination

There had already been information relating to errors from similar looking infusion pumps with different flow unit settings. Poor communication accounts for more than 80% of the root causes of sentinel events reported to the Joint Commission (JCI) [6]. Communicating information to health care professionals in a way that is relevant to the task can be challenging. Care in our healthcare institutions are provided by teams of individuals working together within a large and complex organisation structure. Simple provision of information is unlikely to be sufficient. There is a need of an effective communication framework around which a dissemination strategy can be designed [7].

Just Culture

Just culture has emerged as an imperative for improving the quality and safety of patient care. The way in which people think, feel and behave in response to risk is receiving increased attention, both amongst academics and professionals who are involved in promoting and regulating safety. Wilde advocated in his book, Target Risk 2 (2001) that safety interventions need to consider risk perception. Our perception of risk [8], however, is not constant; it varies with both the individual and the context. Promoting a just culture in the organisation is vital to patient safety as it recognises that many of the errors can arise from the interactions between human operators and the systems in which they work. Recognising that to err is human [9] and that competent professionals can make mistakes is important.

Crisis Management

These infusion pump chemotherapy overdose medication errors were a major crisis that not only harmed the patients but caused significant psychological ordeal to patients' family members and staff. There were legal and reputation risks to the organisation. The adverse wide media coverage of the two events brought considerable negative responses from our stakeholders and the general public. The credibility and reputation of organization was heavily influenced by the perception of our responses during crisis situations. The quick response successfully mitigated the risk of serious injury or fatal outcome, which reduced substantial negative impact on the organisation.

These two chemotherapy overdose medication errors had served as a wake-up call for hospital to be prepared and be proactive in anticipation of potential risk that could arise from the use of medical device for the administration of chemotherapy drugs. The initiation of literatures search and reviews for antidotes, and having information in readiness to deal with potential over dosage of chemotherapy drugs was mooted and put in place by the pharmacy. This formed part of the control management plan to mitigate possible risk that may reoccur.

In addition to improving the organization and communication abilities to respond to a crisis in a timely
fashion, a framework was set with clear roles and responsibilities and process related organizational requirements in crisis handling. This incident spurred on a series of hospital initiatives and campaigns to put patient safety as first priority. These include the formation of Patient Safety Council, designation of Patient Safety Officer to focus on medical errors prevention, improvement of safe medication practices and the development of risk management plan, all running concurrently with the promotion of a strong safety awareness culture.

**Medication Safety Culture & Awareness**

Two of the major initiatives that made great impact in helping hospital to create a better and high level of medication safety culture & awareness were the consultation visits made by Institute for Safe Medication Practices (ISMP) consultants in April 2010 and Medication Safety Self Assessment survey that was funded by Ministry of Health, National Medication Safety Taskforce.

The three-day ISMP team site visits in several clinical, specialised units and various pharmacies generated extremely beneficial discussions, especially with the frontline staff. There was real time advice and recommendations put forth for change. The four-member ISMP team comprised of two pharmacological experts, a physician and a nurse, and they offered valuable advice and facilitated diverse exchanges with our physicians, nurses, pharmacists and allied healthcare professionals. During the visits, the focus was directed on safety culture and awareness, environment, system, training and medical devices use. After the visit, assessment report and recommendations were provided and a taskforce was formed for implementation of the action plans.

The ISMP Medication Safety Self Assessment was conducted in November 2010, and it helped the hospital to advance safe medication use and identify challenges and opportunities for change. These included the standardisation of medication administration devices, and the plan to leverage on SMART pump technology for safe medication delivery.

**Patient Safety Culture**

When things go wrong, it is often easier to focus on the particular processes, people or equipment that failed, and ignore underlying cultural issues. Developing a culture of safety is critical and that should be regarded as a core element of efforts to improve patient safety and care quality in healthcare setting. Staff within an organization need to have a constant and active awareness of the potential for things to go wrong. It is necessary for both the staff and the organisation to acknowledge mistakes, learn from them, and take action to put things right.

An organization can improve on the safety culture only when leaders are visibly committed to change and when they enable staff to openly share safety information. The Joint Commission’s leadership standards specify that leaders must create a culture of safety and quality throughout the hospital [10]. The safety initiatives should depend on the building a workplace culture that is intrinsically motivated to improve reduce errors and complications, rather than by forced upon by external factors such as accreditation requirements.

Measuring how good the safety culture is within an organisation helps to provide a starting point for change. The Patient Safety Culture Survey allowed us to assess ourselves in various dimensions of patient safety. Human actions are almost always affected by circumstances outside a person’s control and it must be recognised that errors, are consequences rather than causes. These consequences cannot easily be avoided since they were not an intended action [11].

In the culture of safety, there is a need for openness in reporting. A non-punitive culture has to be initiated from the top of an organization and permeated through all levels. Every employee, not just those involved in safety, can influence the establishment of a culture of safety. To promote a good reporting culture, there must be a structure where personnel have sufficient trust in the system that they are willing to report their errors. This together with a learning culture and a just culture will contribute to a strong patient safety ecosystem to reduce harm to patients [12]. Such culture would add value to the organisation where latent causes of accidents can be identified and addressed.

These two chemotherapy overdose errors served as pertinent lessons for our Pharmacy department and the hospital. It heightened our patient safety awareness and shaped our design of subsequent hospital processes, with patient safety as our top priority. It has useful lessons for other institutions to improve patient safety. A strong organizational patient safety culture is key and undergirds all initiatives to target zero harm. This chemotherapy overdose adverse event is now used as a teaching case study for root cause analysis on device safety. It illustrates the importance of a strong patient safety culture in a healthcare organisation.
ACKNOWLEDGMENTS

We would like to thank Dr Soh Lay Tin for her inputs to the medical management of the cases and the late Dr Manuel Joseph Gomez for his inputs on medication safety.

DECLARATION OF CONFLICTING INTERESTS

The authors declared no conflicts of interest.

FUNDING

The authors received no financial support for the publication of this article.
REFERENCES


5. Cohen MR, Schneider P, Niemi K. Medication errors: ISMP, Effective Approaches to Standardization and Implementation of Smart Pump Technology, A continuing education program for pharmacists and nurses,


**Fig 1: RCA Chart**

1. Sentinel Event
2. Failed processes involved in the sentinel event
3. System and human factors behind failed processes

<table>
<thead>
<tr>
<th>LEVEL OF ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. EVENT</td>
</tr>
<tr>
<td>(1) “Event” refers to the Sentinel Event. (a) State the nature of the sentinel event in one phrase (e.g. suicidal death; mismatched blood transfusion; wrong side surgery; etc.). (b) Give a brief summary of the medical and surgical history of the patient (if any). (c) Then describe in detail what happened in chronological order. For sentinel events which had resulted in death, please state the cause of death signed up in the Certificate of Death; OR if the event is reported as a Coroner’s case, please state that it is a Coroner’s case and indicate the cause of death ascertained by the Coroner (if available).</td>
</tr>
</tbody>
</table>
### 2. **FAILED PROCESSES INVOLVED IN THE SENTINEL EVENT**

(2) This refers to the processes that culminate in the sentinel event.

(a) These processes can be broken down into a series of concise pertinent key steps i.e. Step 1 → Step 2 → Step 3 and so on, eventually resulting in the sentinel event listed in column 1(a).

This information can be distilled from column 1(c).

Only the identified failed processes should be ticked.

<table>
<thead>
<tr>
<th>(a) Breakdown of the processes into key steps</th>
<th>Tick the identified failed processes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Usage of a different Pump (Legacy Plus) as Shortage of usual Chemo Pump (Legacy 1)</td>
<td>☑</td>
</tr>
<tr>
<td>2. Setting of Chemo Drugs (Wrong dose for the default unit)</td>
<td>☑</td>
</tr>
<tr>
<td>3. Counter Checking of Setting (Did not detect error)</td>
<td>☐</td>
</tr>
<tr>
<td>4. Setting up of pump to patient</td>
<td>☐</td>
</tr>
<tr>
<td>5. Pump Delivery of Chemo Medication into patient</td>
<td>☐</td>
</tr>
<tr>
<td>6. Pump Chemotherapy Overdose</td>
<td>☐</td>
</tr>
</tbody>
</table>
### LEVEL OF ANALYSIS

<table>
<thead>
<tr>
<th>3. <strong>SYSTEM AND HUMAN FACTORS CONTRIBUTING TO FAILED PROCESSES</strong></th>
<th>(a) Failed processes identified</th>
<th>(b) Causal Statement/s</th>
<th>(c) Identification of system AND human factors (Root cause)</th>
<th>(d) Risk reduction strategies and their implementation – what, when and who</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) This refers to specific factors that <strong>contribute to the failed processes in 2(a)</strong>, which can be either system factors, human factors or a combination of both (most cases).</td>
<td><strong>A. Setting of Chemo Drugs</strong> (Wrong dose for the default unit).</td>
<td>Lapse of focus on the correct default unit rate resulting in the dose not set according to the actual rate.</td>
<td><strong>System Factors</strong>&lt;br&gt;1. Use of a different type of pump that is less frequently used for chemotherapy drugs&lt;br&gt;2. Pump similar looking and not user friendly&lt;br&gt;3. Design of CADD Legacy-plus pump did not highlight actual unit rate (ml/hour) on the main panel unlike the Cadd Legacy-1 pumps which highlighted ml/24 hour&lt;br&gt;4. Actual display of the ml/hour is in one of the options of the smaller green electronic display&lt;br&gt;<strong>Human Factors</strong>&lt;br&gt;1. Mindset Focus of rate of the more frequently used pump</td>
<td>1. Use of only one type pump for chemo drugs – Immediate action by Pharmacy Department&lt;br&gt;2. Labeling the Legacy 1 pump for “Chemo Use only” and labeling Legacy plus for “Antibiotic Use only” prominently – Immediate action by Pharmacy Department&lt;br&gt;3. Label “ml/hour” prominently on all Legacy Plus pumps –Immediate action by Pharmacy Department&lt;br&gt;4. Ensure adequacy of number of pumps including loaning pumps from other hospitals in Singapore if there are shortages of CADD Legacy 1 – Immediate measure for Pharmacy Department&lt;br&gt;5. Highlight potential for human error in pumps to all relevant staff and lesson learnt – Immediate action by KKH&lt;br&gt;6. Inform MOH, HSA, and pump manufacturer of the incident and the potential for error in such situation – Immediate action by KKH</td>
</tr>
<tr>
<td>(a) Indicate the failed processes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Determine the causal statement.&lt;br&gt;Example: The pre-operative protocol does not include the checking of site of operation by the doctor, which increased the likelihood of the doctor performing a surgery on the wrong site.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Identification of system factors and human factors by listing and explaining in details, followed by stating <strong>within brackets - the root cause.</strong>&lt;br&gt;Example: Lack of formalized protocol for determining the side of operation in OT (Lack of protocol).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) To list down in details, the risk reduction strategies to correct the root cause/s that contributed to the failed processes. Please indicate “when” these strategies will be implemented and “who” these strategies are aimed at.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Example: To implement a pre-operation protocol by dd/mm/yy. To be circulated to all OT staff and doctors for their compliance.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Counter Checking of Setting (Did not detect error)</td>
<td>Lapse of focus on the correct default unit rate</td>
<td>System Factors 1. Points as above.</td>
<td>As above plus 1. Enhance Chemo Protocols checklist to ensure independent check – Immediate action by Pharmacy 2. Enhance Chemo Protocol to highlight prominently that ml/24hour is only applicable to Legacy Pump 1 – Immediate action by Pharmacy 3. Chemo protocols to add an additional safeguard measure – patient to be observed for 1 hour and check before going home KKH - 3 months time frame</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td></td>
</tr>
<tr>
<td>during counter checking</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Independent counter checking was done for first patient but No independent counter checking for second patient Human Factors 1. Mindset Focus of previous rate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Near Fatal Chemotherapy Overdose Incident - Patient Safety Lessons and Impetus for Organisational Culture Change

Fig 2: Similarly Looking CADD-Legacy 1 and CADD Legacy PLUS infusion pumps

Fig 3: Follow up recommended actions for implementation by the hospital

Pharmacy

a. With immediate effect, the hospital should discard pumps in ml per 24 hours and to use only pumps standardized for ml per hour. The current checklist for CADD-Legacy 1 pump should therefore be discarded.

b. Each type of pump should have their respective checklists for different protocols. The name of the pump on the checklist should be in bold. The infusion rate on the checklist should be highlighted in bold to prompt the checking of the infusion rate on the pump itself.

c. There should be separate independent checking by two Pharmacists with checklist for each prescription, processing and programming of pumps used.

d. The need to validate the calculation check with a mental approximation should be included in the checklist.

e. All pharmacy staff needing to use infusion pumps must be trained and certified competent on the use of the pumps designated for use for chemotherapy and also educated on the delivery rate before they can handle such orders.

f. The training materials should cover all the possible risks and errors that have been earlier identified. All Pharmacy staff needing to use infusion pumps, including newly employed staff handling infusion pumps, must read and sign a circular highlighting the possible errors with regard to the errors in the rate of infusion. A case history can be helpful to drive home the message.

g. To review staffing and training needs as well as supervision in view of increasing workload in the hospital. Conduct formal training on pump use for new staff and refresher training for older staff. All new pumps acquired will require formal training for staff.
h. Pharmacists should educate patients on the proper handling as well as trouble shooting of the pumps designated for use. This should be indicated on the checklist.

i. A simplified patient information pamphlet containing relevant important information needs to be given for the first course of chemotherapy. For subsequent courses, Pharmacists should reinforce to patients on the use of the pumps, including checking for earlier than intended completion of the infusion.

j. There must be a hotline number and the handphone number of the oncology Pharmacist indicated on the pumps for patients to call if they encounter problems with the pumps. It is preferable that the hospital on-call pharmacist answers the hotline.

k. Pharmacy should provide an after hours’ workflow to handle pump-related problems experienced by patients.

l. To develop a workflow for overdosing, including a coordinated team that needs to be in place to respond to the event.

**Nursing**

a. Before attaching the pump to the patient, double independent checks should also be carried out by nurses. Checklists need to be in place.

b. Nurses would need to formulate a checklist and do verification before final administration.

c. To allow for an hour for the pumps to run before sending patients home. This would allow the infusion rates to be checked.

d. All inpatients requiring chemotherapy should be cohorted in the designated wards for chemotherapy. The wards should be staffed by trained nurses.

**Across the Hospital**

a. To establish as a hospital policy that only pumps delivering a rate of ml per hour can be used in the hospital.

b. All equipment that has to be sent for servicing must be replaced with the same type of equipment, and if there is no replacement, the prescribing doctor has to be informed.

c. The use of substitute equipment should be discouraged. Where there needs to be a substitution, the HOD and the prescribing doctor should be informed and the users have to be adequately trained. To have a P&P in place on the substitution of equipment when equipment is sent for inspection and maintenance.

d. To purchase service contracts for the pumps should have the provision for replacement units built in.

e. All cancer centres should work together to share medication errors information including policy with regard to combating overdosing and the use of antidotes.

f. At a more macro level, hospital to participate in the setting up of a centralized antidote centre.

g. To proactively share pertinent patient safety information with staff and other institutions.
Building a Patient Advocacy Network in an Asian Healthcare System to Enhance Patient Experience and Patient Safety

Ai Ling Sim-Devadas¹, Ellil Mathiyan Lakshmanan¹, Zann Foo³, Sook Mei Chang²

1. Co-chairs, SingHealth Patient Advocacy Network (SPAN)
2. Office of Patient Experience, Singapore Health Services (SingHealth)
3. SingHealth Duke-NUS Institute for Patient Safety & Quality (IPSQ)

ABSTRACT

Patient engagement & partnership to improve healthcare and elevate the patient experience, can work well in a community in Asia, where patient partnership is a new concept. Using the development of SingHealth Patient Advocacy Network (SPAN) as the case study, the key factors for enabling the successful development of patient partnership and patient advocacy, are distilled. SPAN secretariat, together with the SPAN leaders, continues to seek further directions and to expand its work to elevate the patient experience, improve patient safety, amplify patient voices and to grow the body of knowledge on patient engagement and patient advocacy for the Asian community.

Keywords: Patient partnership, patient advocacy network, patient safety, patient experience, patient engagement

INTRODUCTION

Patient engagement has long been recognised as an approach to improve patient experience, patient safety and healthcare. Hospitals and healthcare systems are increasingly engaging patients and family caregivers as partners in their design, delivery and improvement of health services.

The Patient and Family Advisory Council (PFAC) has emerged as a strategy for systematic patient engagement and a tool to elevate patient and family-centred care. It is a well-established approach in many healthcare organisations in Northern America, Europe and Australia, having proliferated in these regions since the 1970s. Patient engagement through PFAC has been recognised as a promising method to improve patient experience, patient safety and patient and family centred care [1]. In a 2018 report on PFACs in New York State Hospitals, it was found that hospitals with high-functioning PFACs reported lower rates of pressure ulcers, sepsis, septic shock, 30-day hospital readmissions, along with better patient satisfaction scores, when compared to hospitals with low-functioning PFACs [2]. A PFAC is generally composed of patients and family caregivers who have used the services of the hospital or health system. Through the PFAC, patients and families are engaged to share their lived experience and perspectives with healthcare providers. It provides a platform for partnership with healthcare professionals [3].
There are significant benefits to be reaped through patient involvement. It provides a richer insight and shines a deeper and broader light on problems and helps us to reframe issues for more amenable solutions. These potential solutions are also free from institutionally limited thinking – to ask “what if?" – which will widen the array of options for improvement and change. These changing relationship between the healthcare professional and the patient gives permission for others to explore and go beyond defensiveness. Individual benefits include patients feeling more confident, developing their skills and expertise while the healthcare professionals reconnect with their own humanity. The overall outcome is better quality decisions being made, restoring and enhancing the trust and confidence in the healthcare system. These benefits transcend individual projects, and can start a virtuous cycle of improving outcomes through co-creation of solutions by healthcare professionals, patients and caregivers working together.

In 2021, the World Health Organisation (WHO) made ‘Engage and empower patients and families to help and support the journey to safer healthcare’ as one of the 7 strategic objectives of the Global Patient Safety Action Plan 2021-2030 [4]. One of the 5 key strategies within this objective is to ‘build the capacity of patient advocates and champions in patient safety’. The strategy advocates instituting measures to fully engage with patients and families to enhance their opportunities to contribute to processes to improve patient safety; and to ‘develop a strategy for involving patient safety advocates and champions as educators.’ Creating PFACs that are focused on patient safety is one of the recommendations.

**SITUATION OF PATIENT PARTNERSHIP IN ASIA**

While PFACs have grown in healthcare systems in Western societies, the story is different in Asia. In Asia, patient groups that are disease-based and independent of hospitals have been in existence in various Asian countries, including India, Philippines, Thailand, Japan, Taiwan, Malaysia and Singapore. However, PFAC in an Asian hospital or healthcare system remains a new concept.

The healthcare systems in most Asian countries are in nascent stages of opening to patient involvement in healthcare decision-making processes. It has been purely driven by the healthcare officers at the ministry and key physicians who might have not seen the value of the consumer’s (patient’s) involvement. Today, there are still physicians in practice that have the impression that patients are not able to comprehend the requirements of their own care; and what more; make decisions for other individuals in the same state of affairs. This is an assumption and a cultural hindrance to the development of patient involvement.

This assumption is also clouded by the fact that some countries in Asia with developing economies have issues such as illiteracy, poverty and affordability to deal with. These basic issues steer the patient away from getting involved in such affairs that take time away from their day to day challenges. The key issue on hand is stigma. This keeps them away upon diagnosis. They might come forth if the condition stabilises, if not it can be very challenging in most disease areas.

Historical cultural practices also govern patient involvement. In Asia, doctors are seen to be “superior” as they can “determine” the life expectancy of the patient. With that in mind, most cultures here let the doctors decide on the next steps for their treatment options. Cultural dominance is a big aspect of Asian culture. It can influence us to an extent that we underestimate. As patients, dealing with disease and coping with the daily challenges are by themselves uphill tasks. Many will go into recluse with their families to find an avenue for a better quality of life.

Therefore, advocacy and elevating the patient’s voice is a very new concept in this part of the world and in Singapore. The issues that have been dealt with have been very clinical and scientific for a long time. It is in recent times that the psychosocial dimension has been recognised as a key factor for progress in patient outcomes and caregiver support. In tandem, there has been a gradual shift in mindset towards patient-centered care and growing acceptance on the merits of patient engagement and patient advocacy in improving healthcare. It is within this climate that patient engagement and patient advocacy started to take root in Singapore.
PATIENT ENGAGEMENT & ADVOCACY IN SINGHEALTH

SingHealth, Singapore’s largest public healthcare cluster comprising 3 General Hospitals, 1 Women's and Children's Hospital, 3 Community Hospitals, 5 National Specialty Centres and a network of primary care polyclinics, has been adopting a patient-centred approach in healthcare through its patient experience offices and patient support groups set up across its network of 11 healthcare institutions. SingHealth is united by a common purpose, “Patients. At the Heart of all we do”. It aims to ensure patients remain well-supported as they journey across the full care continuum offered by SingHealth. In continuous improvement and innovation, SingHealth has adopted a patient-centred approach by engaging patients and families in the co-creation process.

In 2017, SingHealth made a commitment to enhance patient engagement and give heed to the patient perspective in the organisation through setting up a patient advisory/advocacy committee, akin to the PFAC. The setup was named the SingHealth Patient Advocacy Network (SPAN). The organisation decided on a nomenclature different from Northern American hospitals. Instead of Patient Advisors, the term “Patient Advocates” was used as it preferred the more proactive meaning of “Advocate”. The inception of SPAN within SingHealth was spearheaded by its SingHealth Duke-NUS Institute for Patient Safety & Quality (IPSQ), led by Professor Tan Kok Hian. Patient engagement (with empowerment and partnership) was seen as a key strategy for improving patient safety and quality. IPSQ identified two key partners, the Group Office of Patient Experience (OPE) and Group Nursing to form a guiding coalition, supported by the SPAN Secretariat.

While healthcare in Singapore has been increasingly adopting patient-centricity in the delivery of care for the past decade, setting up a patient advocacy group in a healthcare cluster, to bring patients and families to the table to improve healthcare, is a new step. Generally, healthcare providers are seen as the experts and patients defer to their advice and direction. There are concerns among healthcare providers that giving patients decision-making authority and roles could lead to confusion and unmet expectations. While patient engagement initiatives had been adopted by some healthcare teams in Singapore hospitals, structured patient engagement through a PFAC aimed at co-development of care and service is new. Introducing a PFAC is a major change, shifting the culture of receiving and delivering care.

It was a greenfield for the staff and the pioneer patient advocates, as PFACs and patient advocacy are new in Asia and Singapore. For both the patient advocates and staff, there were neither local reference points, nor Asian models, nor a structured system with effective patient engagement tools and training to harness the patient's voice and lived experience.

The SPAN Secretariat and founding Co-Chairs of SPAN (Ms Ai Ling Sim-Devadas and Mr Ellil Mathiyan Lakshmanan) took reference from online PFAC materials published by Northern American hospitals. This helped the team to structure its programmes and chart its development. Through partnership with the SPAN Secretariat staff and pioneer group of patient and family advocates, SPAN began to build its membership, programmes and projects. Since 2017, SPAN has grown from a 13-member setup to its current membership strength of 50 patient and family advocates, offering valuable perspectives and involvement in more than 100 projects.

Today, beyond participation in healthcare improvement projects, SPAN actively advocates for more patient engagement throughout SingHealth. SPAN amplifies the patient’s voice through speaking engagements, such as talks and webinars with healthcare professionals. By contributing to the conversations on improving healthcare (e.g., through live-streamed panel discussions on topics such as “Patient experience during the pandemic”, “Kindness in healthcare” and “Patient engagement in healthcare improvement”) and being on the same platform as healthcare professionals, SPAN has helped change mindsets and positively impacted the involvement of patients in the decision-making process.

With a good headstart, SPAN Patient Advocates have since received frequent invitations to join various high-level hospital commissioning committees to provide perspectives at a strategic level, as well as judging panels of national-level awards and competitions such as the Singapore Health Quality Service Awards, Singapore Health Inspirational Patient & Caregiver Awards, Singapore Healthcare Management poster abstract competition and the National Dental Centre Singapore (NDCS) Director’s Awards, to provide the patients’ perspectives.
What is most significant is how PFACs and patient engagement (in the form of SPAN) have started to take root within SingHealth institutions. SPAN has demonstrated to the wider healthcare community in SingHealth how partnerships can be built with patients and families and how to co-create and co-develop solutions with patient advocates. This has led to the growth of SPAN@Institution in Hospitals and National Centres in SingHealth.

**ROADMAP FOR BUILDING A SUCCESSFUL PATIENT ADVOCACY NETWORK – CASE STUDY ON SINGHEALTH PATIENT ADVOCACY NETWORK (SPAN)**

With the successful development of the patient advocacy network within SingHealth, in a country and culture where patient engagement is new, the authors have reflected and distilled the key factors for enabling its development.

1) **Have Strong Leadership Commitment**

In any organisation implementing change, leadership buy-in and commitment is essential. This is key, especially when what is being introduced would radically impact the organisation's culture and work processes, as well as the healthcare team's relationship with patients and families. Strong leadership endorsement and commitment is, therefore, a critical first step for any healthcare institution planning to introduce a patient advocacy network in their healthcare system. Engaging patients and caregivers as key partners – with the strong belief by SingHealth leadership that this should be a key strategy for the organisation for building a robust safety culture, SPAN was born.

2) **Get The Right People**

"People are not your most important asset. The right people are." This quote by business guru, Jim Collins, hits the nail on the head on what is needed to drive a budding patient advocacy network. Having the right staff from the organisation to work on the endeavour, and recruiting the right patient advocates who will become the pioneer members, are key ingredients for a successful concoction.

3) **Build a Guiding Coalition**

SingHealth teams from IPSQ, OPE and Group Nursing came together to shape the development of SPAN. The leaders of each department were appointed as Advisors to SPAN, with staff from IPSQ and OPE forming the dedicated SPAN Secretariat, which was important in driving the initiatives, work and activities that ranged from volunteer recruitment and management, to project development, staff outreach and more.

4) **Start with a Dedicated Group of Patient Advocates**

It is important to begin with a dedicated group of patient advocates who are committed to the network’s vision. Beyond the motivation and drive to achieve shared goals, this also helps to build trust with healthcare providers. SPAN started in 2017 with 13 members. To grow SPAN in the early days, recruitment for patient advocates was deliberate from the start, with the intention of bringing in members with the right attributes to contribute and support its growth.

Back when patient advocacy and engagement were new in healthcare improvement projects, it was important that SPAN members were able to champion the cause of improving patient experience and patient safety in meetings and forums, while at the same time, build trust with healthcare professionals in these partnerships. This means that it is crucial to be selective and recruit only suitable members with the right attributes that SPAN valued. These desired SPAN attributes (Table 1) are being Insightful, Motivated, Passionate, Adaptive, Confident and a Team Player (IMPACT).
Table 1 – Desired attributes of a SPAN Patient Advocate

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insightful</td>
<td>Able to draw constructive insights from his/her own experiences to help others learn and improve</td>
</tr>
<tr>
<td>Motivated</td>
<td>Willing to listen and respect different opinions and perspectives</td>
</tr>
<tr>
<td>Passionate</td>
<td>Keen to improve the healthcare landscape in Singapore, which is aligned with SPAN’s purpose</td>
</tr>
<tr>
<td>Adaptive</td>
<td>Sees beyond personal experiences and shows concern for more than one issue/agenda</td>
</tr>
<tr>
<td>Confident</td>
<td>Comfortable with speaking up in a group and interacts well with people from different walks of life</td>
</tr>
<tr>
<td>Team Player</td>
<td>Works well in a team; able to commit time to attend meetings and be involved in projects</td>
</tr>
</tbody>
</table>

The consensus among SPAN Advisors and the secretariat team was to ensure quality recruitment over quantity. We were mindful of the need to have members who can contribute confidently and constructively to projects and meetings at all levels in the healthcare institutions. As such, recruitment growth was kept slow and steady to bring focus to the building of relationships and competencies among members.

From the pioneer group, patient advocates with leadership capabilities were identified to serve as SPAN co-chairs and workgroup co-leads. This establishment of a leadership structure for SPAN was an important milestone for the development of SPAN (Table 2). Today, patient advocates continue to be recruited through referrals from healthcare professionals and patient advocates.

Table 2 – SPAN Structure
5) Promote Onboarding and Competency Development of Patient Advocates

While recruitment for members with the right attributes took care of having the right people, we needed to do more to onboard SPAN members, helping them to develop their skills and knowledge. This was essential especially in Singapore’s context where patient advocacy is still a new concept.

To equip SPAN members with the right competencies, we (the authors of this paper and the SPAN Secretariat) developed the Patient Advocate Communications Training (PACT) Programme. A mandatory half-day workshop for all SPAN members, it aims to achieve the following learning outcomes:

- Understand the role and responsibility of a patient advocate in hospital workgroups and committees
- Recognise the opportunities and challenges as a patient advocate
- Learn to communicate the patient’s perspective
- Acquire skills to build trust and manage difficult situations

Due to the pandemic, the PACT workshop was moved to blended learning in 2020 – a mix of asynchronous learning on the Learning Management System (LMS) before a Zoom Workshop for discussions and skills practice in communicating the patient’s perspective, as well as communicating to build trust and manage difficult situations.

PACT is the foundation programme for SPAN members. We have since developed a Training Roadmap for Patient Advocates with workshops to build competencies in story-telling, design-thinking and quality improvement (Table 3).

Table 3 - SPAN Development Roadmap

<table>
<thead>
<tr>
<th>Programmes (existing &amp; to be developed)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advocating at Organizational Level</strong></td>
</tr>
<tr>
<td>6. Championing Patient Advocacy &amp; Change in Healthcare (Leadership &amp; Management*)</td>
</tr>
<tr>
<td>7. Coaching &amp; Developing Patient Advocates (through mentorship matching)</td>
</tr>
</tbody>
</table>

* Covers healthcare policies

<table>
<thead>
<tr>
<th>Programmes (existing &amp; to be developed)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Application at Team Level</strong></td>
</tr>
<tr>
<td>5. Patients for Patient Safety: Co-production &amp; communications in Healthcare Improvement</td>
</tr>
<tr>
<td>a) Quality Improvement in Healthcare</td>
</tr>
<tr>
<td>b) Human Factors Fundamentals</td>
</tr>
<tr>
<td>c) Design Thinking in Healthcare</td>
</tr>
<tr>
<td>d) Qualitative Methods - Qualitative research methodology &amp; application</td>
</tr>
<tr>
<td>Duration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Programmes (existing &amp; to be developed)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For all SPAN Members:</strong></td>
</tr>
<tr>
<td>1. Introduction to Healthcare, Quality &amp; Patient Safety (e-module)</td>
</tr>
<tr>
<td>2. Introduction to Patient Advocacy &amp; Engagement (e-module)</td>
</tr>
<tr>
<td>3. The Art of Story Telling as Patient Advocates</td>
</tr>
<tr>
<td>4. Patient Advocate Communication Training (PACT) (e-module), follow by PACT (via zoom)</td>
</tr>
<tr>
<td>Duration</td>
</tr>
</tbody>
</table>

6) Empowerment and Co-creation with Patient Advocates as the Guiding Principle

From the start, the Advisors and the Secretariat of SPAN were clear that empowerment and co-creation with Patient Advocates would take centre-stage in how SPAN would be organised. This guiding principle shaped the Network and demonstrated the style of engagement with patients and families that SPAN wants to introduce to the healthcare teams in their approach to healthcare improvement projects.

For the pioneer Patient Advocates, this guiding principle was based on openness and generous sharing, discussion and co-creation was empowering and encouraged many to participate actively to build SPAN and contribute to improvement projects. An example of the co-creation, was the Vision, Mission and Core Values for SPAN (Table 4). This was co-created with members in 2018 through a number of Visioning sessions.
Table 4 - Vision, Mission and Core Values

<table>
<thead>
<tr>
<th><strong>VISION</strong></th>
<th>Empowered patients. At the heart of quality healthcare.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MISSION</strong></td>
<td>To advocate partnership-in-care between healthcare professionals and patients to enhance experience.</td>
</tr>
<tr>
<td><strong>CORE VALUES</strong></td>
<td>Compassion. Integrity. Collaboration.</td>
</tr>
</tbody>
</table>

7) Drive Culture of Patient Engagement Through Communication and Hard-wiring Processes Within the Organisation

In driving a culture of patient engagement, the Secretariat and SPAN adopted a two-prong approach through communication with healthcare teams and embedding processes that encourage patient engagement.

a) Reach Out to Healthcare Teams

Reaching out to healthcare teams to communicate the need for patient engagement and how SPAN can help to improve healthcare processes and experience is key. SPAN had to be introduced to the healthcare teams in SingHealth institutions. This was done through sharing at various stakeholders’ and partners’ platforms within SingHealth and its institutions. The mission, vision and expertise that SPAN brings were communicated at these platforms. Pilot projects were taken on to create the opportunities for SPAN to collaborate with healthcare teams. In the process of collaboration, it provided an excellent platform for exchanges and learnings, where both parties brought their perspectives in achieving a common goal to enhance safety and quality of care, as well as overall patient and staff experience. The learnings were shared and best practices spread.

The genuine communications and many conversations between healthcare teams and SPAN have brought trust and good word of mouth. This helped SPAN reach out to more healthcare teams since its establishment in 2017. Requests from healthcare teams to partner SPAN have gained good momentum and in the right direction, where SPAN at SingHealth will support the setting up of SPAN at each of its institutions, in the next few years. The SPAN model successfully implemented at the cluster level will be spread across its 11 institutions, where membership from institutions will grow to support institution specific improvements and the community of advocates coming together to share learnings from within the healthcare cluster.

b) Embed Processes that Encourages Patient Engagement

To hardwire the need for patient engagement and patient perspectives in healthcare improvement projects, patient engagement is included, for example, as a criterion in the annual SingHealth Duke-NUS Quality and Innovation Day Poster Awards where healthcare teams who partnered patient advocates, patients and families in their improvement and innovation journey are recognised at this cluster event. In embedding patient and family engagement in healthcare improvement, a project matching feature will be embedded in the SingHealth Improvement and Innovation Portal (SIP). SIP will be the one-stop improvement project registration and ideas generation portal for healthcare teams to register their projects, source for ideas and indicate their interest in partnering with SPAN. Resources on patient engagement strategies will also be shared via this portal, including the “Engagement Toolkit with Patients and Families for Healthcare Improvement Projects”, co-developed by SPAN and staff from SingHealth Innovation Office.

Adopting a structured methodology where both healthcare teams and patient advocates are equipped with common knowledge and tools such as Quality Improvement and Design Thinking for continuous improvement, will enhance the partnership experience. Healthcare Quality Improvement and Design Thinking workshops are conducted for both SPAN members and healthcare teams within SingHealth institutions. Patient feedback provides insights and when studied add great value to improve healthcare experience and safety. Hence, it is important to constantly review processes through feedback loops. The support from OPE and IPSQ enables SPAN to gain insights into patient feedback, where key issues are often discussed at SPAN Annual Think-out.
sessions to determine the key areas to work on. Tapping on technology as an enabler in gathering and analysing feedback, crowdsourcing of ideas, sharing of best practices and challenges are key to successful patient engagement and co-creation of value.

8) Develop Meaningful and Impactful Activities and Programmes for Patient Advocates and Healthcare Staff

Above all, in all we do, the activities and projects driven by SPAN must be relevant and meaningful to the patient advocates and healthcare staff. It must benefit both parties (Table 5). What that means, is what we do, must contribute to improving patient experience and patient safety as well as demonstrate partnership with healthcare teams through thoughtful consideration of their needs and priorities too.

Table 5 – Meaningful Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Plain Language</td>
<td>150 commonly used medical terms and jargon into layman terms</td>
<td>To improve communication between healthcare professionals and patients by “speaking the patient’s language”</td>
</tr>
<tr>
<td>Engagement Toolkit with Patient &amp; Families</td>
<td>A guide to engaging patients and families for healthcare Improvement Projects</td>
<td>To demonstrate the steps to include patient engagement in healthcare improvement Projects.</td>
</tr>
<tr>
<td>Partnership with healthcare teams during COVID-19</td>
<td>Recruit volunteers from the public to act as translators for affected migrant workers posters, flyers and videos to allay concerns of foreign workers</td>
<td>To encourage and provide support to healthcare staff and migrant workers during COVID-19</td>
</tr>
<tr>
<td>COVID-19 Patient Survey</td>
<td>Survey among patients and caregivers. Followed by focus group discussion to deep dive into specified topics</td>
<td>To provide insights of patient experience during COVID-19 and propose actions to address identified gaps in healthcare facilities</td>
</tr>
<tr>
<td>Be Kind to your Healthcare Team</td>
<td>To have patients and families express their thanks and appreciation after interaction with healthcare workers</td>
<td>To encourage patients and families to be kind to healthcare team at the point of care</td>
</tr>
<tr>
<td>PEx Talks</td>
<td>Patient Experience Talks at various healthcare institutions’ events</td>
<td>To share the voice and stories of patients and also to raise awareness of benefits of harnessing patient perspectives</td>
</tr>
<tr>
<td>Events &amp; Webinar</td>
<td>As speaker, panellist or part of judging Panel</td>
<td>To share and raise awareness of patient perspectives</td>
</tr>
<tr>
<td>Healthcare Improvement Projects</td>
<td>As project members</td>
<td>To provide input from user perspective and serve as a sounding board</td>
</tr>
<tr>
<td>Healthcare Commissioning Committees &amp; Workgroups</td>
<td>As members</td>
<td>To provide input from user perspective and serve as a sounding board</td>
</tr>
</tbody>
</table>
9) Make Patient Advocacy Fun!
Finally, because patient advocacy is a collective of patients, families and staff coming together to make healthcare better, it is important to make it fun. Only then can barriers be eliminated so patients and healthcare providers can share freely and build on one another’s ideas. We also recognise that SPAN members are volunteers who contribute actively because they find meaning in improving healthcare, while at the same time, enjoy being part of a friendly community of patient and family advocates.

In making SPAN fun, we found that the following work well:
- Informal networks through WhatsApp chat groups help to build bonds. Secretariat staff are part of these chat groups and participate actively with members.
- Lunch and Coffee Chats, especially over a shared love for favourite food. For the SPAN Co-Chairs and Secretariat - it was Prawn Noodles (!)
- Regularly reaching out to members, maintaining friendship - The Co-Chairs and Co-Leads of SPAN regularly reach out to members assigned to them as part of the Buddy system. This was important especially during the pandemic, when we stopped meeting face-to-face.
- Annual Year-End Party where SPAN leadership, advisors, secretariat, members and partners celebrate the contributions and experiences in improving healthcare for patients and healthcare teams. It is also an opportunity for everyone to get together and bond.
- Most importantly, the SPAN Secretariat and Leadership practise a generous, inclusive and open approach which engenders fun at work!

Outcomes
SPAN has been actively involved in projects with healthcare teams from the various institutions in the healthcare cluster. Although effective outcome measurement will require more time for co-created solutions which were implemented, there has been increasing calls for SPAN to be involved in projects at all levels. From January 2018 - December 2021, SPAN had been involved in 105 projects (see examples in Table 6)

Table 6 – Some Examples of Projects

<table>
<thead>
<tr>
<th>S/N</th>
<th>Project Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Consultation on Informed Consent from MOH</td>
</tr>
<tr>
<td>2</td>
<td>COVID-19 Translator by SPAN and Changi General Hospital</td>
</tr>
<tr>
<td>3</td>
<td>Mobility-X FGD by SGH Division of Organisation Planning &amp; Performance</td>
</tr>
<tr>
<td>4</td>
<td>National Dental Centre, Singapore Chatbot</td>
</tr>
<tr>
<td>5</td>
<td>Consultation by MOH Health Regulation Group on Consumer Education Strategy</td>
</tr>
<tr>
<td>6</td>
<td>Ministry of Health, Singapore Focus Group Discussion</td>
</tr>
<tr>
<td>7</td>
<td>IBM Design Thinking Workshop &amp; FGD for ECC &amp; NDCS by SingHealth ECC &amp; NDCS Planning Team</td>
</tr>
<tr>
<td>8</td>
<td>Future Outpatient Journey Taskforce by SingHealth Marcoms</td>
</tr>
<tr>
<td>9</td>
<td>Elective Surgery Taskforce by SingHealth Office of Strategic Management</td>
</tr>
<tr>
<td>10</td>
<td>Singapore General Hospital Business Office service transformation</td>
</tr>
<tr>
<td>11</td>
<td>Consultation on Patient Education Material by National Cancer Centre Singapore</td>
</tr>
<tr>
<td>12</td>
<td>Feedback for Informed Consent Forms by Singapore General Hospital Obstetrician &amp; Gynaecologist</td>
</tr>
<tr>
<td>13</td>
<td>Patient Management IT System by Integrated Health Information Systems Pte Ltd (IHIS)</td>
</tr>
<tr>
<td>14</td>
<td>SPAN Initiated Survey on COVID-19 experience</td>
</tr>
</tbody>
</table>
More than the impact that is made at the project level, SPAN has demonstrated to the wider healthcare community in SingHealth on how partnerships can be built with patients and families, and how solutions can be co-created and co-developed with patients and caregivers. As a result, it has encouraged the formation of PFACs in individual institutions in SingHealth, or what we refer to as SPAN@Institutions.

Starting with SPAN@KKH in 2020 and SPAN@SGH Department of Emergency Medicine in December 2021, PFACs are being formed in the other hospitals and National Centres at the time of writing. The move towards forming PFACs at the institution level is very encouraging as it signals how each institution is moving towards embedding patient engagement and patient advocacy within their systems. This is also necessary as many improvement projects are at a local level, and practices and processes need to be customised to meet institution-specific needs.

On a national level, SPAN has also been consulted by healthcare agencies, who require feedback and inputs on matters ranging from government policy to effectiveness of public education information brochures. Its composition of a diverse group of patients across all demographics, committed to working with the healthcare institutions for improving patient experience, safety and overall outcomes makes it an ideal patient organisation for such purposes, and at present is the only such patient and caregiver group. In 2022, SPAN Leadership, together with its advisors and secretariat from SingHealth made an important decision to expand its reach to patient organizations in Singapore. The Singapore Patient Advocate Connection (SPACe) was initiated as a

<table>
<thead>
<tr>
<th>15</th>
<th>SingHealth ARTpreciate Wellness Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Redesign of care process and the environment - Bright Vision Hospital</td>
</tr>
<tr>
<td>17</td>
<td>Singapore General Hospital Emergency Medicine Building Commissioning Committee</td>
</tr>
<tr>
<td>18</td>
<td>National Heart Centre, Singapore service vision and service values</td>
</tr>
<tr>
<td>19</td>
<td>Blueprint of patient journey by Singapore General Hospital &amp; Public Service Division</td>
</tr>
<tr>
<td>20</td>
<td>Elective Care Centre &amp; National Dental Centre Singapore (ECC &amp; NDCS) Commissioning Committee</td>
</tr>
<tr>
<td>21</td>
<td>Reading Materials on iPAD for Patients in Isolation Ward at Singapore General Hospital.</td>
</tr>
<tr>
<td>22</td>
<td>Improving the Adoption Rate of Electronic &amp; Mobile (E&amp;M) Appointment transactions in National Cancer Centre of Singapore</td>
</tr>
<tr>
<td>23</td>
<td>Community Care Facility 14-day Patient Activity Itinerary by SingHealth Group Office of Patient Experience</td>
</tr>
<tr>
<td>24</td>
<td>Focus group discussion by Ministry of Health, Singapore</td>
</tr>
<tr>
<td>25</td>
<td>National Dental Centre, Singapore Chatbot Trial 2.0</td>
</tr>
<tr>
<td>26</td>
<td>My SurgeryApp, Singapore General Hospital</td>
</tr>
<tr>
<td>27</td>
<td>Information pamphlet on pregnancy and radiological examination scheduling by Singapore General Hospital Division of Radiological Sciences</td>
</tr>
<tr>
<td>28</td>
<td>Meals To Smile About by National Dental Centre, Singapore</td>
</tr>
<tr>
<td>29</td>
<td>Ministry of Health, Singapore Diabetes Care – Expert Work Group</td>
</tr>
<tr>
<td>30</td>
<td>Agency for Care Effectiveness (ACE) Campaign</td>
</tr>
<tr>
<td>31</td>
<td>Dialogue with ACE Consumer Engagement &amp; Education (CEE) Team</td>
</tr>
<tr>
<td>32</td>
<td>SingHealth Engagement Toolkit with Patient &amp; Families</td>
</tr>
<tr>
<td>33</td>
<td>SingHealth Tower Wayfinding Project</td>
</tr>
</tbody>
</table>

And many more
half-day event organized by patients for patients. It aimed to create a high-level platform for national patient organization leaders and healthcare to connect and develop patient and family engagement capabilities for patient advocacy and healthcare improvement in experience and safety for patients and healthcare workers. The inaugural event was held on 29 October 2022 with more than 220 participants from patient organizations and support groups, patients, caregivers and families, and healthcare teams.

On a regional level, SPAN is encouraging patient engagement and patient advocacy in healthcare systems in Asia-Pacific. By actively participating in initiatives and programmes on platforms by the World Health Organisation (WHO), the International Alliance of Patients’ Organization (IAPO), Asia-Pacific Patients Congress (APPC), The Beryl Institute, SPAN aims to build capacity and capability not only among patient advocates, organizations and healthcare facilities within SingHealth, but also in Singapore, Asia-Pacific and beyond.

FUTURE DIRECTIONS

While we have set-up a patient advocacy network and attained certain achievements, our work is not complete. The SPAN secretariat, together with the SPAN leaders, continues to expand its work to elevate the patient experience, improve patient safety, amplify patient voices and grow the body of knowledge on patient engagement and patient advocacy for the Asian community. As we work towards this vision, these are the areas we would be considering for the future.

1) Measure outcome and impact of patient and family engagement in patient safety & experience

As we move towards measuring the outcome and impact of patient and family engagement, relevant indicators from Strategic Objective 4 “Patient and Family Engagement” published in the “WHO Global Patient Safety Action Plan 2021 - 2030” will be taken as one of the key reference documents in helping SPAN to measure the impact its initiatives bring:

- Number of policies and guidelines on safer healthcare co-developed with SPAN
- Number of established networks of patient advocates and champions through SPAN Model or collaboration
- Number of established patient and family advisory committees (or its equivalent)
- Number of developed and implemented procedures for disclosure of adverse events to patients and families
- Number of patient-reported experiences or related safety outcomes

Other measurements such as some of the following will be considered for continuous sharing and learning:

- The Patient and Family Engagement Climate within SingHealth
- The outcomes of improvement and innovation projects, relevant to the inputs from patient advocates
- Sharing through speaking at conferences and written materials such as manuscripts, posters, bulletin, case studies, guides & toolkits)

Ultimately, the aim is for SPAN to have partnership and engagement experiences shared with healthcare teams as well as other patient advocacy organisations and networks, and for patient advocacy models to be spread and strengthened through the growing advocacy network to improve healthcare where patients and staff are truly at the heart of all we do.
2) Expand diversity of SPAN members and continue to build trust
A collaborative model works when there is sufficient trust. In this respect, SPAN will continue to engage both healthcare teams and its members in regular dialogues (embedded in the system) and in encouraging open-mindedness through facilitating the dialogues, especially so when it intends to expand the diversity of its membership to contribute to healthcare improvement and innovation as well as experience. Putting in place a framework for engaging SPAN members and in empowering healthcare teams and advocates in effective communication is one of the key focus areas of SPAN.

3) Build a group of patient safety champions to help and support the journey to safer health care
(Who Global Patient Safety Action Plan 2021-2030)
SPAN, through IPSQ, has been introduced to the WHO Global Patient Safety Action Plan 2021 - 2030 (GPSAP) and has participated in the Asia-Pacific Patients Congress Consensus Building Workshop in 2021, where it facilitated a group discussion focusing on Strategy 1 of Strategic Object 4 - Patient and Family Engagement. The Global Patient Safety Action Plan (GPSAP) on Patient and Family Engagement Co-Creation Consensus Workshop Report was published in 2022 [5,6].

SPAN was also invited to speak at the Global Actions for Leadership and Learning Organisations for Patient Safety (GALLOPS) on “The Role of Patient Advocates in Advancing Healthcare Experience & Outcome”. GALLOPS was developed by IPSQ and its curriculum mapped to GPSAP with the aim to accelerate action to implement global action on patient safety in Asia, establish a network of patient safety advocates and promote multi-disciplinary teams to prioritise and improve patient safety. These were opportunities and valuable experience for SPAN co-chairs in playing a part in driving patient advocacy beyond SingHealth.

GPSAP together with SingHealth’s strategy map has guided SPAN’s strategic planning. Driving patient safety and building a group of patient safety champions are key focus areas of SPAN. It will continue to equip its patient advocates as well as healthcare teams with the knowledge of global actions in making healthcare safer and in playing roles in eliminating avoidable harm.

4) Grow capacity and capability of patient advocates as well as healthcare professionals involved in work to improve patient experience and patient safety.
SPAN will continue to curate training and development programmes and initiatives to grow capacity and capability of patient advocates and healthcare professionals. The aim is to empower both parties to be able to work collaboratively in understanding the pain points for better patient and staff experiences, and safety.

Some recommendations are:

● Co-develop programmes in the training of patient advocates to be empowered to contribute to co-developing policies, guidelines, establish networks and patient and family advisory committee, develop and implement processes/ procedures such as disclosure of adverse events, reporting of experiences and related safety outcomes

● Co-develop programmes in the training of healthcare professionals such as residency communication training, empathy and compassion, strategies in engaging patients and families

● Partner knowledge experts and organisations to establish collaborations in areas such as training and research in patient advocacy, sharing of best practices.

● Introduce a train-the-trainer model to sustain training and development
5) Enhance engagement with SPAN patient advocates during the pandemic and beyond when there is less face-to-face interaction

Learning from the COVID-19 pandemic, continuous conversations with SPAN members and healthcare teams are essential to establish new relationships and strengthen existing ones. Leveraging technology and having the engagement, including training and development on suitable platforms, such as video-conferencing and e-learning, is necessary for adaptation. Strong leadership at the organisational and patient advocacy network levels, and strong support and allocation of institution resources to the patient advocacy network and support groups, are critical in enabling the group of volunteer advocates to continue with the agenda, as well as to respond, recover and thrive during a crisis such as a pandemic. Therefore, the development of advocacy leadership to drive the network is an important strategic investment.

6) Develop Patient Engagement and Patient Advocacy Resources

Having walked this journey to set-up a patient advocacy network within a healthcare cluster in a country and culture where patient advocacy is new, SPAN would like to support other healthcare organisations in developing their capability in patient engagement and patient advocacy. To do so, we would like to contribute to the body of knowledge on patient engagement and patient advocacy for the Asian community.

SPAN published the “Engagement Toolkit with Patients & Families for Healthcare Improvement Projects” in 2021. It was co-developed by the Co-chairs of SPAN and the Director of the SingHealth Office for Service Transformation. It serves as a simple guide for healthcare teams to engage patients and families for healthcare improvement projects and in introducing SPAN.

Moving forward, to support the development of SPAN@Institutions and WHO patient and family engagement initiatives, SPAN aims to co-develop implementation guides and toolkits to:

- Support SPAN@Institutions in setting up a patient advocacy structure at respective SingHealth Institutions;
- Provide technical advice through test-bedding of WHO patient and family engagement guides and tools in Singapore healthcare facilities; and
- Produce relevant implementation guides as well as case studies to elevate patient and family engagement

CONCLUSION

This has been a remarkable journey for everyone in SPAN. In the past five years, we have demonstrated that engaging patients and families through SPAN (a PFAC) to improve healthcare and elevate the patient experience, can work in an Asian community. At the heart of it all, the desire to build trust, commitment and a shared vision of doing what matters for the patient has helped us drive this forward. While we continue to grow, we hope to have more conversations with healthcare organisations in Singapore and in Asia in growing and measuring the impact of patient engagement and patient advocacy in the region. Together, we can make healthcare better and safer for everyone.

ACKNOWLEDGEMENTS

We would like to thank everyone in the SingHealth Patient Advocacy Network (SPAN), the SingHealth Duke-NUS Institute for Patient Safety & Quality (IPSQ), the SingHealth Group Office of Patient Experience (OPE), SingHealth Group Nursing and the SPAN Secretariat for their support, contributions and guidance for SPAN and for this writeup.
REFERENCES


2. New York State Health Foundation. Strategically advancing patient and family advisory councils in New York State Hospitals. Institute for Patient and Family Centered Care, June 2018.


Empower your Career in Patient Safety & Healthcare Quality

Duke-NUS Medical School Graduate Certificate
National University of Singapore Graduate Diploma
National University of Singapore Master’s Degree

Inaugural intake in Academic Year 2023
Application opens in April till May 2023
Classes will commence in August 2023

Please refer to the website for more details on the requirements, programme, fees, important dates and frequently asked questions.

Programme website: https://www.singhealthdukenus.com.sg/ipsq/acad

For enquiries, email: ipsqacad@singhealth.com.sg