Protecting Patients' Safety

Our Journey in the NHG Harm Reduction Collaborative

“Alone we can do so little;
together we can do so much.

Helen Keller

This is the story of us coming together and persevering with patient safety work despite the many challenges faced.

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Foreword

"First do no harm" is the age-old adage of good medicine. No clinicians would want to see their patients harmed. However, in the many cogwheels that drive the complex system of care, there lurk unseen risks that trip us up. Harm in the system impoverishes the quality of life of our patients, leaves the care team scarred and erodes the public's trust in the healthcare system.

In the first decade of National Healthcare Group's (NHG's) quality movement, we came together to work on key causes of harm. Serious adverse event rates halved within a decade. The healthcare system is now more robust and safer. However, the adverse event rates are trending upwards due to increasing disease complexity associated with an aging population and changes in our care model. Today, the issues that lead to harm are more challenging and the solutions are much harder to implement. Rolling out measures without fully understanding system-level impacts and inter-relationships between processes may have unintended consequences. Such measures consume manpower, adding to the load the workforce is already shouldering and precipitating stress and even neglect. Their impact on harm reduction is limited or negated.

This calls for creative solutioning. It would involve consulting knowledge outside of one's practice areas and optimising the overall system, not the individual parts. Healthcare facilities are stepping out into the fields of high reliability engineering, ergonomics, and human factors to find answers. In addition, the gathering of like-minded members to work towards a system goal can yield synergies. The method adopted by NHG Harm Reduction Collaborative (HRC) has these characteristics amongst others, to leverage the benefits of scale and collective learning from the best.

At the time I am writing, the HRC journey is in the final lap. Along this route, inroads have been made. Ten sets of interventions have been successfully piloted and will be implemented at more sites within the institutions. Of these, six have garnered interest outside of the institutions that champion them, and plans are underway to spread each change across NHG.

I congratulate my colleagues in the HRC for the progress made thus far and wish them all the best in the work ahead. They deserve all our support and encouragement. The greatest source of strength would come from the joy of seeing how the fruits of their efforts are adding years of healthy life to our patients. To them, I say, "Press on, your work matters to our patients and their families!"

Prof Lim Tock Han
Sponsor and Steering Committee Chair,
NHG Harm Reduction Collaborative
Group Chairman Medical Board, NHG

Preface

In any endeavour to improve patient safety, the application of quality improvement principles and methods is a necessary requisite. The NHG Harm Reduction Collaborative (HRC) is no exception. Deming's Model of Quality Management consisting of 14 core concepts was a guiding light for our Collaborative stakeholders and collaborators. The following were some of the key important concepts from Dr Deming that helped us build a strong foundation for our work in the HRC.

Create constancy of purpose for improving products and services

Since the early days of NHG as a healthcare cluster, we have put patient safety and reduction of harm to patients as a key goal. This led to the institution of NHG's Patient Safety Programme, which has been in place since 2000. Over these years, we have continued to maintain, enhance and sustain the programmes and activities supporting patient safety. The various Collaboratives over these years, including this latest HRC, are the most visible manifestation of that resolve to continually strive towards zero harm.

Cease dependence on inspection to achieve quality

Understanding the processes of care and the careful application of human factors was brought to the fore in this Collaborative. This was particularly helpful to tackle chronic and recurrent errors. It allowed many teams to identify solutions using human factors engineering principles that support individual staff to perform in a reliable and sustainable manner without the need for constant inspection.

Improve constantly and forever every process of planning, production and service

This particular principle was a reminder for constant testing and to not be satisfied with the status quo. Failure was to be embraced as a learning opportunity and not to be a "showstopper". Even when improvement targets were achieved, teams were encouraged and asked if they could do their job a little better tomorrow.

Adopt and institute leadership

This Collaborative faced unprecedented challenges due to the onset of the COVID-19 pandemic just weeks after we started the initiative. Resources on the ground were stretched and teams were diverted to address pressing needs. Some teams were even disbanded as staff were deployed out of institutions to community facilities. Despite these many challenges, teams persevered even though some were forced by various circumstances to take a hiatus. This speaks to the leadership, both on the ground as well as in the senior ranks of the organisation.

Drive out fear

Over the past 15 years, NHG has identified building a strong safety culture as a fundamental requirement in the quest to reduce patient harm. This Collaborative continued to build on the efforts with renewed emphasis on building psychological safety and efforts to reduce mental stress in staff.

I want to thank NHG and its institutions for embarking on the Harm Reduction Collaborative, and for persevering through during the difficult COVID-19 period, from 2020 to 2022. It has been an honour and a privilege to contribute to this endeavour as an advisor to the team. I have benefitted from the camaraderie and the experience, having been both a student and a coach throughout this journey.

A/Prof Tai Hwei Yee
Advisor and Steering Committee Member,
NHG Harm Reduction Collaborative
Group Chief Quality Officer, NHG (2015-2022)

Message

The Harm Reduction Collaborative (HRC) represents both continuity and change. It is a continuation of NHG's patient safety journey. It adopts the improvement methodology that had been used successfully in four previous NHG's collaboratives. At the same time, it breaks new ground by being the first collaborative to address harm from multiple fronts simultaneously. The HRC journey itself was anything but plain sailing, as we would come to expect of any change endeavour of such scale. The complexity of change management is a known known at best or known unknown at worst, but the external circumstances that surround a change project are in the realm of unknown unknown.

> "Quality is never a coincidence. It is always the result of high intention, sincere effort, intelligent direction and skilful execution.
>
> **William A Foster**

A/Prof Gervais Wansaicheong
Chairman, Implementation Committee, NHG Harm Reduction Collaborative
Senior Consultant, Diagnostic Radiology (Clinical), Tan Tock Seng Hospital

COVID-19 comes to mind. For about a third of the HRC's tenure, we carried out meetings and teambuilding activities on virtual mode due to safe management measures. We were forced to adapt. When the restrictions were lifted, gradually and in various permutations and combinations, we realised that the technology of virtual teaming combined with physical meetings enabled even more possibilities for collaboration. We gained some momentum. When our institutions were bracing up to implement the Next-Generation Medical Records (NGEMR) system, time extension was requested to complete certain project milestones. We acquiesced.

In the spirit of "all share, all learn", we wrote this book. It was put together with the hope of illuminating the two change concepts for quality improvement. Firstly, while not every change is an improvement, improvement requires change. Secondly, the ability to develop, test and implement change is essential for quality improvement.

In the pages to come, readers can access cluster- and project-level information spanning the various QI stages - planning, executing, and spreading change.

We would like to express our sincere appreciation to all committee members and expert panellists. You had given of your time so generously, to guide and nurture this community. To the improvement teams, you were resourceful, courageous and unyielding. It is our privilege to work alongside such a resilient community that the HRC had forged.

Ms Claudine Oh
Co-chair, Implementation Committee, NHG Harm Reduction Collaborative
Assistant Director, Operation Admin, Yishun Health

1 Call of the Summit

Treacherous slopes, inclement weather, and acclimatisation are challenges typically associated with mountaineering. The mountaineer is a multitasker and relies on various skills and aptitudes - physical and mental - to surmount the challenges, safely. There are interesting parallels we can draw. When we participate in improvement work, we are not exposed to the elements, but we work within a certain organisational culture (or climate) which we seek to influence and make conducive for change. Resistance and learning curves are the slopes we must overcome. Multitasking is par for the course. Going by the words of Maureen Bisognano, President Emerita, Institute for Healthcare Improvement, "everyone has two jobs", we deliver and improve care at the same time, perpetually.

Answering the call

Unlike mountaineering, embarking on the quest to improve safety is a necessity rather than choice. Another difference is that we fix our eyes on the path ahead and we ascend, never descend. The stakes are high if we do not change the status quo urgently, or we back-pedal. Studies done by the World Health Organisation in 2021 in high-income countries suggest that 1 in 10 patients is harmed while receiving hospital care. Any adverse event is one too many. We set goals, each of which is a summit that beckons us to approach. It calls out to us in a familiar voice that reminds us of our duty to our patients "first, do no harm".

The NHG Harm Reduction Collaborative (HRC) is a continuation of NHG's patient safety journey. The Collaborative itself exemplifies change for it seeks to address multiple sources of harm simultaneously, departing from the approach taken in preceding collaboratives. Below, we course through the circumstances leading to its formation. Readers interested in the origins and evolution of the patient safety movement at NHG can read our book, *Building a Home for Patient Safety*.

Surveying the terrain

The vision of National Health Group is "adding years of healthy life". Preventing illnesses and promoting health-seeking behaviours among the population it serves represents one of two key strategies. The other, improving patient safety and delivering good outcomes, forms the bedrock of its quality agenda. In this respect, continuous effort has been made over the years to understand the issue of patient harm and identify opportunities for improvement. A year after its establishment, in 2001, the first Adverse Event Study (AES) was conducted. Three more studies were done, in 2007, 2010 and 2017.

The 2017 study conducted by NHG Group Quality (GQ) was notable for its coverage. The study was not restricted to inpatient hospitals but was extended to a community hospital, specialist outpatient clinics (SOCs) and primary care. It ascertained the prevalence, types, and characteristics of Adverse Events (AE) in 2016 at these sites. It therefore provided a baseline for the prevalence of AEs in Yishun Community Hospital, NHG Polyclinics, and SOCs in the Institute of Mental Health, Khoo Teck Puat Hospital, National Skin Centre and Tan Tock Seng Hospital.

The study revealed that the AE rates for the inpatient and outpatient populations were 14.2% and 3.7% respectively. In the inpatient population, therapeutic errors, non-surgical procedure events and drug-related injuries accounted for most of the AEs. In the outpatient population, the top three AE categories were drug-related injuries, therapeutic errors and operative events. The evidence highlighted that healthcare-associated infections (HAI), procedural safety and medication safety were important workstreams that warranted attention. GQ conveyed this to NHG Clinical Board, and in its recommendations, proposed a fourth workstream - digital transformation - to be added to the radar. This was prompted by developments surrounding the introduction of the Next-Generation Electronic Medical Records (NGEMR) system across NHG institutions which could have potential implications on patient safety.

The work and this book

The work ahead would require nothing short of an enterprise event to accomplish - one that would bring together seven institutions and two business units to collaborate on 14 improvement projects. With the blessings of the NHG Clinical Board, the NHG Harm Reduction Collaborative (HRC) was established. Its aim is to reduce preventable harm by 50% in three years. At the time of writing, all the improvement teams have completed pilot studies and are in various stages of implementation. Some are moving on to the sustain and spread phase.

Looking back, the HRC journey does resemble a mountaineering expedition in some ways. There were moments for "all learn, all share" as there were times for deferring to the experts - leaders who steered the course and coaches who extended a hand in difficult situations. There was perspiration from the effort, and inspiration from the knowledge exchanged and camaraderie forged. This book features what we learnt on the way up, and the 'views' that had enriched the journey.

Collaboration is set to become an important vehicle in healthcare to achieve an increasing number of goals, whether it is improving healthcare, reducing costs or improving the patient's experience. We hope this book will be a timely addition to local resources about large-scale healthcare collaboration in Singapore.

Medication Safety Collaborative (2003 to 2006)

Improve medication safety through the reduction of Adverse Drug Events (ADE)

Critical Lab Results Collaborative (2007 to 2009)

Achieve timely communication of critical lab results

Reducing Methicillin-resistant Staphylococcus Aureus (2007 to 2009)

Reduce MRSA infection and transmission

NHG Collaboratives through the years

High-Alert Medications Collaborative (2009 to 2013)

Prevent, detect and mitigate harm from high-alert medications

Harm Reduction Collaborative (2020 to 2023)

Reduce preventable harm by 50%

NHG Collaboratives through the years

2 Gearing Up for the Journey

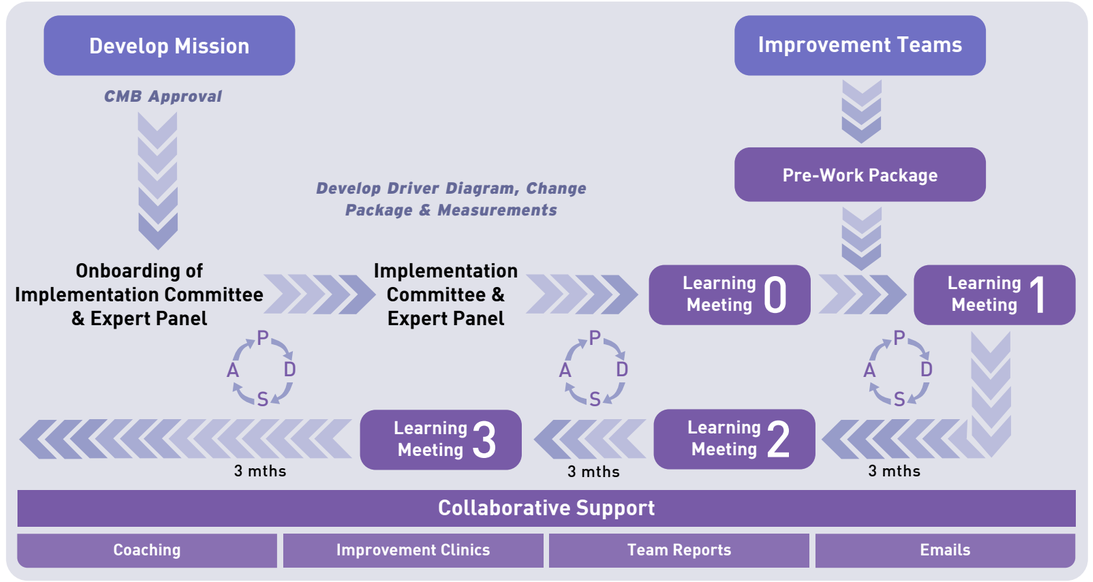
The NHG Harm Reduction Collaborative (HRC) was launched on 17 July 2020. The preparation work involved a good measure of doing and contemplating. We contemplated the characteristics it should take on and this was the consensus among NHG Quality leadership: The HRC would bring together interested organisations and recognised experts for improvement activities towards a common system goal. It would focus on local testing of changes, learning, adjustments, and regular assessments of progress. It would make use of peer learning for rapid spread and scale. The bottom line is system reliability and sustainable outcomes.

Readying the tools

The HRC uses not one but a suite of tools. These were identified from the start, during which decisions were also made concerning how to adapt them to NHG. NHG Group Quality (GQ), working with the Implementation Committee, sought to provide a tool for each purpose. They also guided members on matters of application and practice.

i. For harnessing collective intelligence

The IHI Breakthrough Series Collaborative Model provides the basis for approaching our work in the HRC. These were the words of the developer: "Sound science exists to guide improvements, but much of this lies fallow and unused in daily work. There is a gap between what we know and what we do." We agree. To close the gap, we created a learning system to enable participating institutions to learn from each other and from recognised experts in the fields they chose. One mechanism involves the sharing of monthly progress reports among teams (including information contributed by coaches and subject matter experts) via the Cluster's e-learning platform. Two others - learning meetings and site visits - are recurring features of this learning system.



The model used by the NHG Harm Reduction Collaborative, adapted from Institute for Healthcare Improvement (IHI)'s Collaborative Model.

ii. For steering change

The HRC does not adopt a catchy slogan for members to recite. Instead, members are equipped with a practical set of questions. Whether their role is in leading a project team or committee, facilitating a process, guiding, or participating in improvement work, every member has been trained to ask and if necessary, revisit the questions during the change journey. These questions help teams structure the work (of planning, developing, testing, and implementing change) in much the same way as that of a scientific inquiry.

The questions do not hamper creativity. Thinking out of the box is encouraged in the ideas generation stage. The questions help teams gain clarity of purpose, of how success can be determined, and of prioritising what gets tested and implemented. The actions in response to all the questions involve tasks that would require additional tools to complete. These will be covered in the next chapter, *Mapping the Route*.

iii. For testing change

We employ Plan-Do-Study-Act (PDSA) learning cycles for testing change. Each cycle comprises four steps: 1) Plan for testing the change; 2) Do as planned, i.e., make changes to existing procedures; 3) Study the results of the change for insights on how to do better; and 4) Act to make the successful changes permanent, or to adjust the changes (in which case another PDSA cycle will begin and the process continues serially), or abandon the changes. This approach would allow our teams to test changes on a small scale, gain quick insights and respond promptly by refining the plan, and then to start again.

The questions and the actions

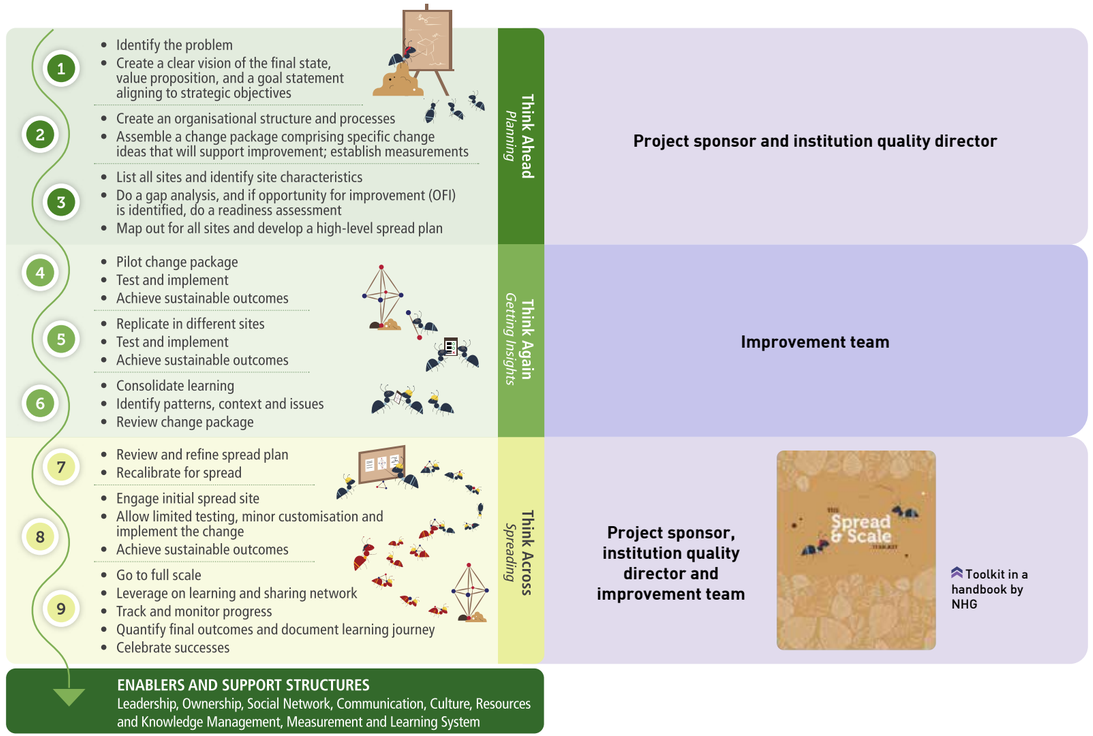
iv. For spreading change

Spreading change beyond pilot sites has been a subject of interest at NHG for many years. Even before the idea for the HRC was mooted, NHG Group Quality had been exploring ways to equip the healthcare improvement community in this area. We developed a toolkit (NHG Spread and Scale Toolkit) which was made available as an online copy in 2018, and subsequently as a handbook in 2021. We also established an online portal (NHG Spread and Scale System) in 2021.

The Toolkit identifies what needs to be done for successful spread, from planning to identifying resources and to engaging the leadership and staff. The Spread and Scale System captures information about quality improvement projects, including those initiated under the HRC. It is a practical avenue, local and familiar, for teams to learn from those who have gone before and helps level the learning curve. One is a resource and the other, an infrastructure facilitating co-creation. Both the Toolkit and System will boost the capability of the HRC in spreading change, insights and knowledge.

Onboarding the team

Individuals from NHG with experience in change management and facilitating quality improvement were onboarded to constitute the Steering Committee and Implementation Committee. Those with subject matter knowledge on the areas to be studied were appointed to the Expert Panel which included a human factors specialist.

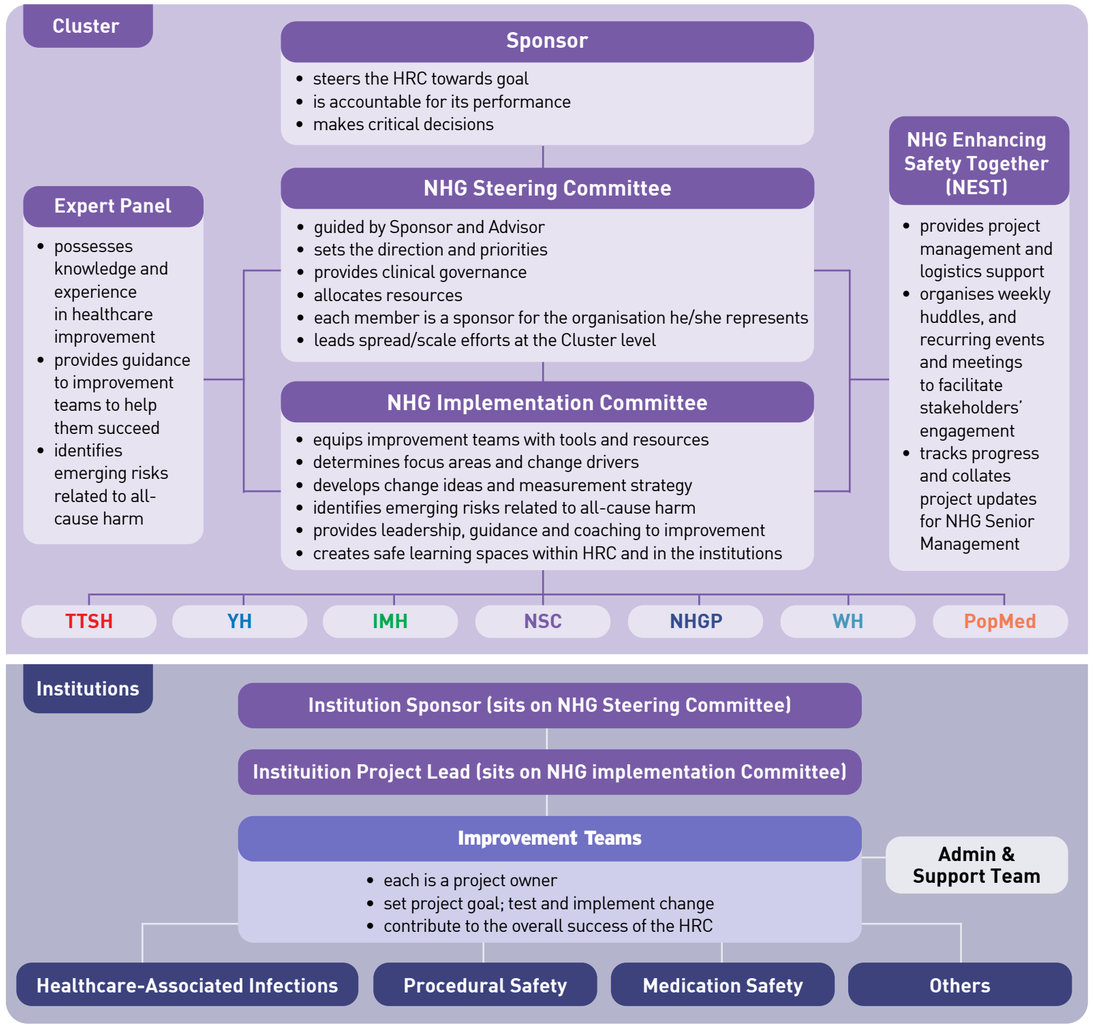


The three stages of spread and scale

Toolkit in a handbook by NHG

At each participating institution or business unit, there was an Institution Sponsor and an Institution Project Lead. The participating members were Institute of Mental Health (IMH), Khoo Teck Puat Hospital (KTPH), NHG Diagnostics (NHGD), NHG Polyclinics (NHGP), NHG Pharmacy (NHGPh), National Skin Centre (NSC), Tan Tock Seng Hospital (TTSH), Woodlands Health (WH) and Yishun Community Hospital (YCH).

In all, a total of 14 improvement teams were established under the HRC's umbrella. Some institutions set up more than one improvement team, while some projects involved cross-institution participation. For example, NHGP teamed up with NHGD for one project, and with NHGPh in another. TTSH had teams that looked at healthcare-associated infections and procedural safety. Another team brought institutions together (PopMed) to address polypharmacy. It is clear that HRC members had availed themselves of the opportunity to identify and address pressing concerns, often going beyond organisational boundaries to do that.



Structure of the Harm Reduction Collaborative

Codifying culture, norms, practices

The NHG Harm Reduction Collaborative Charter

Guiding principles

We:
- are equal partners in the NHG Harm Reduction Collaborative ("the Collaborative");
- have a shared responsibility for the aims of the Collaborative;
- embrace the "all teach, all learn" philosophy;
- build capability and capacity for safety and quality improvement at all points of care;
- focus on the needs of patients and families to achieve best patient outcomes that are sustainable and cost-effective;
- present the respective views and needs of our institutions rather than our individual needs and views;
- seek to make consensual and transparent decisions based on best available evidence-based practices and the science of improvement; and
- act as responsible stewards for any funds, resources and enablers made available to the Collaborative.

Methods

Three fundamental questions from the Model of Improvement will guide the Collaborative:

1. "What are we trying to accomplish?"
   - 50% reduction in preventable harm in three years.
2. "How do we know that a change is an improvement?" Through
   - the development of measures/indicators and data collection;
   - tracking implementation progress by monitoring outcomes (holistic and patient-centred), processes and balancing measures; and
   - maintaining transparency of results and processes to ensure comparability of data for data-sharing and benchmarking purposes.
3. "What changes can we make that will result in improvement?"
   - identify and test effective means of capturing existing and new knowledge, and spread such practices within and across institutions and Cluster;
   - share promising practices and lessons learnt from local (NHG), national and international healthcare community; and
   - participate actively in sharing quality improvement initiatives and innovations in the learning platforms, forums and meetings organised by the Collaborative and at national level.

Expectations

NHG Institutions are committed to:
- embed the Collaborative's objectives into our institutions' or Cluster's work plan priorities and strategic planning, with the provision of appropriate resources to achieve those objectives;
- actively participate, contribute to co-create and shape the Collaborative together as a Cluster, and with patients;
- establish a data-driven, patient safety and quality improvement approach across our institutions and Cluster;
- actively share relevant patient safety and improvement data as part of the Collaborative's data-sharing agreement;
- enable mutual learning and coaching within our institutions and with other NHG institutions;
- plan for sustainable leadership in Collaborative and train our people; and
- create and sustain an active Community of Practice to share promising practices and lessons learnt from our involvement in the Collaborative.

Excerpts from the HRC Charter

3 Mapping the Route

In the popular children's book *Alice in Wonderland*, the Cheshire cat told Alice, the protagonist: "If you don't know where you want to go, then it doesn't matter which path you take." This quote has been appropriated in management circles as a reminder to organisations that in the absence of goals, their strategy can be anything and they will still succeed – at reaching non-goals! Doing the wrong thing, even if impeccably, amounts to suboptimal use of resources. Wiser are those who start with the end in mind and focus their efforts and resources on the right things to attain it.

The change itinerary

That end, or vision in NHG's case, is "adding years of healthy life". Keeping our patients safe across care settings (acute care, aged care, and preventive care) is a contributor to this vision and against this backdrop, a role was carved out for HRC to deliver change of impact – to reduce preventable harm by 50% in three years. Having established this as HRC's aim, the next step was to map out the route to get there.

The process took place in consultation with the Steering Committee, the Implementation Committee and the Expert Panel. Placing the HRC aim at the centre, the group contemplated the high-level factors (primary drivers) that would need to be influenced to achieve the aim. Moving on, they considered in turn the next set of factors (secondary drivers) that would need to be influenced to yield the desired effects on each primary driver. From this analysis, the HRC's strategic direction was put into place. Without going into the details, the first diagram shown here provides a summary of the train of thought that shaped the HRC change itinerary.

AIM - Reduce Preventable Harm by 50% in 3 years

Key Focus Areas	Supporting Structures	Enablers
• Design Highly Reliable Process to prevent: – Healthcare-associated infection – Procedural-related harm and complications – Medication-related harm – Risks associated with Digital Transformation	• Create a Robust Measurement and Reporting System • Develop Learning Systems and Communities of Practice	• Supporting a Safety Culture • Build Effective Teams and Communication • Build High Reliability Culture and Practices • Embed Human Factors into Processes and Mechanisms

HRC'S strategic direction

From the HRC's strategic direction, more granular information was subsequently added to guide efforts in creating the following levers of change (five primary drivers), which straddle key focus areas, supporting structures and enablers:

1. Designing high-reliability processes; three additional sets of analyses were done to identify the specific Interventions and bundles for each focus area (healthcare-associated infections, procedural-related harm and medication-related harm);
2. Establishing measurement system for decision-making;
3. Building learning systems and a community of practice;
4. Strengthening safety culture; and
5. Establishing effective multidisciplinary teamwork and communication.

The Implementation Committee and the Expert Panel assisted in this work. They considered in sequence what change areas, change concepts and testable change ideas would potentially bring about the desired improvement, and enriched the exercise by sharing best practices relevant to the context. Eight sets of analyses were carried out in total. The information was aggregated to form the HRC's Change Package which in due course, was endorsed by the Steering Committee. With the onboarding of improvement teams, each team would go on to develop a change package specific to the project embarked upon. But before that could happen, these prospectors of change would need other information as explained next.

Primary Driver	Secondary Driver	Tertiary Driver	Key Change Areas	Change Concepts	Testable Ideas (actionable)
Design and implement highly reliable process for key focus areas	Implement evidence-based interventions and bundles to prevent medication-related harm: INSULIN	Reduce insulin errors	Implement drug adjustments during transition between "Nil by Mouth" and feeding	Standardise by creating a formal process	Implement NBM protocols and poor oral intake management
			Enhance formulary management	Reach agreement on expectations	Create and implement drug and therapeutics committee
			Enhance patient activation	Coach customer to use product/service	Engage and teach patients how to participate in care and self-care
					Use digital technology that has patient decision support tools to promote self-care, where possible
	Implement evidence-based interventions and bundles to prevent medication-related harm: CHEMOTHERAPY	Improve coordination of chemotherapy	Design human factors approaches into oncology practices	Standardise by creating a formal process	Standardise the pumps used in the healthcare setting
				Use affordances	Simplify and standardise the medication label so that it contains information critical to the nurses' task of prepping the patient
				Stop tampering	Switch from electronic pumps to fixed-rate mechanical pumps whenever possible
			Ensure reliable ordering of chemotherapy drugs	Standardise by creating a formal process	**Use standardised approach for prescribing chemotherapy drugs** 1. Optimise use of prescribing system and standardise chemo order practices 2. Use computerised order sets or pre-printed orders for chemotherapy drugs
				Give people access to information	**Develop process to ensure communication with pharmacy and nursing when medication order is changed** 1. Review and revise current policies and procedures 2. System auto routes medication order changes to pharmacy and nursing; highlights promptly if the order has been processed
				Use constraints	**Do not accept verbal orders for chemotherapy drugs** Improve communication between providers and eliminate all verbal and/or telephone orders
				Use constraints	**Set dose limits for chemotherapy drugs** 1. Develop working groups to assess dose limits 2. Maximum allowable dose for each chemotherapeutic agent is set so that the prescriber cannot accidentally select a dose outside the safe range
				Develop contingency plans	**Require peer consultation and review for unusual orders** 1. Consultation and review of the variation outside the limits set by an approved clinical peer who is another prescriber certified to order chemotherapy

A segment of the HRC's Change Package (continued on page 23)

A segment of the HRC's Change Package

Destination markers

When an intervention is deployed for testing and a change is observed, project teams need measures to gauge if the change is an improvement, much like how checkpoints or landmarks announce arrival at a destination. Measures are decided at the start so that improvers know what to look out for, how to make sense of a change and what the next steps will be. What is not (or cannot be) measured is not managed.

The HRC's approach to measuring is detailed in the Measurement Strategy Document (MSD). It provides definitions of the various types of measures and data elements, and outlines strategies for data collection and reporting. It spells out the reporting requirements for monthly and bimonthly measures. It specifies the required measures that teams must track and report to the project office, NEST. Improvement teams may choose to report optional measures and/or develop new ones suited to the context of their studies. As teams obtain new insights and information over the course of their work, the measurement strategy could be fine-tuned and improved over time. The MSD is therefore an 'organic' document.

Both documents - the HRC's Change Package and MSD - form the basis for the execution of improvement activities and measurement of progress. They are central to orienting and aligning improvement efforts towards attaining the HRC's aim.

Fuel for the journey and safety

Mountaineers depend on rations to sustain them for the journey. To maintain positive momentum, they exercise precautions to stay safe and protected from the elements. Although not identical in the methods used, the planning of the HRC did factor in considerations of equipping committees and teams and supporting the endeavour ahead.

A key resource required in the HRC's case was funding for the purposes of engaging manpower, conducting workshops, meetings and audits, and purchasing hardware, software and IT services for the setup and maintenance of data and measurement infrastructure, among other requirements. Cluster leadership had approved a sum to be set aside for the HRC's use from FY2020 to FY2022. Support was once again demonstrated when it approved the HRC's request for a one-year extension to FY2023. This was on account of the delays encountered in several of the projects owing to COVID-19 and the requests by some institutions to scale down on the improvement activities to focus on the transition into the Next-Generation Electronic Medical Records (NGEMR) system.

Within the HRC, its senior leadership had envisaged several forms of support required and ensured arrangements were in place. These include the setting up of a secretariat (NEST) and an Expert Panel. While NEST's primary function is coordinating the work in connection with governance and execution, it is ready to assist project teams who may need administrative help from time to time. For advice on planning and execution of improvements, project teams can consult with any members from a 14-strong Expert Panel who are experienced in quality improvement and are knowledgeable in the various focus areas adopted by the HRC.

On the eve of setting off, the HRC took the words of Dr W Edwards Deming - that all work is a system of interdependent parts - as parting advice. As optimistic and positive as we are about the power of change, we must be vigilant. No matter how well the intention of change is, there could be unintended repercussions within and outside of the focus areas adopted, and we must be mindful of this. The sources of harm could lay elsewhere, and this should also be a concern.

We provided for some mechanisms to monitor harm. One involves the tracking of a series of big-dot measures comprising indicators such as average length of stay, return to the emergency department within 72 hours and the number of serious reportable events arising from any of the focus areas. Complementing these measures is the Harm Surveillance Study which deploys quick trigger in retrospective case reviews to track incidence of adverse events over time. All these help serve as a pulse check to monitor the situation across the HRC's focus areas and to detect other sources of harm/risks of harm, e.g., ongoing changes in the healthcare system. Another is conducting an Adverse Events Study (AES) after the conclusion of the HRC.

Process measure	Data on adherence	Formula
Percentage of patients with indwelling catheters (IDC) who are reviewed appropriately	• Nurse reviews IDC daily or at least thrice a week (Mon, Wed, Fri) with Team Doctors for appropriate indications for IDC; or • Nurse reviews IDC as and when necessary if there is a Trial-Off-Catheter (TOC) plan or date and TOC Protocol has been ordered.	Total number of IDC reviewed or TOC plan updated / Total number of patients with IDC x 100
Percentage of correct use of Trial-Off-Catheter (TOC) Protocol	• Nurse issues the TOC Protocol to doctor if there is no indication for continuation of IDC use.	Total number of TOC Protocol used correctly / Total number of patients for TOC) x 100
Percentage of compliance with TOC Protocol	• Pre-TOC preparation, bladder charting and bowel clearance. • Scheduled 3-hourly potting and encourage fluid intake about 400-600mls over the next 6 hours unless contraindicated. • Nurse performs bladder scan when NPU or PVRU after PU/BO, within 6 hours after TOC and inform doctor of results.	Total number of compliance / Total number of expected compliance x 100
Outcome measure		
Rate of CAUTI per 1000 urinary catheter days *	• Numerator: CAUTI events are determined after investigation by Infection Control nurse based on CDC international guideline and definition of CAUTI. Investigation is triggered during daily surveillance of abnormal urine culture results collected at the chosen location. • Denominator: Urinary catheter days are collected electronically from nurses' documentation. Urinary catheter days refers to total number of days in which a patient has an indwelling urinary catheter device at the chosen location within the month of interest.	Number of CAUTI / Number of urinary catheter days x 1000
Ratio of urinary catheter utilisation *	• Numerator: Urinary catheter days - see description above. • Denominator: Patient days refers to total length of hospitalisation for each patient at the chosen location in the month of interest.	Number of urinary catheter days / Number of inpatient days x 1000

** Reference: National Healthcare Safety Network. Urinary Tract Infection (Catheter-Associated Urinary Tract Infection [CAUTI] and Non-Catheter-Associated Urinary Tract Infection [UTI]) Events, January 2023.*

Examples of measures (from a project by YCH to reduce rate of CAUTI)

4 The Ascent Begins

Each change initiative requires vectors and agents to effect and spread change. In this regard, the agency of the improvement team cannot be underestimated. Its members are directly involved in bringing about change through planning, and developing, testing, and implementing change ideas. All teams in the Harm Reduction Collaborative (HRC) were encouraged to organise their work around a quality improvement framework. This framework consists of four stages: planning and assessment; testing and implementation; evaluation; and sustaining and spread.

The work of the improvement team follows a trajectory much like the process of scaling up a mountain. There is a start, a goal, and in between, ever-increasing altitudes to surmount. We feature some vignettes to give readers a flavour of what could be expected in each stage, the choices made by improvement teams in terms of response and approach, and what they considered helpful.

The journey that started it all

Before we bring on the vignettes, we share a staff's recollections about the work needed to prepare the ground for a collaborative. The passage - from conception to launch of the HRC and the commencement of improvement projects - was a journey that had to be made before another could begin.

Handbook by NHG providing a framework for quality improvement

Understanding the terrain

"It was the early days of the COVID-19 pandemic. Given my training in clinical pharmacy, I was deployed to set up home delivery services and medication management services at the Central Pharmacy Services Centre. In fact, a significant section of the healthcare workforce was deployed to battle the pandemic on various fronts. Under such circumstances, how should we get the Harm Reduction Collaborative (HRC) off to a good start? How should we communicate the intent of the Collaborative and marshal leadership support at all levels across NHG institutions? Was there not a better time to launch the HRC?

These were the questions I had to grapple with in my role helming the programme office, NEST. NEST was tasked to coordinate all manner of strategic, administrative, executive and governance activities throughout the HRC's term. But before any of these could commence, we needed to engage with stakeholders to establish a common ground. The case for a collaborative in exceptional times (the 'why') must be established and clarified to all.

Preparation is key

I recall one of my first tasks was to conduct a comprehensive stakeholder analysis to assess stakeholders' level of involvement and what support or commitment the Collaborative would ask of them. The information obtained allowed me to tailor the meetings to the respective groups of stakeholders. This way, we ensured the judicious and effective use of everybody's time to achieve the objectives of the engagement sessions.

Continued on next page

NEST organised a series of small group meetings with each of the participating institution's senior leadership to share about the vision, rationale and plans of the HRC. This was usually followed by more engagement efforts which, owing to safe management measures, were carried out through virtual meetings, phone calls and emails in place of in-person meetings. During virtual engagements with senior leadership, middle management and committee members, we provided an open feedback loop for each group of stakeholders. The key thrusts of our messaging revolved around clarifying the HRC's intent, demonstrating why improving and ensuring ongoing focus on patient safety is an even greater imperative in a crisis, and introducing the Collaborative Model and evidence of its use in transformational change.

> "It was all about marshalling support. With the wind beneath our wings, we took off against all odds.
>
> **Ms Julia Ng**
> **N.E.S.T (NHG Enhancing Safety Together)**

Learning and teaching

The NEST team also participated in a considerable amount of equipping work to prepare improvement teams for the work ahead. In the process, I found myself 'fast-tracked' into hands-on learning, about everything and anything related to quality improvement (QI), large-scale improvement initiatives, and the nuts and bolts of planning and executing agile improvement projects. With that knowledge, and through consultation with the NHG Implementation Committee and Expert Panel, NEST and I assembled and adapted a set of tools to facilitate and document each phase of the collaborative, which ranges from horizon scanning to identify risks and opportunities for improvement, project management and governance. I also showed improvement teams how to put them to use. The suite of tools included driver diagram, change package, measurement strategy, day-at-a-glance (DAAG) schedule, toolkit on conducting quick PDSA cycle, and templates for conducting pilot studies, to name a few.

The effort involved in starting a collaborative was a journey of its own, filled with uphill challenges. In ascending the slopes, these words came to mind: 'If you want to go fast, go alone. If you want to go far, go together.' How very true except that in our situation, we went fast too befitting the urgency of harm reduction in a time of crisis. Despite the challenges, we persevered to complete the ground work needed for the HRC launch on 17 Jul 2020 and Learning Meeting 0, a familiarisation session on 17 Nov 2020. I was driven by the belief that the hard work is worth it because harm reduction initiatives improve patient safety and with persistence in efforts, we can consistently deliver safe care."

> "It was worthwhile to engage stakeholders before piloting our interventions.
>
> **Dr Ng Tat Ming**
> **Team Lead**

Encounter at each stage

Planning and Assessment

Project: Improving clinical outcomes among at-risk patients through a person-centred approach in medication management (PopMed)

In our project, we had planned to use a person-centred care approach to help at-risk patients manage their medication. These patients have complex medication regimes and receive care from multiple healthcare settings. In assessing the problem, we studied the causes of polypharmacy among at-risk groups and identified patient-related factors as one of them. The key change ideas that informed the interventions were characteristically person-centred, with features such as shared decision-making with the patient on plans and care goals, the use of patient activation tools to deliver medication-related self-care information and planning for longitudinal follow-up.

At the conceptualisation stage, we did more than just evaluate the project in terms of the advantages it would accrue. We were framing the medication management of such patients as a multi-disciplinary team effort. There would be many stakeholders involved, working in concert, to support the provision of services across the continuum of care. The multidisciplinary collaboration would empower the patients in self-managing their medication.

Engagement of stakeholders was important to translate concept to reality. We started very early, before the pilot study began, to identify and engage with the stakeholders – pharmacists, doctors, and clinic staff. Mapping out key levers with driver diagrams helped us to systematically tackle the problem of polypharmacy, one step at a time. The stakeholders were involved in this process too by contributing feedbacks and ideas.

> We did an in-depth analysis and learnt to accept new information that came our way.

Dr Sennen Lew Jin Wen
Team Lead

Planning and Assessment

Project: Reducing the combined ICU Central-Line Associated Bloodstream Infection (CLABSI) rate by 50% in 3 years (Tan Tock Seng Hospital)

A range of infection control and prevention practices had been in place for a few years, but the rates of Central Line-associated Bloodstream Infection (CLABSI) in the ICUs remained high, especially at the MICU. This became our pilot site and here's how we analysed the problem.

Process charting was done to detail the steps performed from the time of admission to discharge. Three micro workflows provided a close-up view and revealed gaps in the insertion of the CV line (CVL), maintenance, and review of the need for CVL. A survey was carried out among doctors and nurses which revealed insufficient sharing of data on CLABSI, variability in the practice of full barrier protection, inappropriate practice in reattempting a new site, and the lack of prompt to review the need for CVL. In addition, a cause-and-effect diagram enabled the drilldown of process-related factors for the insertion and maintenance of CVL, and the identification of causal factors related to healthcare workers, the patient, environment, and equipment.

There were more causes than there were the resources to address them. To prioritise the list of causal factors, multi-voting was conducted. The pareto principle yielded the top four but the team was able to focus on the next four as well, leveraging in part on interventions that were able to address more than one root cause. The interventions were found to be useful and were spread to four other ICUs.

There were unexpected findings along the way! We found that performing blood cultures in patients with no clear indications and performing cultures from existing indwelling vascular lines can contribute to CLABSI prevalence. These factors were not apparent when we went through the fishbone diagram and process charting. We came to understand that there are multiple extraneous variables coming into play when multiple parties are involved in the process of central line insertion and maintenance.

> We were fortunate to have people willing to advise and point us in the right direction.

Dr Daphne Lee Hui Min
Team Lead

Testing and Implementation

Project: Reducing medication errors associated with MERP Category D Parenteral Opioids by 50% over 3 years (Yishun Health)

Our project is on medication errors associated with the use of MERP Cat D parenteral opiods. It was early 2021 when we embarked on it; the COVID-19 pandemic was still ongoing. We got through the first hurdle – of gathering team members together to meet up virtually for discussions. Everyone persevered and showed up for every meeting despite their busy schedules and deployment.

Then we were presented with another challenge. We had data from only six cases from 2020 to work on. When the team tried to use the Root Cause Analysis (RCA) approach to analyse the cases, we soon ran into difficulties. The limitation became obvious when we were faced with significant information gaps - staff resignation, staff being rotated out and staff who were not able to recall the events one year on. Even without such gaps, the small data set would have made it difficult to draw meaningful conclusions.

Just as things appear to be stagnating, we received a piece of advice that would prove to be the turning point of the project. A/Prof Tai Hwei Yee suggested at one of the learning meetings that we consider using Failure Mode Effects Analysis (FMEA). We took on the suggestion and discovered it was a challenging and intensive process – many of the team members had never done an FMEA before. We also had to continually refine our analysis, going back and forth, conducting surveys and speaking to ground staff to verify its accuracy. However, we made it through. Our confidence soared at the thought that we had identified the root causes and we could move forward.

Our experience was like wandering in the wilderness. We were fortunate to have people willing to advise and direct us to the right path. We will always be grateful to them for their generosity in imparting their knowledge and helping us to grow in our quality improvement journey.

> We considered issues of user adaptation and motivation, and of sustaining the new practice.
>
> **Dr Sreedharan Geetha Sajith**
> **Team Lead**

Testing and Implementation

Project: Improving the detection and intervention of antipsychotic-induced EPSE among inpatients by screening 100% of eligible patients using EPSE assessment tools (Institute of Mental Health)

To address the frequent occurrence of antipsychotic-induced extrapyramidal side effects (EPSE) among psychiatric inpatients, we introduced a new standard work process for their assessment. Central to this is the use of a screening and assessment tool that we had developed and validated through expert panel reviews, team discussions, and feedback from ward nurses and doctors.

To familiarise nurses with the new work process, training materials were developed. These were used in conjunction with practicum sessions to equip nurses with the necessary competencies to assess EPSE. Follow-up training helps to ensure that their level of competencies is maintained.

Conducting the EPSE assessment takes additional time. The improvement team took frequency and timing for EPSE assessments into consideration to prevent overburdening the nurses. The co-lead, an advanced practice nurse based in the ward, has been able to encourage the nurses and help them adapt. The following efforts have been particularly helpful - conducting training programmes to familiarise users and to demonstrate benefits, and respecting feedback by exploring the changes that can be made to the workflow so that it is sustainable. In addition, recognising the nurses' efforts by ensuring that they do not go unnoticed by their colleagues and the management, has been helpful in forging acceptance. The incorporation of the project tools into the balance scorecard of the wards has also helped in the process.

The improvement team makes it a point to review the workflow periodically to ensure greater efficiency with minimal wastage of resources. EPSE assessment forms should be easily accessible and users need not make additional efforts to locate them. These forms are not presently a part of the hospital electronic records but will soon be following our request to have them incorporated in the NGEMR system. This improvement will go a long way to 'oil' the process and facilitate subsequent spread to other sites.

> We refined our change initiatives over and over to make them doable.
>
> **Dr Teh Tiong & Mr Joel Gan**
> **Team Leads**

Evaluation

Project: Achieving zero Serious Reportable Events in 3 years among NHGP patients requiring general X-ray examinations (NHG Polyclinics with NHG Diagnostics)

To address issues related to X-rays done on the wrong side and/or site, we started with visual signages (Lifesaver markers) that were pasted on the relevant spots. We then enhanced the visuals using Left/Right (L/R) stickers. In addition, we also informed the radiographers to mark the site and side with a sticker on the region of interest after verifying with the patient.

Evaluation was carried out through surveys. For the Lifesaver visual aid markers, the survey revealed an increase in confidence of radiographers by 50% in being able to ascertain the correct side even when performing under pressure. For the L/R stickers, it was found that only 51% of radiographers were using these. Evaluation had shed light on the practical challenges experienced by users which led to new improvements.

For example, users' reactions were mixed, and this prompted members of the improvement team to travel to each clinic to understand more. Users shared that they were likely to forget to use the stickers if they did not see them. Hence, stickers were relocated from X-ray consoles into X-ray rooms or on the X-ray machines to create more visibility. It also transpired that while radiographers generally believed in the effectiveness of the measure in reducing laterality errors, the majority felt that using the stickers on every X-ray procedure was not viable. The preference was for stratifying usage, by targeting certain user groups (e.g., students, new radiographers under supervision, radiographers who had recently encountered laterality errors) and focusing use on cases involving multiple examinations on different sides.

The insights from this process had enabled us to review and refine the interventions to make these more workable for the radiographers. Change initiatives must be doable if they are to be sustainable for a period sufficient to create an impact: "Don't practise until you get it right. Practise until you can't get it wrong." Since the introduction of Lifesaver visual aid markers and L/R stickers, the incidence of laterality error has been on a downward trend.

> We have a plan.
>
> **Dr Eow Liu Yin**
> **Team Lead**

Spread

Project: Reducing the number of actual medication events related to insulin at pre-operative wards by 50% over 2 years (Woodlands Health)

The problems associated with insulin errors are multifaceted. We embarked on several small projects, each led by a team member, to jointly address this matter in preoperative wards. The initiatives have resulted in sustained improvements in the pilot sites.

The challenges in spread – across nesting sites and to relevant departments at the Woodlands Hospital when it opens – are multifaceted too. Besides the new workflow in a new hospital, we anticipate difficulty in measuring and interpreting results as our team will transition to a new hospital in phases from various nesting sites. Where we are right now, spread is complicated by the high staff turnover at different nesting sites, making it a challenge in training and standardisation. Differences in practice exist among staff located at different institutions.

We are not deterred and have prepared a spread plan. Take for instance, hyperkalemia kits, one of the interventions. We had identified the clinical areas in the new hospital that would benefit from the intervention and incorporated the workflow into the Woodlands Health's policy on hyperkalemia management. There are ward champions to perform weekly checks on each kit to ensure it is fully stocked and ready to be deployed. There are also regular audits and yearly e-learning sessions with a competency checklist to identify the required knowledge, skills and abilities. A briefing on hyperkalemia kits will form a part of the induction programme for new nurses. With a plan in place, and with supportive senior leaders and mentors and a safety culture, we can navigate the challenges together.

Looking back, the effort from each preceding stage of the quality improvement journey was important. Each step must be done correctly, and the right questions asked. When preparing to test, "how do we know if change is an improvement?" At the implementation stage, "how can we canvass for support from ground staff?"

Getting buy-in, applying the principles of the psychology of change, and having the right support i.e top management committed to change, resources etc. had facilitated greatly our work in piloting change. These will continue to be vital for the spread efforts.

At Learning Meeting 6, participants learnt about the SEIPS (Systems Engineering Initiative for Patient Safety) model and its use for spreading change

Supported each step of the way

Over the course of the Harm Reduction Collaborative (HRC), a community of practice (COP) has steadily developed. The sharing of insights and learning have become an integral part of the COP life. This is one which took us some time to plan for, followed by even more effort from the community to cultivate it. We will introduce some of the mechanisms of support and collective learning that were co-created which enabled improvement teams to connect with one another for support, and with leaders, coaches and resource persons for advice and ideas.

i. Learning meetings

Learning Meetings (LMs) are like the lodges mountaineers go to, for temporary shelter, conversations with other travellers and quiet reflections, before heading out again. Held in between action periods, LMs help improvement teams face up with current challenges and brace them up for emerging concerns. This platform is conceived to provide a safe environment where teams learnt and were supported by their leaders. Members of the Implementation Committee (IC) played multiple roles of a teacher, facilitator, and cheerleader. For the participants in improvement teams, there is the opportunity to get to know one another and build connections and a network of support.

Also by intentional design is the selection of the topics featured, and the timing. These include QI tools and principles relating to developing, testing and implementation of change, setting up a team progress report, team- and will-building, change management and psychology, Kotter's Change Model and NHG's Spread and Scale framework. IC members facilitated group activities among improvement teams, setting in motion thought-provoking conversations, and co-creation of ideas and insights. Huddles, held typically at the end of each meeting, brought leaders and teams together, to renew their resolve and contemplate next steps.

Teams from NHG institutions with the facilitators at LM6

"When presenting to our stakeholders, we often went down a long and convoluted path. Having worked on the project for two years, there were just so many things we wanted others to know. We realised we left the audience confused instead! At a learning meeting, we heard Ms Jacinta Ong's sharing "Begin with the end in mind". We relooked at ways to make our communication concise, leveraging data and 'unique selling points' in terms of the project's impact and contributions. We got our points across more effectively as a result.

Dr Shaik Noor
Team Lead

Project: Reducing prescription error rate of MRSP drugs (NHG Polyclinics and NHG Pharmacy)

ii. Coaching

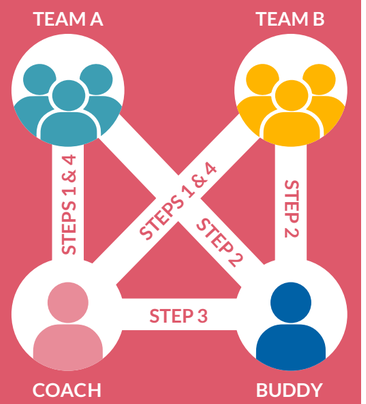
In the spirit of "all learn, all share", the HRC designed a buddy-based coaching model to fuel active and fluid interactions between participating institutions. Individuals experienced in healthcare improvement work and those with specialised expertise (e.g., in improvement methodologies) were recruited as coaches. A coach and a buddy coach were assigned to each improvement team to assist them in overcoming challenges encountered during their journey. The coaches themselves gained from cross pollination of ideas as they interacted with improvement teams from other NHG institutions. Coaches provided guidance and encouragement during action periods and in monthly reviews to keep teams on track.

BEYOND INSTITUTION BOUNDARIES

In executing the HRC activities, team dynamics are fluid, reflecting the active exchanges across institutions as well as the spirit "all teach, all learn". A buddy-based (or peer learning) coaching model fuels the interactions. Each project team is assigned a coach and a buddy who are Implementation Committee members from other NHG institutions. Through them, project teams learn from the experience of other institutions, while the duo learn from each other how to coach more effectively.

Cross-pollination of ideas and learnings through buddy-based coaching

1. Coach reviews each team's work.
2. Buddy reviews each team's work.
3. Coach and Buddy discuss each project.
4. Coach provides feedback to each team.



Buddy-based coaching model

> I had the opportunity to wear two hats. The first was that of a learner, the other, a coach. Under the buddy-based coaching model, I worked with Dr Tung to offer support to improvement teams in various forms such as sharing with them methods, tools and feedback. This was an effective arrangement. The teams were open to share, learn and consider new possibilities. The secretariats were tireless in coordinating schedules and finding time for regular meetings. It's been a rewarding journey for me, enriched with camaraderie forged with like-minded people. We all want to reduce harm for our patients.
>
> **Ms Jacinta Ong, NHGPh**
> **Implementation Committee Member**

iii. Site Visits

At each round, institutions take turns to invite other members over, to learn about the projects under their care, the challenges and the plans forward. Between 2022 and 2023, two rounds of site visits were conducted.

Site visits provide a platform for engagement, a great way for senior management to demonstrate support for the work. Their presence inspires confidence that leaders are accessible, approachable, and invested in the change effort.

Touring the sites provide an opportunity for experiential learning and first-hand observations. Participants observe at close range what works and where pitfalls lurk.

> The HRC site visits and the discussions regarding the implementation of our institutions' project were helpful. The site team learnt a great deal, especially about the spread strategies through those discussions and benefitted from the resource booklets provided.
>
> **Dr Giles Tan, IMH**
> **Steering Committee Member**

Presentations by improvement teams open the doors for cross team and cross-institution exchanges and collaboration. Teams learn and discover together.

Site visits are pit stops for teams to:

- refuel with encouragement that is generously given
- recalibrate plans with help from coaches and IC Members
- recharge with a newfound sense of solidarity

5 The Summit in Sight

At the time of writing, the Harm Reduction Collaborative (HRC) is on the final leg of its journey. Fourteen pilot studies were conducted. Six had garnered interest outside of the institutions that championed them. For these projects, the NHG Implementation Committee is planning to perpetuate each change beyond the pilot sites, within the institution and across NHG.

Press on!

Under this plan, individuals with the knowledge and skills on quality improvement will be selected to form spread teams. They will implement tried-and-tested initiatives while pilot teams will share knowledge and experience. The plan, introduced at the final Learning Meeting, includes the use of the SEIPS (System Engineering Initiative for Patient Safety) model for spreading improvements. Subsequently, at the final Site Visit, the community will share the progress made, and highlight areas where further support is needed. This helps ensure that our collective efforts remain adaptive and aligned with the overall aim – reducing preventable harm by 50% in three years.

Spread and Scale is a challenging process. It requires planning, resource identification, and engagement with leaders and stakeholders for support and buy-in. Studies show that 70% of pilot studies do not go beyond initial success. With a spread plan, a toolkit (NHG Spread and Scale Toolkit) and engagement sessions as mentioned earlier, we are positioning ourselves in the best way possible for this endeavour.

Keep in shape

We often associate certain qualities with a mountaineer or an athlete. Striving and not giving up, the mountaineer eyes the next adventure while the athlete works at improving her last record. Both must keep fit, train hard and equip themselves with whatever it takes to succeed in the next challenge. This is the spirit of *kaizen* that fuels improvement work. We celebrate interim gains, but we will not rest on our laurels until every patient is safe from preventable harm.

The improvement community of NHG is larger than the HRC and has been actively promoting safety. In time to come, the Collaborative will be stood down, but the safety agenda stays. All the work that has been going on outside of HRC, without fuss and fanfare, complements and augments the HRC's work. It sharpens our saw; by contributing towards capacity- and capability-building, ensures that we are fit, and getting better at making safety a reality for more and more patients.

Some aspects of the work, as we will address next, are more relevant to one group of staff, but everyone's effort counts towards the greater (system) goal. Leaders, supervisors, and ground staff, medical, nursing, allied health, operational and logistical teams - everyone plays a part in creating a safe system. Even when not spearheading initiatives, all can participate through embracing safe practices, continuous learning and exercising vigilance. The steadiness of practice is what will make safety sustainable over the long haul.

i. Building endurance

The quest for greater patient safety includes building a high-reliability system that can maintain performance at high levels of safety over long periods of time. With senior leadership's endorsement, each NHG entity has embarked on a change management programme. It aims to train staff who have been identified for the role of a change leader. Participants will acquire skills such as promoting and getting buy-in for change ideas, planning for change, inspiring teams, launching change initiatives, and supporting the change.

Reducing variation is necessary to achieve higher reliability. Imparting the skills needed to detect and manage variation is one part of a multi-pronged strategy to grow the capability

CPIP participants at a graduation ceremony. Clinical Practice Improvement Programme is conducted by NHG's Institute of Healthcare Quality.

Managing telehealth risks was the subject explored in a webinar and workshop organised by NHG Group Quality on 2 May 2023.

for continuous improvement. The other is access to data. With regard to the former, NHG's Institute of Healthcare Quality is the Cluster's flagship training centre which conducts all manner of courses and workshops on quality improvement. As for the latter, the NHG Quality Value Data Mart, when ready, will enable users to draw upon more data with greater ease to guide and inform improvement work.

ii. Balancing risk-benefit tradeoffs

Innovation comes with risks, but this should never be a justification to avoid it. The use of technology is no longer a matter of choice; circumstances necessitate it. Take for example, telehealth. It has proven its value during the pandemic and beyond. It has allowed for the continuity of care and helps mitigate some of the inconvenience from care disruption. Its risks can be managed.

There are ways to leverage the benefits of a new initiative, a tool or a technology while keeping harm at bay. At NHG, we use a self-assessment questionnaire (SAQ) to facilitate discussions among users to evaluate existing and new initiatives, to create awareness of potentially unsafe practices, and to identify safe practices that should be promoted and expanded upon. Information exchanges are important too, and these should be planned and structured. There are platforms for Quality Directors and Risk Leads to participate in discussions, to learn from each other's experience and to preempt complications or harm. There are avenues to raise awareness among staff, such as through webinars and newsletters, on the use of technology like telehealth, automated medication management systems and others.

Logo of the NHG Good Catch Award. Magnifying glass symbolises the constant search for improvement opportunities; handshake symbolises collaboration to care with compassion.

iii. Watching out for signs of strain

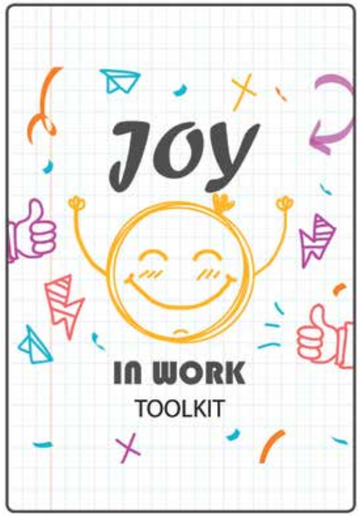
A good example of this can be found within the HRC itself. The Collaborative employs a series of big-dot measures to act as a pulse check, to monitor results of the focused improvement areas identified, and as a sensor for emerging sources of risks from ongoing changes in the healthcare system. These include conducting retrospective surveillance reviews using trigger tools and assessing the safety signals through the review of Serious Reportable Events (SREs) occurrences, Mortality and Morbidity reports and incident reports. An Adverse Event Study will also be conducted after the HRC stands down.

Outside the HRC, staff can be timely messengers of where things have gone or could go wrong. Good Catch initiatives are implemented within NHG institutions. Varying in design and implementation details, all programmes seek to inculcate a positive culture. The belief that everyone can contribute towards upholding high standards of care is empowering. To drive this culture further, NHG launched the Good

NHG Good Catch award recipients with GCMB, Prof Lim Tock Han, at NHG Quality Day 2023.

Catch Award (GCA) at the Cluster level on 1 March 2023. It is open to all employees from NHG institutions and entities. Participants submit a Good Catch Story which will be assessed on a few levels, such as his/her involvement in the discovery process, whether the detection leads to opportunities for improvement, and if so, whether he/she collaborates with others to bring about the improvement.

Finally, strain in the system can manifest as workplace stress in multiple forms. The demands of work outweigh the capacity to fulfil. The work environment is hazardous. The culture extracts high accountability from staff but provides little empowerment. The list goes on. Some of the solutions, the likes of manpower and resource allocation, reside within the realm of national policymaking. Others are within the Cluster's/institution's remit to create new and better possibilities. Initiatives such as the Employee Wellness Programme, Joy In Work (JIW) and the provision of psychological safety and second victim support are some examples that demonstrate NHG's commitment to put people at the centre of care delivery. Healthcare is, after all, humans taking care of other humans.



The Joy in Work Toolkit for staff to achieve joy in work in four steps: Let's Chat, Finding Gaps, Let's Improve and Let's Track. Working in teams, staff identify key elements of joy in work, assess areas for improvement and existing barriers, prioritise areas to focus and evaluate progress.

The importance of supporting healthcare workers was the theme of NHG Quality Day 2022.

Leave the light on

There is strength in numbers. NHG chose collaboration to address preventable harm. Collaboration will increasingly feature as an important mechanism in our population health efforts. It would involve working hand in hand with healthcare and community partners across acute, aged and preventive care settings. Synergies abound when we team up, to complement each other's capabilities, pool resources and share knowledge. We will be in a stronger position together to provide better healthcare and health.

The HRC had made contributions into a bank that has been accumulating knowledge since the quality movement began more than 20 years ago. The question that arises is: What can we share with our partners in a growing health ecosystem? The gains derived from each improvement project extend beyond results, science, and methods, to include the experience acquired in the process of leading, facilitating, and influencing change. The knowledge is multifaceted. This leads to further questions: What is relevant and useful to our community partners? How should we disseminate it? Who shall be the messenger to bring forth this knowledge? We may not have all the answers now; with a collaborative mindset, we will find our way forward.

In a time of rapid change, one thing is certain. Patient safety must be forged through collaborative efforts and the growth of collective wisdom within NHG and beyond. We must be ready to reach out when the opportunity knocks. We will leave the light on. Across the vast mountain range filled with summits, we shall serve as the lodges of knowledge for the community of improvers on their way to the pinnacle of quality and patient safety.

Dr Tung Yew Cheong
Group Chief Quality Officer

The Projects

Procedural Safety

Medication Safety

Healthcare-Associated Infections

Projects in Progress

Scan the QR code to read the detailed write-ups on the NHG Group Quality intranet site.

Radiological Examinations

1 **To achieve zero serious reportable events (SRE) due to X-ray-related incidents in three years for all NHG Polyclinics (NHGP) patients requiring X-rays.**

Detection

To err is human. Even for professionally trained radiographers, X-rays may be inadvertently done on the wrong side and site. Reducing errors would minimise unnecessary radiation exposure to patients and prevent delays in diagnosis and management, while maintaining staff morale.

Analysis

Our team did a causal analysis which highlighted four key concerns - human factor, cognitive load, environment and experience of radiographers. Human error was observed as one of the causes, where there was a mismatch of action and intention during the X-ray procedure. Some radiographers may have occasional memory lapses and need to refer to the procedural details at the workstation. There is a risk of radiographers working based on their assumptions and this may lead to the incorrect procedures being done. High cognitive load, constant time pressure and high workload increases risk of radiographers making mistakes.

Radiographers constantly work with the left and right sides of the patient in different orientations. Unfamiliar environments can disorientate them, increasing the chances of errors. However, replicating the same room configuration and equipment for all polyclinics is not feasible. Additionally, junior radiographers may feel overwhelmed, thus increasing their risks of committing errors.

Improvement

A qualitative survey conducted found that radiographers prefer visual signages for learning. Hence, the team introduced visual aid markers to help the radiographers better identify the laterality during procedures. Colour-coded 'L' (Left) & 'R' (Right) Lifesaver markers that correspond to the patient's laterality were pasted on the table, erect bucky and the patient's chair in the procedure room. These markers helped radiographers to ensure the correct side is being examined, easing the cognitive load of radiographers.

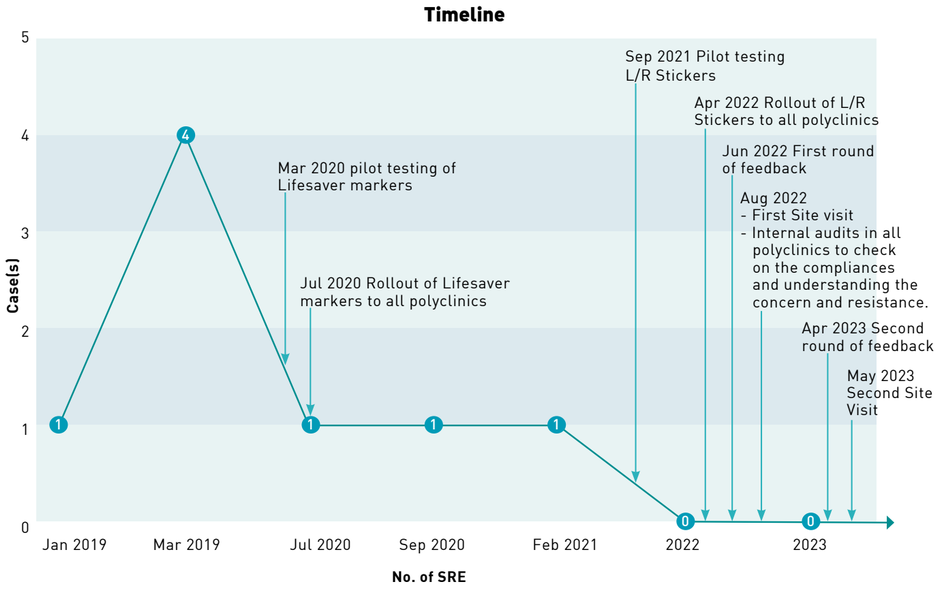
Outcome

After the implementation of Lifesaver markers, we saw a reduction in the incidences of laterality errors. To achieve the aim of zero incidents, L/R stickers were introduced as an extension of the Lifesaver markers to annotate the anatomical site and side to be imaged.

Improvements in radiographers' confidence level and a reduction in stress level were observed. Their confidence in decision-making amidst distractions increased by 50% when it came to distinguishing the left from the right side.

Despite the opinion that the stickers are effective, a majority found it impractical to use the L/R stickers for every procedure. It was highly preferred to stratify the usage of the stickers for targeted groups, such as students and new radiographers under supervision, radiographers with recent laterality errors and cases involving multiple examinations with different sides ordered.

Outcome



Run chart shows a downward trend on the incidence of laterality and no incidents were recorded in 2022

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Antipsychotics

2

To improve detection and timely intervention of drug-induced extrapyramidal side-effects (EPSE) for inpatients on antipsychotics by screening all eligible patients at Institute of Mental Health (IMH) using EPSE assessment tools.

Detection

EPSE may occur during treatment with antipsychotics. The Mental Health Trigger Tool study (2014) showed that Adverse Drug Events (ADEs) constituted 60% (67 out of 110 incidents) of all Adverse Events (AEs) identified in IMH inpatients. Over 56% (38 incidents) of these ADEs were EPSE related to antipsychotics. The NHG AE study conducted in 2016 also reported that about 50% of outpatient drug-related injuries at IMH were EPSE related.

Analysis

In 2018, a nurse-led prevalence study in IMH acute psychiatric wards showed that 30.5% of patients on antipsychotics experienced EPSE, of which 7.9% of patients had moderate to severe symptoms. In 2021, our team also identified EPSEs in 24% of patients being assessed.

Some antipsychotics can cause EPSE that are as distressful as the psychotic symptoms they are meant to treat. These EPSE not only have a negative impact on patients' quality of life but may also lead to poor compliance to prescribed medications, ultimately leading to poor treatment outcomes. This underpins the importance of early detection and treatment of EPSE.

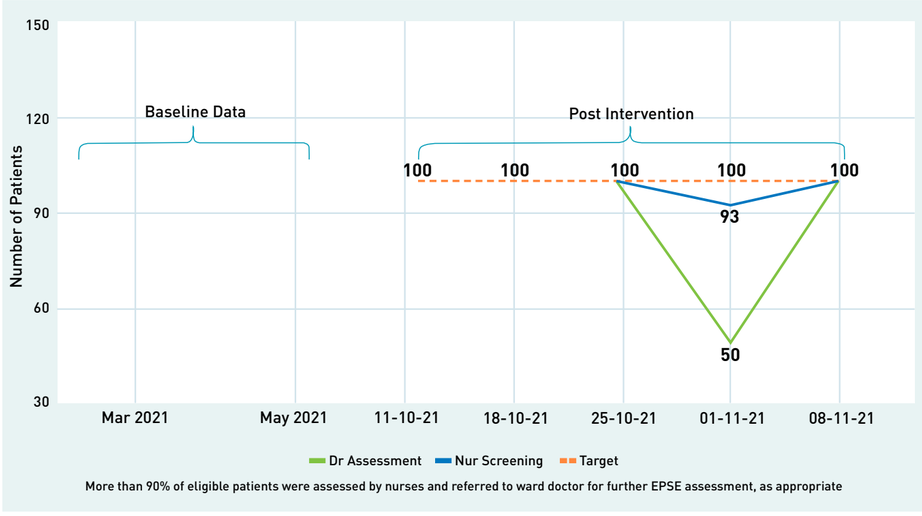
Improvement

1. In response to a lack of standardised assessment methods and work processes for EPSE assessment (although there were widely used EPSE assessment tools, these were too cumbersome for routine use in the wards), our team designed a validated tool for the hospital to use. Our tool consisted of a 6-item nurse's assessment scale, with an 8-item doctor's assessment scale. This tool allowed early detection and intervention of EPSE by guiding nurses in flagging up any of the six positive triggers on our scale.
2. A work process for EPSE assessment was created to guide nurses on when and how to assess EPSE, with follow-up action from the ward doctor. Our team carefully considered the frequency and timing for EPSE assessment by nurses so that it was not too overwhelming on top of existing patient care activities.
3. EPSE assessment training materials with practical sessions were developed and implemented for equipping nurses to perform EPSE assessment. Ward APN also conducted follow-up training sessions to maintain nurses' competency on EPSE assessment.
4. To increase patients' and family's awareness about antipsychotic-induced EPSE and how to seek help, a short educational video was produced for their viewing at the patient's activity area.

Outcome

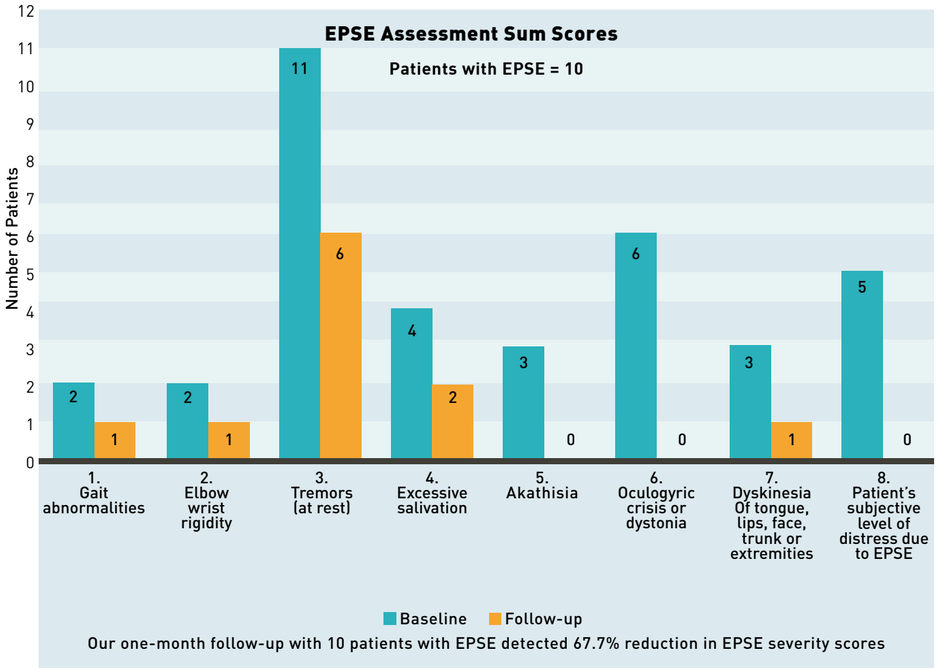
- Reduced patient harm and psychological distress experienced by patients
- Improved patient's medication compliance, thereby reducing the chance of a relapse and readmission
- Improved patient's quality of life
- Increased patient and family satisfaction, and staff job satisfaction too
- Reduced length of stay and costs of care; improved overall quality of life for the patient

Audit was carried out by ward APN fortnightly and any gaps identified were discussed with relevant team members with a view to improving the process further.



More than 90% of eligible patients were assessed by nurses and referred to ward doctor for further EPSE assessment, as appropriate

Outcome



Our one-month follow-up with 10 patients with EPSE detected 67.7% reduction in EPSE severity scores

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Biologics

3

To reduce medication errors (actual and near misses) involving biologics at the National Skin Centre (NSC) to zero by Dec 2023.

Detection

NSC stocks eight types of biologics for treatment of skin conditions. Each has its unique dosing regimen. Some come with a patient assistance programme, and additional administrative work for pharmacy staff during prescription processing. The complexity involved in processing a biologic prescription makes the process highly prone to medication errors.

NSC has been working to reduce such errors since 2019. A spike in actual errors had prompted the team to conduct a root cause analysis (RCA) and enact some interventions. The number of biologic errors remained at zero for about a year. However, in Feb 2021, one error occurred, indicating that existing safeguards may not be sufficient.

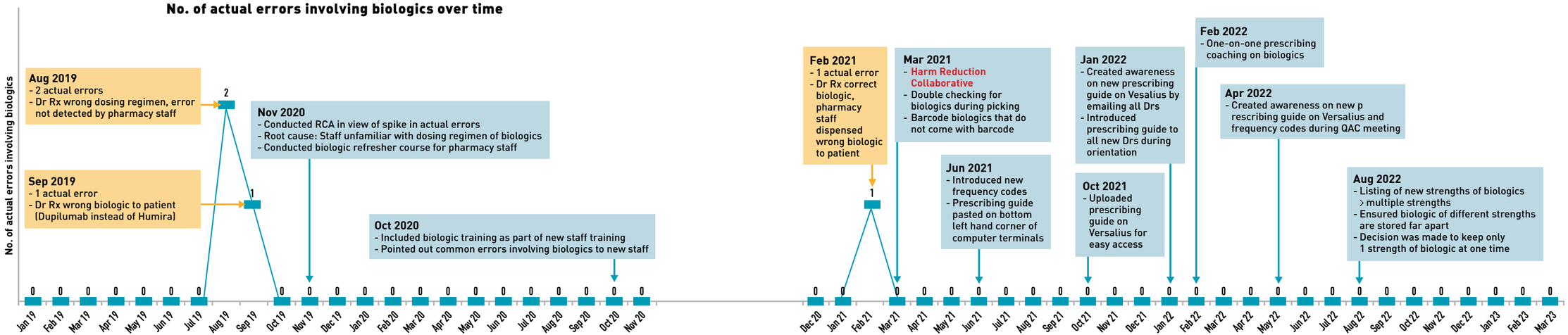
Analysis & Improvement

With the launch of the NHG Harm Reduction Collaborative, we took the opportunity to reconvene in 2021. This enabled us to revisit the issue and deal with it in a systemic fashion, as follows:

Problem	Intervention
Staff picks the wrong biologic.	Implemented the requirement of 2 independent checkers during verification process.
Biologics do not come with barcode on product packaging; hence, staff were unable to do barcode verification.	Barcoded all biologics. Task focused team to investigate barcoding all new drugs that do not come with barcode.
There were limited prescribing frequencies in Vesalius. With more biologics on board and with varying administration frequencies, there is a need to activate more prescribing frequencies in Vesalius.	Introduced new prescribing frequency codes.
Doctors tend to order biologics on a per vial basis instead of in milligrams.	Pasted prescribing guide at bottom left-hand corner of computer terminals of H clinic.
Limited accessibility of prescribing guide (was only found in H clinic).	Uploaded prescribing guide onto Vesalius for easy access by doctors; included detailed instructions on how to order biologics with correct frequency and dose in the system.
Some doctors are not aware of the new prescribing guide on Vesalius.	Created awareness by emailing doctors the new prescribing guide; introduced prescribing guide to all new doctors during orientation.
Prescribing near miss trends showed that a few doctors were making mistakes repeatedly.	Implemented one-on-one coaching on prescribing biologics.

Outcome

Since Mar 2021, the number of actual errors involving biologics has remained at zero.



Through a series of eight interventions implemented from Mar 2021 to Apr 2022, the team achieved the aim of reducing medication errors involving biologics to zero.

The positive results achieved could be due to a combination of factors:

- Scope is well-defined, enabling focus and ease of tracking.
- Interventions are kept simple, thus facilitating implementation and sustainability.
- Processes are systematised; all who are involved know the do's and don'ts.

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Insulin

4

To reduce the number of actual medication events related to insulin by 50% over two years at Woodlands Health (WH) pre-operative wards.

Detection

Our improvement team selected this topic because insulin is the highest reported high alert medication in our incident reporting repository.

Analysis & Improvement

We performed a deep dive analysis of all insulin-related medication events reported at WH preoperative wards from May 2018 to Dec 2020 to understand the underlying problems. The information gathered from previous root cause analyses of the incident reports may not be complete, but some interesting inferences could be derived. Based on these and local experience, our team created a new driver diagram and using a Pick Chart prioritised the change ideas for implementation.

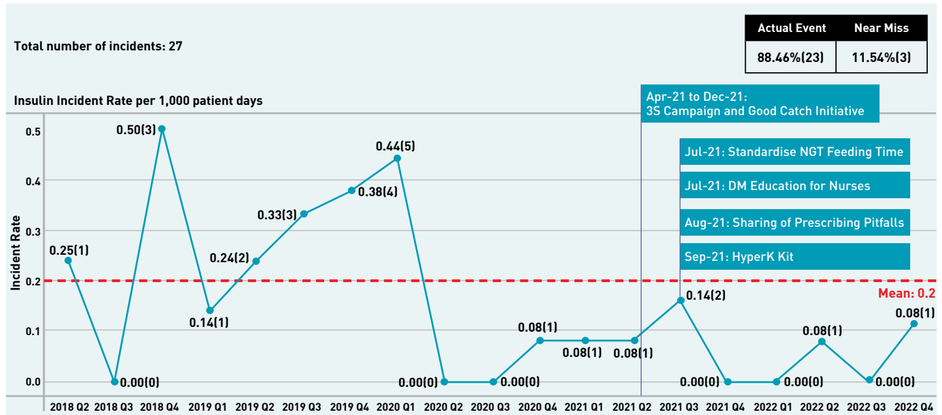
Change concept	Key Change
Culture of safety and improvement	Rally everybody behind this cause through the 3S Campaign – See it, say it, solve it! • Speak up for safety training – to speak up and respond appropriately • Good catch initiative • Publicity videos and engagement sessions • Leaders provide a safe environment for staff to speak up
Workflow and practices	Use hyperkalaemia kit to reduce insulin errors related to the treatment of hyperkalaemia.
	Standardise the timing of nasogastric tube feeding for diabetic patients across the four preoperative wards.
Staff knowledge and competency	Educate doctors on safe prescribing practices.
	Collaboratively review diabetic mellitus (DM) training for nurses by the medication safety committee and nursing educators. Insulin-related medication events were regularly shared with the nursing educators to include in the nurses' DM training. The course aims to equip nurses with awareness to identify lapses in insulin orders and clarify misconceptions about DM management.
Good teamwork and coordination	Communicate all new, amended, and discontinued insulin orders or any doubts via phone calls or face-to-face between nurses and doctors. A survey on doctors-nurses communication on medication ordering was conducted to understand and gather information about communication issues on the ground. Our improvement team will review the insulin cases related to miscommunication issues and discuss the possible mitigation strategies to improve communication between nurses and doctors.

Outcome

Since the implementation of the improvement initiatives, the insulin incident rate at WH preoperative wards was kept below 0.2 per 1000 patient days.

The outcomes of the individual projects:

i) Hyperkalaemia kit - There was no insulin error related to hyperkalaemia treatment since the implementation of the pilot project.
ii) Safe prescribing education for doctors – Reduction of pharmacist interventions considered prescribing near misses from 46% to 29% over one year after education sharing with doctors.
iii) Diabetes mellitus nursing training – 53% of nurses have completed the course.
iv) "Say it – Let's speak up for patient safety" course was launched on e-learn in Apr 2023 to train staff to speak up for patient safety using the CUS tool.



The impact of the initiatives on insulin incident rate at WH preoperative wards

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MERP Cat D Parenteral Opioids

5

To reduce serious parenteral opioid errors at Yishun Health by 50% over three years.

Detection

In 2020 and 2021, Yishun Health's Medication Safety Committee noted an uptick in the number of errors involving opioids. Six out of seven MERP D errors involved parenteral opioids. A decision was made to investigate this.

Analysis

Root cause analyses (RCA) for these six errors that occurred in 2020 found these were resulted from human factors and failure to perform independent counterchecks.

On further analysis of error patterns, we found that the errors involving nursing staff usually occurred in the ICU and General Ward and were due to erroneous programming of the infusion pump and issues with the pump-human interface. A majority of the errors involving medical staff were by junior doctors working in the Emergency Department, which often arose during the process of diluting and administering bolus parenteral opioids.

Improvement

Table 1 summarises the key drivers that targeted areas with the highest Risk Priority Number (RPN) scores.

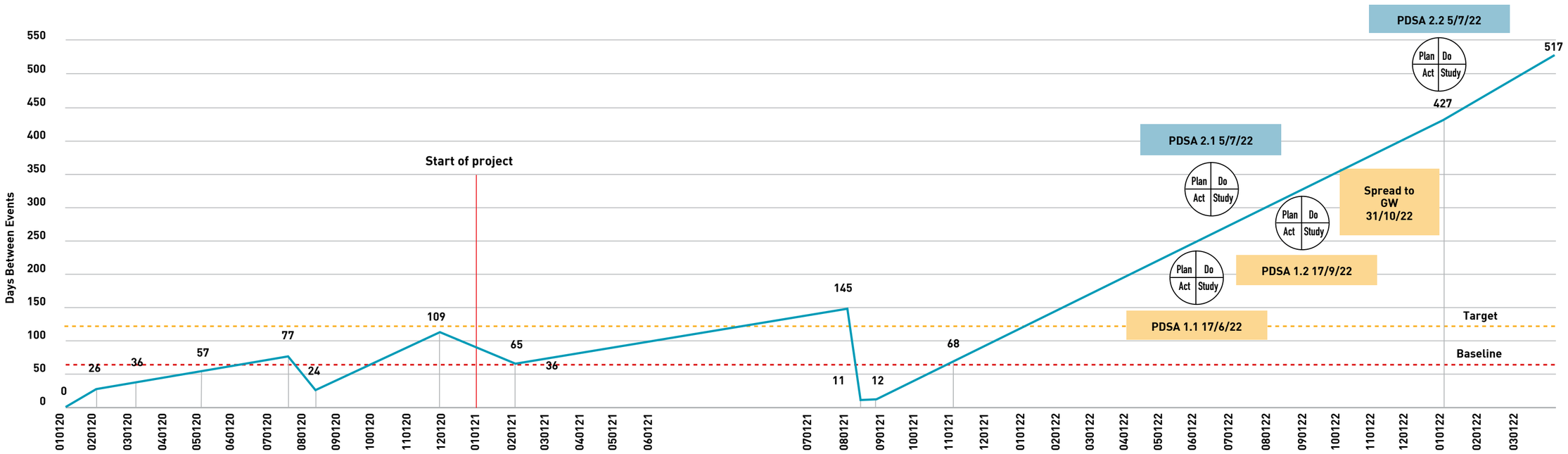
Aim	Primary Drivers	Secondary Drivers
To reduce MERP D parenteral opioid errors by 50% over three years	Highly trained staff who are competent in handling opioids	Develop robust training programme.
	Highly reliable work processes with safeguards to govern the use of opioids	Conduct independent double checking prior to administration; ensure closed loop medication management; ensure patient assessment and physical checks are done; build in safety measures/error detection into IT system for prescribing and administration; limit prescribing of IV and infusion opioids to trained personnel.
	Effective teamwork and communication between staff	Ensure a robust and effective handover process; avoid verbal orders where possible and perform readback if conditions do not allow immediate transcription of verbal order.
	Safe working environment	Reduce distractions during medication administration; ensure effective staffing and rostering; review workload distribution.
	Organisation culture that promotes safety	Demonstrate strong leadership for safety culture; empower middle management to create the conditions for psychological safety; promote staff engagement.

Improvement

Table 2: The results and interventions from FMEA covering the process of parenteral opioid usage from the point of prescription to administration and monitoring.

Process steps with highest RPN scores on FMEA	Interventions	Primary Driver
Administration by nurse Co-signer to verify that pump settings on pump display are correct. After syringe is loaded, nurse selects the correct drug and dosage in the pump's drug library. After the selection, nurse returns to the pump menu to select VTBI (Volume to be infused) setting to enter VTBI information.	Nurses to countersign on drug label after counterchecking on pump settings	Highly reliable work processes with safeguards to govern the use of opioids
Administration by doctor Doctor dilutes opioid and administers the correct volume of drug to patient. Doctor to label syringe if medication is not immediately administered.	Didactic and hands-on teaching with competency assessment for administration of bolus IV opioids for ED junior doctors	Highly trained staff who are competent in handling opioids

Outcome



Errors reduced from six in both 2020 and 2021 to zero in 2022. The average number of days between events increased: 2020 (55), 2021 (56), and 2022 (427)

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Medications Requiring Special Precaution (MRSP)

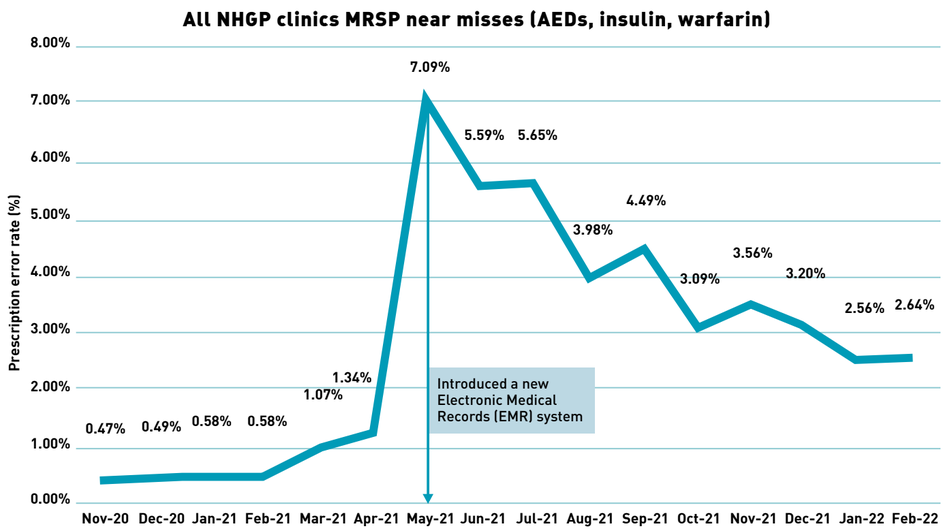
6

To reduce the prescription error rate of MRSP drugs in NHG Polyclinics (NHGP) from 4.1% to below 0.1% in two years.

Detection

NHGP introduced a new Electronic Medical Records (EMR) system in May 2021. There have been reports of increased near misses, or pharmacy interventions, as prescribers were facing new user interfaces and different ordering methods. This problem was also seen when prescribing MRSP drugs, which have a narrow therapeutic index with potential medication harm.

We focused our attention on the MRSP drugs that contributed to the nine prescribing medication errors in 2021. These were anti-epileptics (AEDs), insulin and warfarin. We believed that interventions targeted at MRSP drugs would also impact the overall prescribing error rates.



Analysis

To understand the problem, we focused on one clinic (Geylang Polyclinic) and analysed the iVENT pharmacy MRSP drug reports. We found 77% of MRSP-related pharmacy interventions were due to:
1. Combination dose prescription (e.g., Novomix 16U am, 20U pm)
2. Transcription error (i.e., different healthcare practices)
3. Drug-drug interactions

From our fishbone diagram, the root causes identified included:
- No automated system in place for medication reconciliation services
- Cluttered view on EMR
- National Health Record (NEHR) not checked
- Multiple tasks on patients
- Different formulation of insulin and AEDs

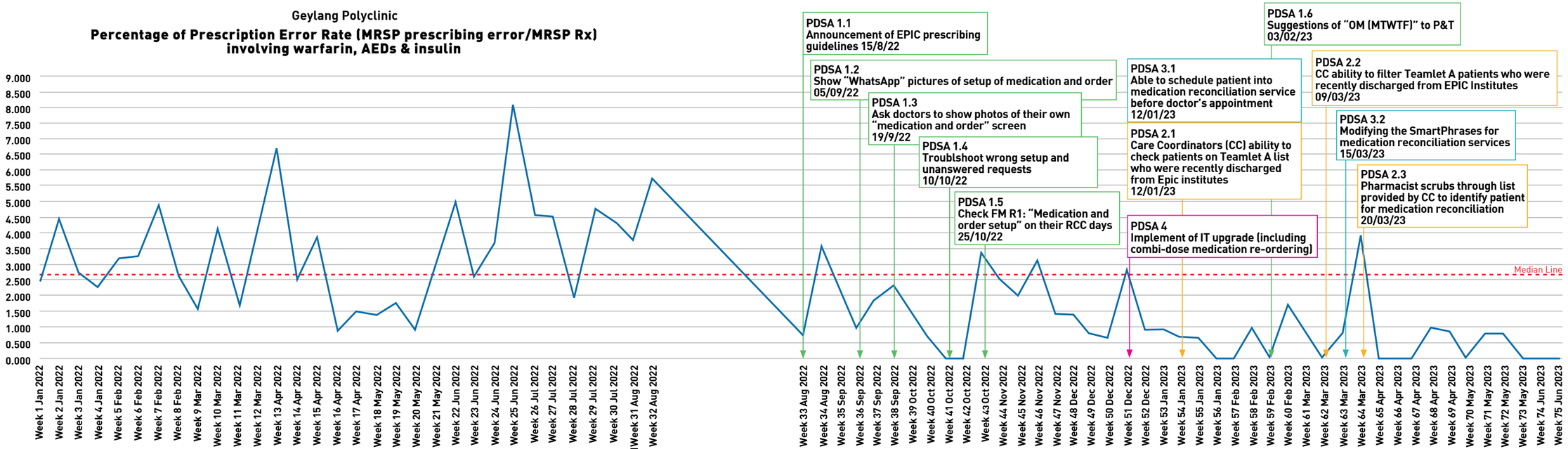
Improvement

We researched published literature used by other healthcare services for ideas on suitable interventions. We then employed an impact feasibility matrix to prioritise interventions (change concepts) to be adopted.

Change concept	Key Change
IT enhancements	Allowing multiple medication selection including medications with combination doses when reordering.
	Improving visibility of medication frequencies, especially with medications that have different doses on different days of the week.
Reduce EMR cluttering	Reducing clutter so that prescribers could view their prescriptions more clearly, enabling them to check their prescription, thus reducing errors.
Identification of suitable cases for medication reconciliation	Selecting patients for pharmacy-led services, especially those with MRSP drugs, to reduce the cognitive load on doctors as post-discharge/step down consults can involve multiple issues and increase the time needed for the consult.
Create a workflow of medication reconciliation services in patients with MRSP medications	Providing pharmacy-led services to review any changes as well as compliance with medications prior to the prescribers' consult.

Outcome

We recorded the number of prescribing errors caught by the pharmacy. The interventions, as shown in the run chart, have resulted in a decrease in prescribing errors.



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Team-Based Approach to Polypharmacy

7

To identify patients at risk of medication-related problems and support their medication management across multiple touchpoints (Tan Tock Seng Hospital and Toa Payoh Polyclinic) to achieve better clinical outcomes and reduce healthcare utilisation.

Detection

Patients on complex medicine regimes and who travel across multiple healthcare settings are at high risk of inappropriate medication use, polypharmacy, and poor medication adherence. A 2019 report showed a 14.5% prevalence rate of polypharmacy among older adults in community, with nearly one-third having adherence issues.[1] Such issues often lead to readmissions and increased healthcare costs.[2,3] In a 2013 study, a significant reduction in medication-related hospital admissions was observed when patients with five or more diseases received regular pharmacist reviews.[4] The medication plans outlined were collaboratively discussed with the patient's physician as part of a care team.

Analysis

Our team, PopMed, developed a model of person-centred medication-related problem resolution featuring a multidisciplinary team-based approach. The aim was to utilise this approach in medication-related support interventions to reduce the number of visits (especially unplanned admissions) to public healthcare institution (PHI).

A 1:1 prospective case-control study over three years was conducted. Eligible participants were patients from TTSH who were being followed up at multiple specialist clinics and Toa Payoh Polyclinic from Aug 2019 to Dec 2022 and who were identified as high-risk.

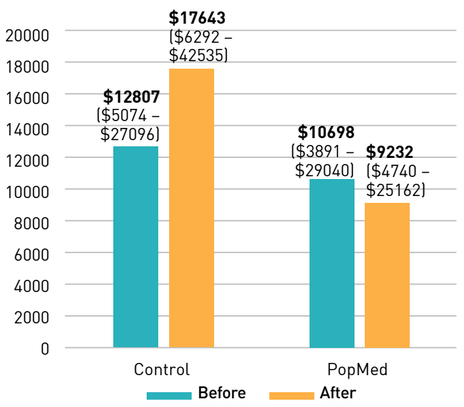
Improvement

This takes the form of pharmacist-run pre-consultation medication reviews (MR) scheduled at least twice every six months, where patients were coached on self-efficacy and their medication therapy was optimised through shared-decision making. Follow-up notes on medication management were communicated to the consulting physician after the session. Patients with no further medication-related problems at two consecutive MRs were discharged. The control group (patients who did not participate in the study) were managed according to the standard care pathways.

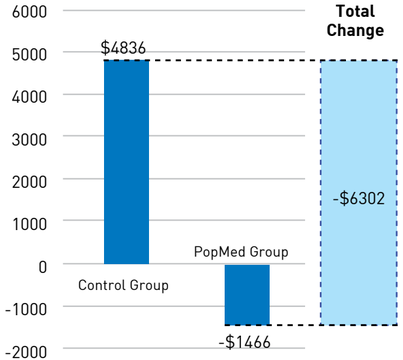
Change concepts that informed interventions		
From:		
Multiple prescriptions from multiple doctors	Episodic counselling during dispensing encounters	Episodic prescription review and interventions
To:		
One **consolidated** source of truth for medications (Patient Medication List)	**Collaborative** approach between patient, doctor and pharmacist to achieve desired health outcomes	**Relationship-based** coaching to achieve goals patient activation and shared decision making
Medication List that flows with Patient Leverage on the National Electronic Health Records & HealthHub to share medication information for follow-ups	**Shared Decision Making** Proposed care plans and interventions are done only with agreement of both doctors and patients	**Leverage on PROMs** Patient-Reported Outcome Measures (PROMs) prompt what adherence barriers patients have towards their medications
Medication Optimisation Reviews are done to ensure safe and effective medication use and to simplify medication regimen	**Appraise Need for Support** Holistic care of the patient is needed and issues beyond medications will require follow-up with other professionals (e.g. Medical Social Workers, community care partners)	**Med Management Tools** Sharing how to use med reminders, pill cutters and self-monitoring tips can shift patients towards self-management of their meds

Outcome

At the time of writing, 187 patients had completed six months' follow-up within study period of which 134 were successfully matched to controls who did not receive PopMed. Total change in median healthcare cost was significantly lower when compared to control. The estimated benefit was 3.6 times the cost of the programme despite similar median age, median Charlson Comorbidity Index (CCI) score and median PHI visits of controls and cases.



Median PHI utilisation one year before and after enrolment



Δ Healthcare Cost = 134 x $6,302 = $844,468
Compared with programme cost of $232,875, the amount saved is 3.6 times higher (i.e. $844,468/$232,875)

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References

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4. AJ Leendertse, et. al. Preventing hospital admissions by reviewing medication (PHARM) in primary care: an open controlled study in an elderly population. Journal of Clinical Pharmacy and Therapeutics, 38: 379-387. https://doi.org/10.1111/jcpt.12069

Catheter-Associated Urinary Tract Infection (CAUTI)

8

To reduce CAUTI rate per 1000 catheter days by 15% over one year following intervention with TOC protocol in Yishun Community Hospital (YCH) wards.

Detection

YCH CAUTI rate was high when benchmarked against MOH's All Community Hospitals' Annual Average CAUTI rate.

Analysis

The team conducted a background survey and research and noted two main contributing factors:

- Staff knowledge on the appropriate indications for continuing urinary indwelling catheter (IDC), assessed from a pre-quiz, was low at 42%.
- 52% of patients admitted to the three pilot wards with an IDC had failed catheter removal/trial-off-catheter (TOC) at least once previously in acute hospital setting.

We hypothesised that a standardised TOC protocol would reduce catheter utilisation and thus prevent/reduce CAUTI in a community hospital setting.

Improvement

We instituted key changes which were informed by these x'change concepts:

Change Concept	Key Change
• Improve workflow • Focus on variation	IDC review board and TOC protocol were created to address the need for a structured and standardised process in reviewing appropriateness to continue/remove IDC. Both the protocol and review board were created based on literature reviews and consultation with various stakeholders. Multiple PDSA cycles were used during the design phase.

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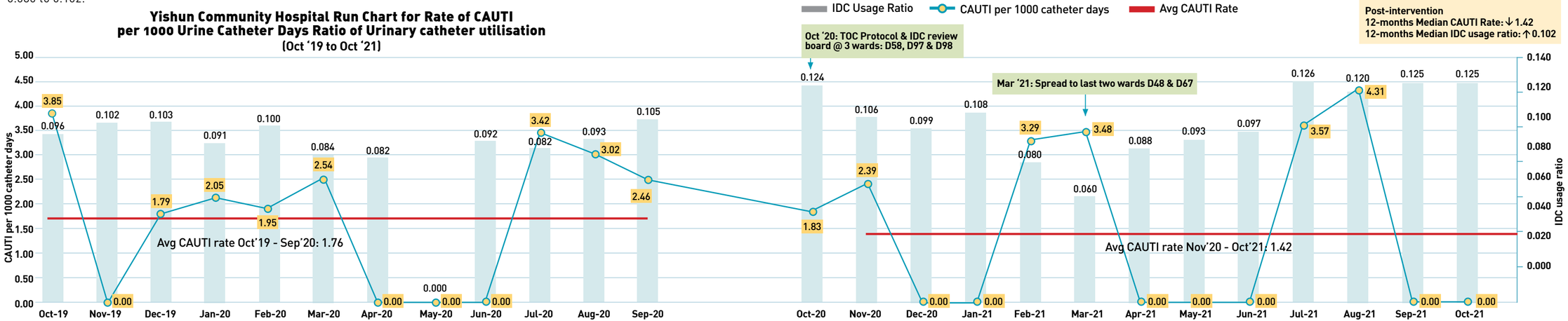
Outcome

The project achieved its aim. The post-intervention 12-months average CAUTI rate (per 1000 catheter days) decreased by 19% from 1.76 to 1.42. This was despite an 18% increase in post-intervention 12-months average IDC usage ratio, from 0.086 to 0.102.



Central Line-Associated Bloodstream Infections (CLABSI)

9

To reduce the combined ICU Central Line Associated Bloodstream Infection (CLABSI) rate at Tan Tock Seng Hospital (TTSH) by 50% in three years.

Detection

CLABSI is a longstanding concern in all ICUs. In 2019 to 2020, we realised that with the changes implemented in the earlier years (such as use of full body drape, full cap, gown, mask and sterile ultrasound probe sleeve), maintaining good infection prevention practices consistently is a challenge due to the frequent rotation of junior doctors and onboarding of new nurses. The Medical ICU had the highest number of cases; hence, this became the pilot site.

Analysis

A survey was conducted among doctors and nurses as understanding their knowledge, attitudes and beliefs were pivotal to the mindset and behavioural change needed for improvement.

Five types of gaps were identified: Insufficient CLABSI data sharing and dissemination; variability in practice of full barrier precaution; lack of proper practice when reattempting new site; lack of prompt to review Central Venous Line (CVL); lack of standardisation in the use of disinfection cap.

Improvement

A site-specific change package was developed based on the findings, learning from best practices guidelines and current evidence, as follows:

SN	Cause	Interventions
1	Insufficient CLABSI data sharing and dissemination	CLABSI Dashboard STOP CLABSI Poster CVC PPE Poster
2	Variability in practice of full barrier precaution	
3	Lack of practice to place waterproof sheet	Placing a sterile towel (waterproof) below the dressing set and over the trolley surface
4	Variability in choice of insertion site	CVC insertion and maintenance audit
5	Lack of proper practice when reattempting new site	
6	Lack of prompt to review CVL	Nursing reminder when CVC is present for → 14 days Monthly data on central line duration → 14 days
7	Poor skin condition	Octenisan wipes

Outcome

With feedback, improvements in practice were seen. Regular audit findings were communicated to the ICU team. Areas of gaps and challenges were raised to the team for learning purposes.

MICU Central Line Insertion Audit Results in Year 2022

SN	Areas Audited	C1 (3)* (Feb 16-17)	C2 (2) (Feb 21-24)	C3 (3) (Apr 6-11)
1	Environmental preparation	☺	☺	😐
2	Patient preparation	☺	☺	☺
3	Personnel preparation - assistant	☺	☹	☺
4	Personnel preparation - procedurist	☺	☺	☺
5	Equipment preparation	☺	☺	☺
6	Insertion site sterile field preparation	☺	☺	☺
7	Ultrasound probe preparation	☹	☹	☺
8	Catheter set preparation	☺	☺	☺
9	Insertion of catheter	☺	☺	☺
10	Optimal catheter type and catheter site selection	☺	☺	☺
11	Post insertion care	☺	☹	☺

Challenging Area
- Difficulty access to back of bed

Gaps Identified:
- Assistants should remember to wear caps during the procedure
- Ultrasound probe and cable should be cleaned with wipes before CVP insertion
- Undrape patient without contamination of insertion site

* Each cycle annotates audit cycle number (number of audit forms received) (audit cycle period)

☺ means area containing only Yes or NA

☹ means at least one NO for the area, except antimicrobial-coated catheter used

😐 means challenging area

To track the CLABSI rate in a more engaging way, we monitored inter-event days. There was a prolonged period from Feb to Jul 2022 where there were no CLABSI events; we celebrated. Morale was kept up through constant encouragement and reminders of good infection control practice when more cases came. We learnt that it takes consistent good effort to reduce infections. The interventions were implemented in the other units with encouraging results.

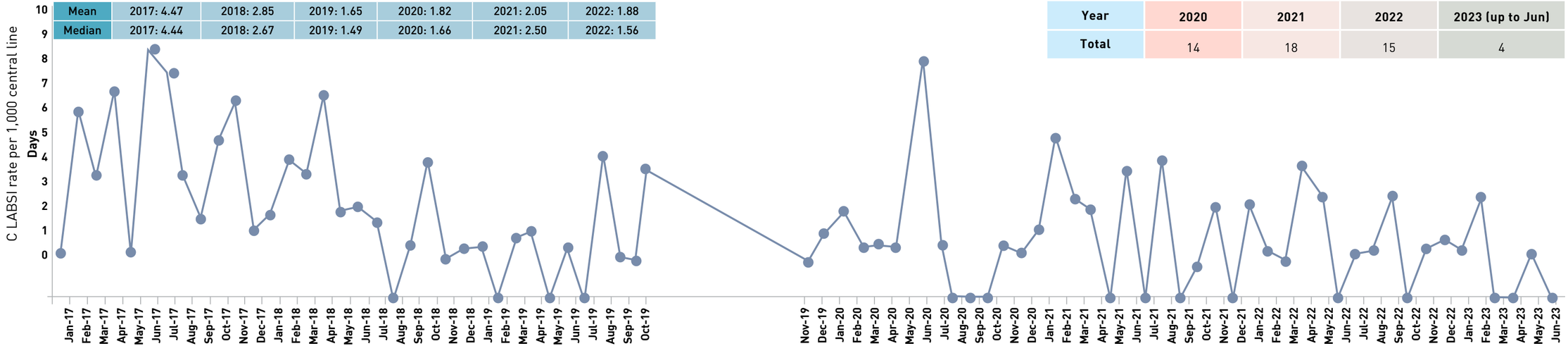
Outcome

With feedback, improvements in practice were seen. Regular audit findings were communicated to the ICU team. Areas of gaps and challenges were raised to the team for learning purposes.

Hospital CLABSI Infections

Mean	2017: 4.47	2018: 2.85	2019: 1.65	2020: 1.82	2021: 2.05	2022: 1.88
Median	2017: 4.44	2018: 2.67	2019: 1.49	2020: 1.66	2021: 2.50	2022: 1.56

Year	2020	2021	2022	2023 (up to Jun)
Total	14	18	15	4



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10. Methycillin-Resistant Staphylococcus Aureus (MRSA)

The problem

Methicillin-resistant Staphylococcus aureus (MRSA) colonisation prevalence for inpatients has been rising steadily since 2016 after initially dropping in the period 2010-2015. While about 5-6% of patients were colonised with MRSA previously, the figure is now approaching 11.4%. Similarly, Hospital Onset (HO) - MRSA infection and bacteraemia rates showed a steady decline until around 2016-2017 from which the rates have been rising slowly but steadily. The absolute numbers have shown a similar steady decline from 2010 to 2016 but from 2017, have gone up more steeply than the rates, owing to an addition of 200 acute care beds from YCH.

The context

The likely reasons for the initial decline followed by a slow but steady rise will be discussed shortly. But first, we note some positive developments. Hand hygiene compliance has steadily improved and is now around 90% and does not appear to be an issue. The standard use and adherence to "bundles" is good and is not likely to be a contributor. We have safety bundles for central line insertion and maintenance, urinary catheter insertion and maintenance and endotracheal intubation and maintenance.

Several pressing issues exist:

1. Severe overcrowding in ED, a contributor of cross-transmission of MRSA and is very difficult to control.
2. Sharing of common toilets in four and five-bed cubicles, another source of cross-transmission not only for MRSA but other multidrug-resistant organisms (MDRO).
3. Increasing MRSA resistance to Chlorhexidine gluconate (CHG), rendering daily CHG baths ineffective for MRSA carriers. Testing of MRSA isolates at SGH revealed that by 2017, over 42% had developed resistance to Chlorhexidine. It is likely that we are experiencing a similar phenomenon at KTPH and that our strategy of administering daily Chlorhexidine baths to high-risk patients may be losing its previous documented effectiveness. In 2015, our infection control team published the data from 2011-2013 which showed that daily Chlorhexidine baths given to patients who screened positive for MRSA on a standard admission swab resulted in a major risk reduction of HO-MRSA infection during their hospital stay (OR for HO-MRSA Infection was 0.129; P = 0.0001).
4. Increase in the number of acute care beds. Since 2016, we have added six D-Tower wards (204 extra beds), taking us from 600 to 800 beds, corresponding to a 1/3 increase. Hence, we should expect to see higher absolute numbers with MRSA carriage and infection (but not necessarily higher rates).
5. Patient profile consisting of many frail, elderly patients, many dialysis patients and many patients with multiple serious co-morbidities. These cases have prolonged LOS and frequent re-admissions and are at very high risk for MRSA colonisation.

The Charlson Comorbidity Index (CCI) is easily tracked by computer. It serves as a surrogate for identifying high-risk patients. The higher the CCI, the more likely the patient has significant risk factors for MRSA colonisation and MRSA infection. These risk factors include dialysis, central line placement, significant skin diseases, wounds, ulcers, gangrene, prolonged LOS and multiple admissions.

Charlson Comorbidity Index
(Mortality Predictor)

Comorbidities and their relative risk

Age:	+1	+2	+3	6+
<50 = 0 50-59 = +1 60-60 = +2 70-79 = +3 >80 = +4	MI CCF PVD Stroke Dementia COPD CTD PUD DM Liver	CKD Mod-Severe Hemiplegia DM with end-organ damage Localised Cancer Leukaemia, Lymphoma	LiverDx. Mod-Severe	AIDS Met.CA

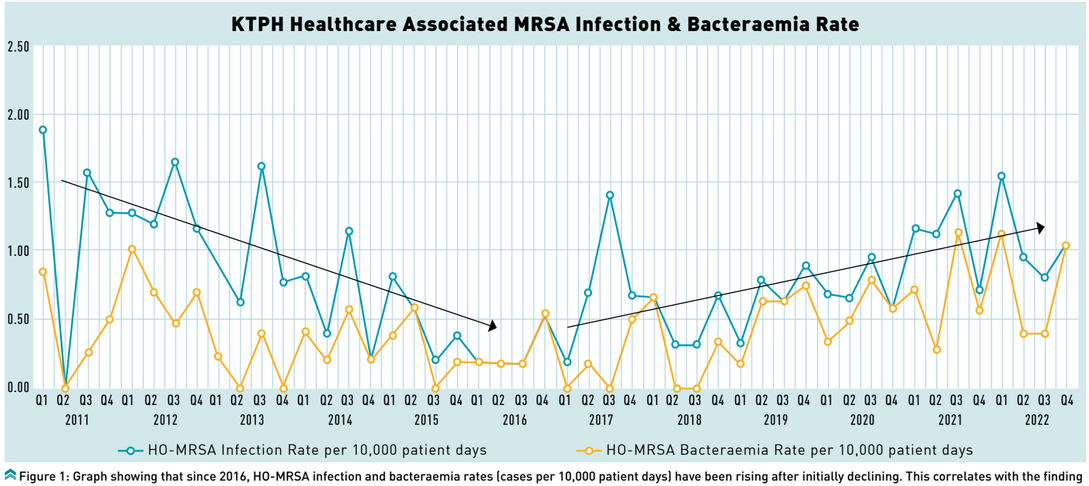


Figure 1: Graph showing that since 2016, HO-MRSA infection and bacteraemia rates (cases per 10,000 patient days) have been rising after initially declining. This correlates with the finding of increasing Chlorhexidine resistance at SGH. We would expect a lag in the resistance at KTPH, a new hospital.

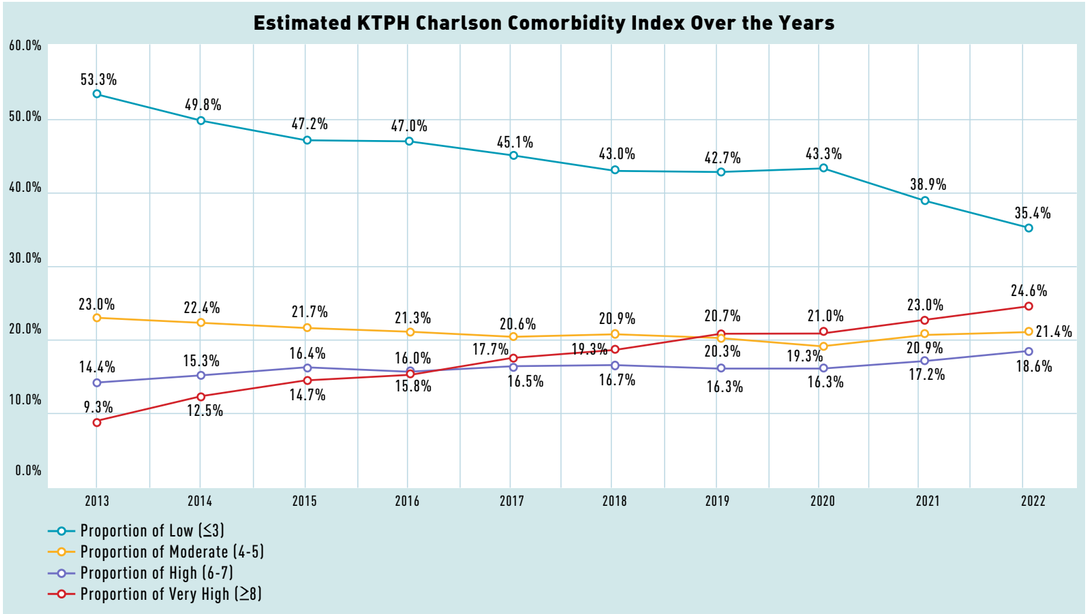


Figure 2: Low-risk cases (53.3%=>35.4%) are steadily being replaced by very high-risk cases (9.3% => 24.6%)

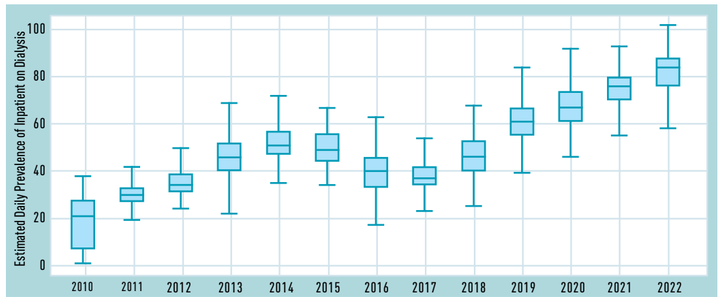


Figure 3: Estimated daily prevalence (median & IQR) of dialysed patients (includes ICU cases and Renal Centre)

The point is that we need to put things in perspective. Over the years, our high-risk patient population has steadily increased. The proportion of our patients in the high-risk or very high-risk categories is very substantial. This means that our denominator has changed. To have a meaningful comparison with previous years, we would need to account for this. Without a correction factor being applied, we would be at risk of making false and unfair comparisons. With it, we are likely to discover that our MRSA bacteraemia rates are stable and can be considered good.

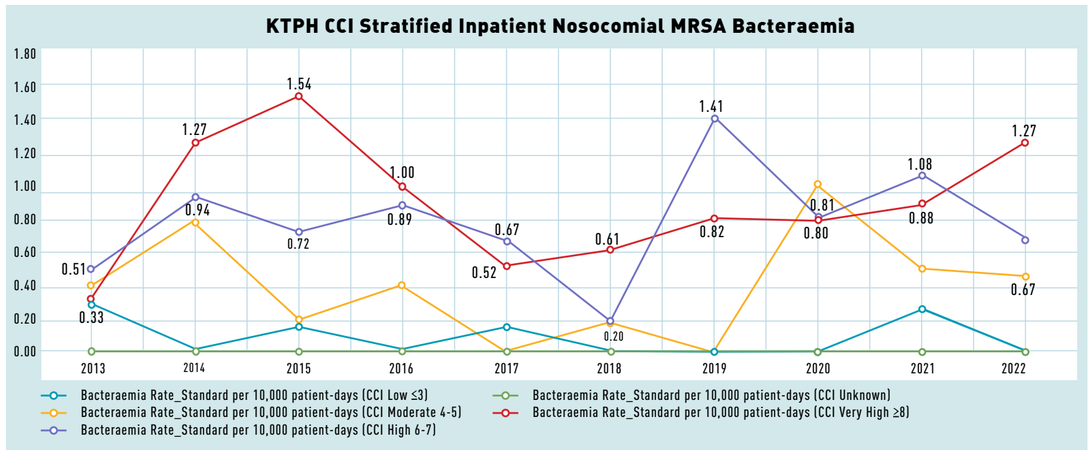


Figure 4: Mean rate (x / 10,000 patient days) of MRSA bacteraemia based on CCI score category

Very high-risk cases (CCI ≥8) occur with a mean rate of: **0.97 (24.6% of patients)**
High-risk cases (CCI 6-7) occur with a mean rate of: **0.82 (18% of patients)**
Moderate-risk cases (CCI 4-5) occur with a mean rate of: **0.40 (22% of patients)**
Low-risk cases (CCI ≤3) occur with a mean rate of: **0.06 (35.4% of patients)**

Note the following:

1. 42.6% (24.6 + 18) of our patient load now consist of high and very high-risk patients
2. Very high-risk cases are **16.2X** (0.97/0.06) more likely to develop MRSA bacteraemia
3. High-risk cases are **13.7X** (0.82/0.06) more likely to develop MRSA bacteraemia
4. Moderate risk cases are **6.7X** (0.40/0.06) more likely to develop MRSA bacteraemia

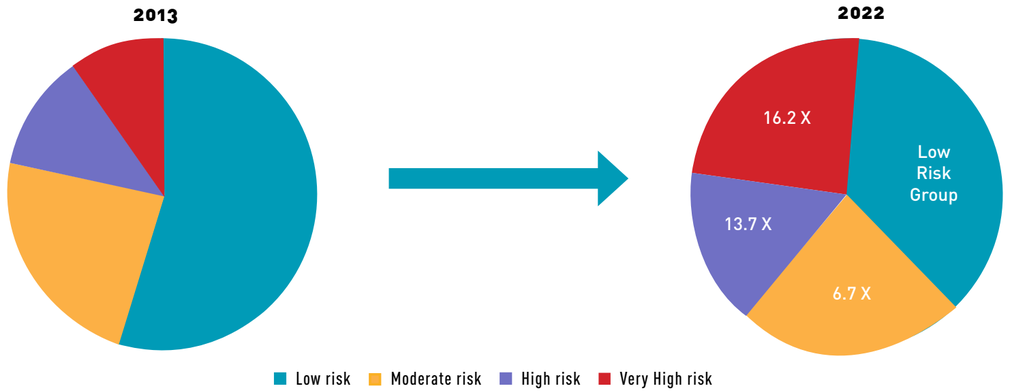


Figure 5: Risk of HO-MRSA infection
Our denominator (10,000 patient days) has changed progressively and markedly over the past 10 years

We have studied our MRSA bacteraemia data carefully with the help of our Clinical Informatics Team (Dr Lin Yi). We have been able to calculate the following important information regarding the rates of infection (cases per 10,000 patient days). For each risk category in Figure 4, the 10,000 patient days used in each calculation consists of only patients in that risk category. In other words, the denominator (10,000 patient days) used in the calculation does not consist of a mixture of risk categories.

Intervention

Initiative 1: Use Octenidine (Octenisan) instead of CHG daily baths in selected patients

Octenidine has been used in Europe since 1987 but was only introduced into Singapore around 2010. So far, MRSA strains have not developed clinical resistance to Octenidine, although in-vitro testing suggests this may eventually become an issue[2]. On the other hand, Chlorhexidine has been in use worldwide since the 1950s and significant MRSA resistance has developed. Octenidine is about 10 times more potent than Chlorhexidine. It is tempting to simply make a universal switch from Chlorhexidine to Octenidine. However, what happened with Chlorhexidine would eventually happen with Octenidine.

Another possible approach would be to rotate usage of these two agents every few years. Although this seems an attractive idea, one must bear in mind that once bacteria have acquired a resistance gene, they do not easily shed that gene. Hence, re-emergence of resistance would occur very quickly. Hence, our infection control team have opted for using Octenidine in a limited manner for high-risk patients, while continuing to use Chlorhexidine where indicated in other patients. We use a hybrid approach - we have selected three high-risk wards for universal use of Octenidine; for all other wards, the patients deemed to be at high risk are selected for Octenidine use. The purpose of this hybrid approach is to allow us to easily track the outcomes of wards where Octenidine use is universal. At the same time, high-risk cases on other wards are not denied the potential benefit of Octenidine. The wards with the highest occurrences of HO-MRSA Infection from 2016 – Sep 2021 are:

- 13 cases – Ward B96 (Renal, GM)
- 10 cases – Ward B85 (GS/Ortho)
- 8 cases – Ward B106 (HFU/GS/Ortho)
- 6 cases – Ward A72
- 5 cases – Ward B76, Ward B86, Ward B95, Ward B105

Based on this track record, we implemented this strategy for Renal Ward B96 in mid-Apr 2021 and Wards B85 and B106 from Sep 2021. As these are high-risk wards, we changed all patients to daily Octenisan baths. We no longer used Chlorhexidine baths. And here's what happened:

Ward B96 (Renal)
- 13 infections in 63 months (2016 => Apr 2023) = 0.206 infections per month.
- 3 bacteraemia cases in 24 months (Apr 2021 =>Apr 2023) = 0.125 infections per month.

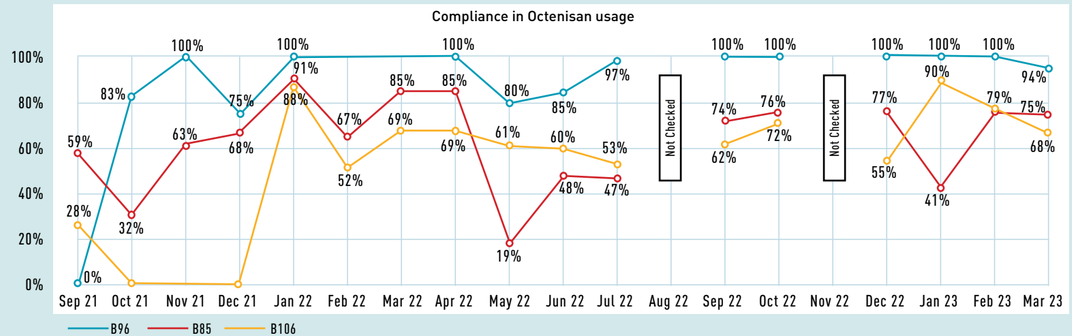
Ward B85
- 10 cases in 68 months (2016 => Aug 2021) = 0.147 cases per month
- 4 cases in 18 months since the switch = 0.222 cases per month

Ward B106
- 8 cases in 68 months (2016 => Aug 2021) = 0.118 cases per month
- 1 case (abdominal fluid) in 18 months since the switch = 0.055 cases per month

We will need more time to see if the switch is truly having an impact. Compliance to the protocol may be an issue

In Nov 2021, we adopted an additional selective approach to protect very high-risk patients and to prevent development of MRSA resistance to Octenisan. All very high-risk patients on other wards were indicated to receive daily Octenisan baths. These cases were scattered throughout our wards, and we needed the help of ward nurses to identify them, and these were: all dialysis cases; all cases with poor skin condition; and all cases with gangrene, ulcers and bedsores.

Octenisan Wash Compliance Monitoring



	Sep 21	Oct 21	Nov 21	Dec 21	Jan 22	Feb 22	Mar 22	Apr 22	May 22	Jun 22	Jul 22	Aug 22	Sep 22	Oct 22	Nov 22	Dec 22	Jan 23	Feb 23	Mar 23
B96	Locked Down	83%	100%	75%	100%	100%	100%	100%	80%	85%	97%	Not Done	100%	100%	Not Done	100%	100%	100%	94%
B85	59%	32%	63%	68%	92%	67%	85%	85%	85%	60%	47%	Not Done	62%	72%	Not Done	55%	41%	79%	75%
B106	28%	Pre-Swab Ward			88%	52%	69%	69%	19%	48%	53%	Not Done	74%	76%	Not Done	77%	90%	79%	58%

Challenges to Compliance
- Fast turnover of patients in the ward
- Patients transferred in came with CHG Gluconate 4% bath bottle
- Patients have own preference of bath shower gel
- Forgot to bring into the toilet to shower
- Forgot to top up emptied Octenisan wash

Figure 6

Hospital Onset MRSA Infections and Bacteraemias
2021

2021	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Overall
Number of Infections	5	2	1	2	2	4	4	3	3	2	3	0	**31**
Patient Days	23,995	20,825	24,075	23,225	24,606	23,372	23,753	22,724	23,539	24,391	23,415	22,881	280,801
Incidences (per 10,000 pt days)	2.08	0.96	0.42	0.86	0.81	1.71	1.68	1.32	1.27	0.82	1.28	0	1.10

2021	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Overall
Number of Bacteraemia	2	2	1	0	0	2	3	2	3	1	3	0	**19**
Patient Days	23,995	20,825	24,075	23,225	24,606	23,372	23,753	22,724	23,593	24,391	23,415	22,881	280,801
Incidences (per 10,000 pt days)	0.83	0.96	0.42	0	0	0.86	1.26	0.88	1.27	0.41	1.28	0	0.68

Hospital Onset MRSA Infections and Bacteraemias
2022

2022	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Overall
Number of Infections	2	2	7	2	3	2	2	1	3	1	4	3	**32**
Patient Days	22,722	22,511	25,679	24,293	24,949	24,336	25,280	25,300	24,700	25,182	24,494	24,994	294,440
Incidences (per 10,000 pt days)	0.88	0.89	2.73	0.82	1.20	0.82	0.79	0.40	1.21	0.40	1.63	1.20	1.09

2021	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Overall
Number of Bacteraemia	2	1	5	1	2	0	1	1	1	1	4	3	**22**
Patient Days	22,722	22,511	25,679	24,293	24,949	24,336	25,280	25,300	24,700	25,182	24,494	24,994	294,440
Incidences (per 10,000 pt days)	0.88	0.44	1.95	0.41	0.80	0.00	0.40	0.40	0.40	0.40	1.63	1.20	0.75

Hospital Onset MRSA Infections and Bacteraemias
2023

2023	Jan-23	Feb-23	Mar-23	Apr-23	Overall
Number of Bacteraemia	3	4	0	1	**8**
Patient Days	24,307	23,045	28,655	27,966	
Incidences (per 10,000 pt days)	1.23	1.74	0.00	0.36	

2023	Jan-23	Feb-23	Mar-23	Apr-23	Overall
Number of Infections	3	4	0	1	**8**
Patient Days	28,309	23.045	28,655	27,966	
Incidences (per 10,000 pt days)	1.06	1.74	0.00	0.36	

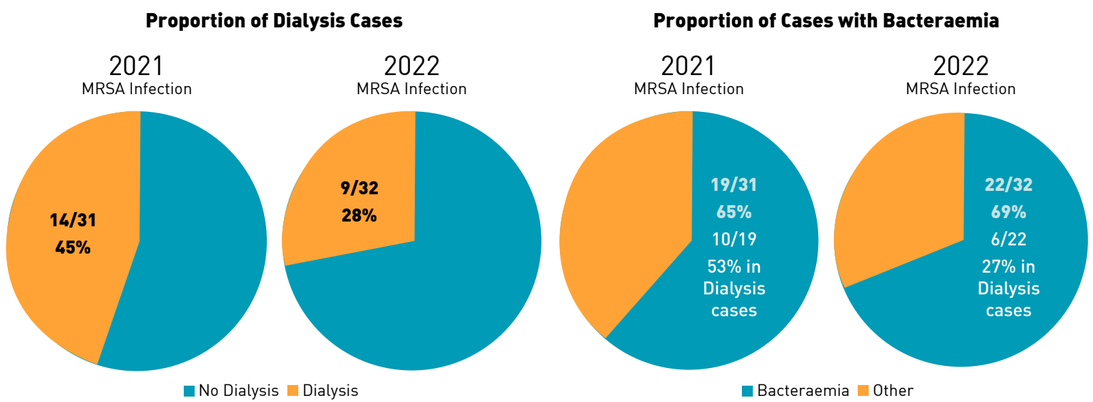
Bacteraemia	8/8
NAG +	7/8
Dialysis	3/8
Line infection	5/8

Source
TDC = 1
PICC = 1
IV thrombophlebitis = 1
Infected psoas hematoma = 1
Zoster skin lesions = 1
Pneumonia = 1

Figure 7: 2021-2023 monthly data

2021 31 Cases
NAG + = **20/31** (65%)
Dialysis cases = **14/31** (45%) (AVF = 5; TDC = 5; other catheter = 3, PDF = 1)
Bacteraemia = **19/31** (61%)

2022 32 Cases
NAG + = **26/32** (81%)
Dialysis cases = **9/32** (28%) (TDC = 6; CRRT = 2; PD =1)
Bacteraemia = **22/32** (68%)



Infections involving lines or tubes			
Line/Tube	**2021**	**2022**	**2023 (4 mths)**
PICC	1	3	1
Chest Tube	1	1	
CSF drain/shunt	1		
TDC	5	3	2
Other dialysis line	2		1
PD	1	1	
IV thrombophlebitis	5	4	1
CAUTI	2	1	
ET tube	1	1	
Tracheostomy	1		
Total	**19**	**14**	**5**

Infections involving other sources		
	2022	**2023 (4 mths)**
SKIN	(12/18)	(1/3)
Poor skin	8	1 (zoster)
Wound	2	
Abdominal surgical site	2	
OTHER	(6/18)	(2/3)
UTI	1	
Respiratory	2	1
Ascites	1	
Intra-abdominal hematoma	1	1
Unknown	1	

Figure 8: Breaking it down

Our strategy may have an impact. Analysis of the details of the cases reveals a significant shift away from infections involving dialysis cases. We are also seeing a greater proportion of cases involving NAG+ cases (Nasal/Axillary/Groin swabs done on admission to screen for MRSA-carriage). Our skin antiseptic approach (using daily antiseptic baths) appears to be reducing the number of non-bacteraemia HO-MRSA infections. Hence, the high proportion of HO-MRSA infections that are actually bacteraemia cases, many of which arise from lines or tubes. Because lines or tubes are covered over with a dressing, it may be that skin MRSA can escape the effect of daily antiseptic baths and result in bacteraemia. To address this possibility, we introduced our second initiative.

Initiative 2: Use of 3M Tegaderm CHG-Impregnated Securement Dressing

CHG-containing gel dressing is proven to be effective in reducing the risk of skin and catheter colonisation and skin flora based on trial studies. This dressing will be implemented hospital wide in April 2023 for patients with central line insertion to help reduce rate of MRSA bacteraemia, along with other measures. We will be tracking our data to observe any significant reduction in line-related bacteraemia.

Note: SchulkeMayr, the manufacturer and supplier of Octenisan does not yet have a similar product

Initiative 3: Reducing MDRO transmission in common toilets

To reduce the transmission of MRSA and other MDRO between patients, we have developed a UVC light disinfection system to be set up in shared toilets. The system had been set up in two toilets in Ward B65. We have demonstrated that it does significantly reduce bacterial counts within 15 minutes (see next table). We have three levels of safety features to ensure fail-safe patient safety. We have received funding to proceed with our project and tenders are completed. We expect to complete hospital-wide installation this year. After Phase 1 is completed, we will embark on Phase 2 to install a central monitoring system to quickly identify and remedy toilets where the UVC system is not working.

	Grab Bar in Toilet	Inner Door Handle & Lock	Sink	Soap Dispenser	Shower Handle	Shower Chair	Grab Bar At Shower Area	Shower Control Water Knob	Cloth Hanger	Toilet Cover
0 Min	50	40	6,400	380	880	14,000	17,000	7,600	<10	12,000
5 Min	<10	<10	190	<10	300	12,000	1,500	210	<10	30,000
10 Min	60	<10	9,000	<10	<10	520	3,200	300	<10	6,200
15 Min	<10	<10	140	<10	<10	1,200	800	200	<10	2,000
↓ Effect by 15 min	↓ 5	↓ 4	↓ 46	↓ 38	↓ 88	↓ 12	↓ 21	↓ 38	–	↓ 6
Effect by 10 Min	↓ 1	↓ 4	↑ 1	↓ 38	↓ 88	↓ 27	↓ 5	↓ 25	–	↓ 2

Figure 10: Efficacy of UVC Germbuster

Conclusion

The profile of the patients presented earlier shows that we are confronted with a difficult challenge. The limited switch to Octenisan seems to be working. The use of Tegaderm dressings for all central lines has started and will help to reduce line-related infections. We expect that the toilet UVC system will result in significant reductions in MDRO cross-transmissions, including MRSA.

Reflections

Infection prevention and control is a very challenging endeavour, largely because we are dealing with a moving target. What worked in the past may not continue to work now and in the future. As seen above, we have witnessed that MRSA strains have acquired increasing resistance to Chlorhexidine, a previous tried-and-tested skin antiseptic. At the same time, our patient population has changed and that increasingly we are caring for people who are high-risk and very high-risk for developing MRSA infection. In addressing these problems, we need wisdom. We need to carefully look at the statistical methods being used to ensure we have understood the problem correctly. We need to adopt a multifaceted response that follows common sense and uses simple, innovative, cost-effective, and achievable strategies. We should also be mindful that the strategies we employ not overburden our staff on the ground. Their tasks are already very challenging. Maintaining staff morale is of utmost importance.

References

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- Increased usage of antiseptics is associated with reduced susceptibility in clinical isolates of Staphylococcus aureus; K. Hardy et al. *MBio* May/June 2018, Vol.8, Issue 3 Research article.

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Suboptimal nasogastric tube placement in hospital and NCID inpatient wards (Tan Tock Seng Hospital)

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