

3rd Call

NHG Open Innovation Challenge 2022

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Name(s): Dr Li Hao, Dr Alvin Soon

Department(s): Otorhinolaryngology, Head & Neck Surgery, Diagnostic Radiology

Institution(s): Tan Tock Seng Hospital

[CS1] A non-invasive way to confirm benignity of thyroid nodules in ultrasonography for the expeditious reassurance of patients and a reduction in the referral rate for Fine Needle Aspiration

- **Prevalence and background of disease:**

Thyroid nodules are prevalent and its prevalence increases with age to over 70% of mainland Chinese older than 80 in a recent study of 7 million participants (1). The majority of these nodules are asymptomatic, being detected by neck, chest or whole-body imaging that is done for an unrelated indication. However, about 8-16% of such nodules are cancer (2), thus ruling out cancer becomes the priority of evaluating thyroid nodules.

- **Clinical Need/Current Practice:**

Unfortunately, current methods of ruling out thyroid cancer are imprecise, resulting in many patients being followed up for fear of missing a cancer. This creates a healthcare burden that cannot be justified because thyroid cancers are generally indolent, and overdiagnosis of small thyroid cancers may not improve survival (3).

Currently, the workhorse for assessing the likelihood of cancer in a thyroid nodule is **ultrasonography**. In Tan Tock Seng Hospital alone, over 7000 thyroid ultrasound scans are done last year. When ultrasonographic appearance of a nodule raises the suspicion of cancer, the patient is referred for a **fine needle aspiration (FNA)**. After FNA, patients with cytology suggestive of cancer are referred for diagnostic hemithyroidectomy. We audited the performance of ultrasonography and cytology for the diagnosis of thyroid cancer in Tan Tock Seng Hospital, and found that the current state-of-the-art methods of risk stratifying ultrasonography, namely Thyroid Imaging and Reporting Data System (TIRADS) or American Thyroid Association (ATA) systems, confer **a high sensitivity of about 95%, but a low specificity of about 15% (4)**. **Because of the limited specificity, many patients still need to undergo FNA in order to further confirm the suspicion of thyroid cancer. Based on FNA, the sensitivity of cytology per the Bethesda system was 94% and specificity was 55% (5)**. This is reasonably satisfactory, and many efforts using molecular testing of the cytological samples are being developed to further enhance the specificity of cytology, but FNA is an invasive procedure that should be avoided if possible. Therefore, it appears to us that improving the specificity of ultrasonography in differentiating benign from malignant thyroid nodules is an obvious clinical need that patients will welcome. This will reduce the need for FNA and provide patients with an expeditious reassurance of benignity that they deserve, allowing them to be discharged from lengthy follow up and improving the value of care for this common condition.

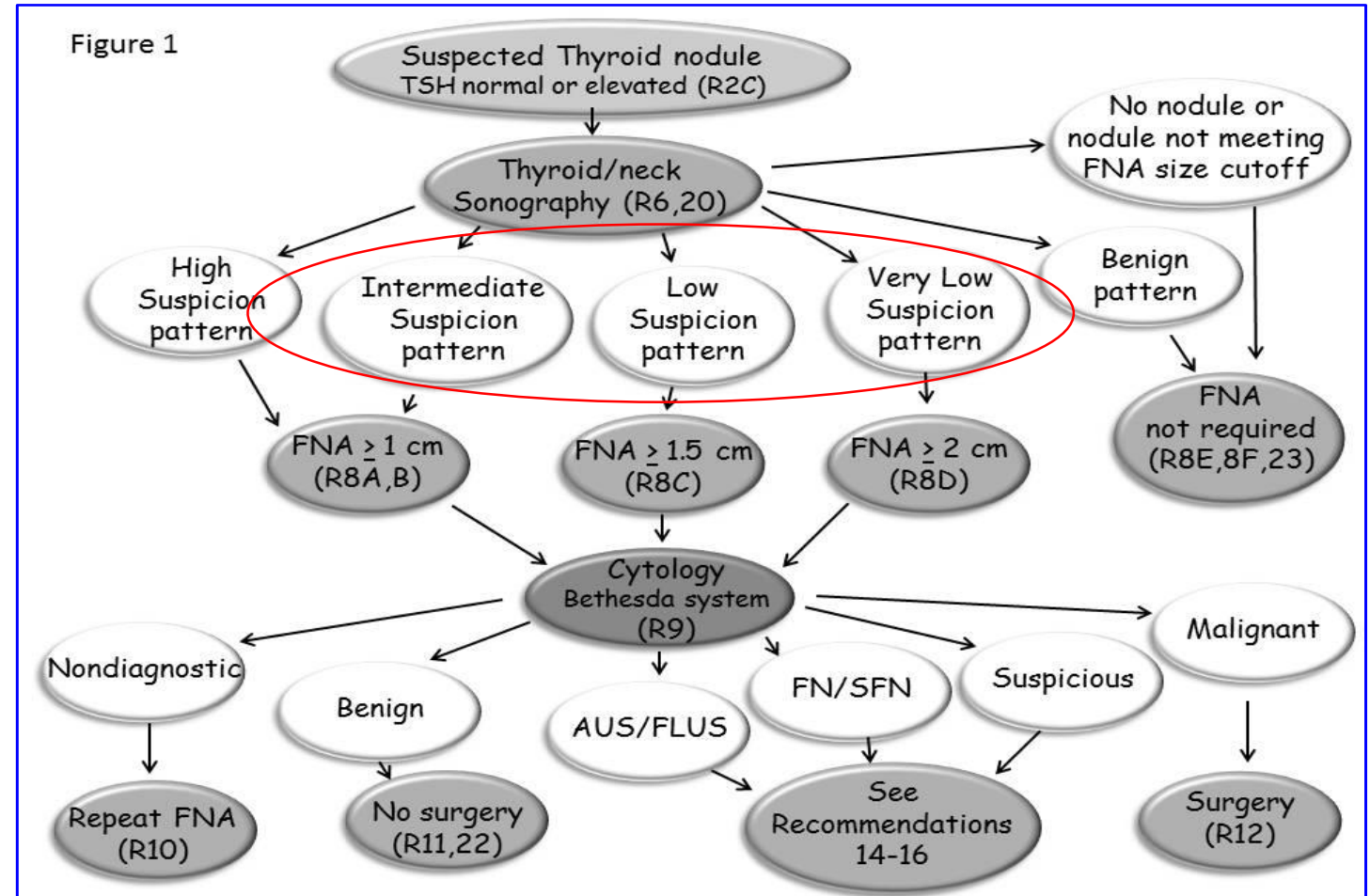
[CSI] Observations and Current Practice

- Clinical Workflow:**

Thyroid nodule >> Blood test to rule out hyperthyroidism (minority) >> Ultrasonography to determine the likelihood of cancer >> Fine Needle Aspiration for nodules that are not clearly benign >> Cytology >> Diagnostic Hemithyroidectomy for nodules that are clearly cancerous or suspicious of cancer

- Clinical Need in workflow:**

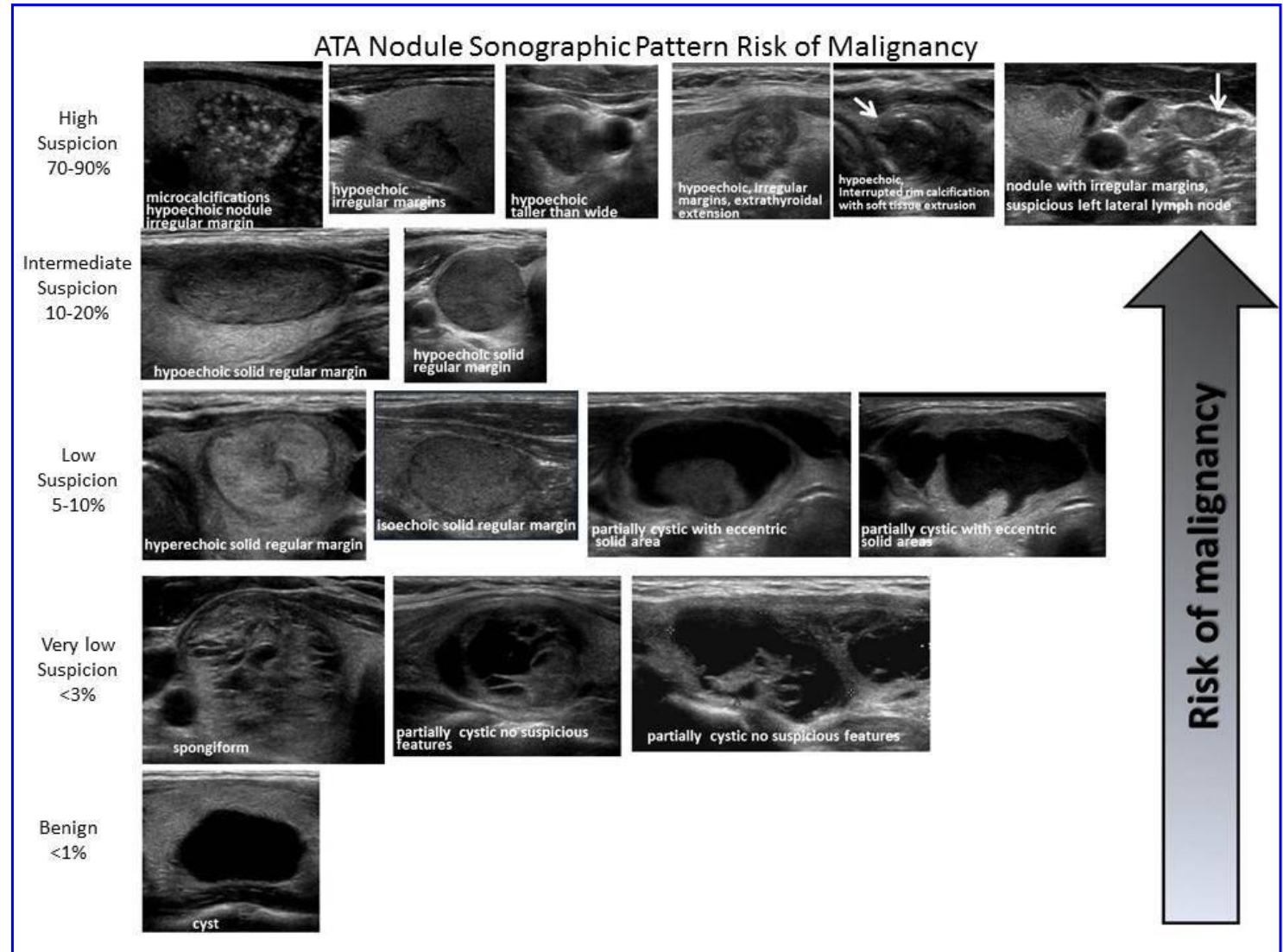
As **ultrasonography** is not specific enough in confirming thyroid cancer, the majority of nodules have very low to intermediate suspicion pattern, requiring FNA to further confirm benignity. This is the reason for many invasive FNAs done worldwide. To reduce the risk of harm caused by FNA, a size cut-off is used to recommend FNA in larger thyroid nodules. This results in the follow-up of many small nodules. During follow-up, one may expect cancers to grow faster than benign nodules, but not in the case of thyroid cancer which usually grows slowly (6). This prolonged uncertainty about the benignity of thyroid nodules is not ideal for patients. Improving the specificity of ultrasonography can increase the chance of confirming benignity upstream, and greatly enhance the value of the entire workflow for patients.



Current workflow in ruling out thyroid cancer (2015 American Thyroid Association guideline), red oval indicates the unmet need (too many such nodules)

[CSI] Ultrasonographic features of malignancy

Difficult to rule out thyroid cancer in those with very low to intermediate sonographic risk of cancer, which comprises of the majority of thyroid nodules.



- **References**

1. Li Y, et al. Prevalence of Thyroid Nodules in China: A Health Examination Cohort-Based Study. *Front Endocrinol (Lausanne)*. 2021 May 26;12:676144.
2. Burman KD, Wartofsky L. Thyroid Nodules. *N Engl J Med*. 2016 Mar 31;374(13):1294-5.
3. Vaccarella S, et al. Worldwide Thyroid-Cancer Epidemic? The Increasing Impact of Overdiagnosis. *N Engl J Med*. 2016 Aug 18;375(7):614-7.
4. Li H, et al. Presentation at Singapore Health and Biomedical Congress 2022
5. Lee BWW, et al. Noninvasive follicular thyroid neoplasm with papillary-like nuclear features and the risk of malignancy in thyroid cytology: Data from Singapore. *Ann Acad Med Singap*. 2021 Dec;50(12):903-910.
6. Cho SJ et al. Active Surveillance for Small Papillary Thyroid Cancer: A Systematic Review and Meta-Analysis. *Thyroid*, 29(10), 2019

- **Shortcoming of current practice (Low specificity in ultrasound scans):**

The shortcoming of the current ultrasonographic systems is that a majority of thyroid nodules have neither highly suspicious features of cancer nor highly reassuring features of benignity. This explains the low specificity. The reason for this is mainly because a group of thyroid cancers, namely follicular carcinoma and follicular variants of papillary thyroid carcinoma - comprising approximately a quarter of all thyroid cancers - have features that overlap with benign nodules. FNA is thus required to rule out such cancers because they have a higher chance of distant metastasis than the more common conventional papillary thyroid carcinomas. Recent advances in sonography, such as elastography, has not improved the differentiation of these cancers from benign nodules. Novel approaches are needed in analysing the sonographic images in order to discern the subtle differences that exist in such cancers but not in benign nodules.

- **Existing solutions in academia:**

Over the years, artificial intelligence, superb microvascular imaging and radiomics have been used to solve this problem. Deep learning networks show promise but does not perform better than human experts (6). Superb microvascular imaging can improve the diagnosis of cancer in thyroid nodules with indeterminate cytology, but it is hard to measure objectively (7). Radiomics is a new approach (8) that can be further explored as it is not yet commercially available. However, another issue with ultrasonography is the operator dependency. Each operator can scan the thyroid at different speed, using scanners of various quality and visualizing the thyroid in different planes. An automated video scan of the thyroid may overcome this hurdle by provide a 3-dimensional rendition of the nodules and collect data that are more complete than the 2-dimensional images that we usually see, but it is not available, either.

- **Clinical and/or economic impact of unmet need:**

By addressing this unmet need, the team could save many patients worldwide from long-term follow-up of their thyroid nodules, reducing their anxiety about cancer and the need for invasive biopsy. The overall cost, time and manpower required in managing thyroid nodules, a somewhat iatrogenic problem, should be reduced as soon as possible. Our patients need an expeditious reassurance for a problem we created that we know is usually innocuous.

- **References**

6. Potipimpanon P, et al. A comparison of artificial intelligence versus radiologists in the diagnosis of thyroid nodules using ultrasonography: a systematic review and meta-analysis. *Eur Arch Otorhinolaryngol*. 2022 Nov;279(11):5363-5373.
7. Chen L, et al. Additional Value of Superb Microvascular Imaging for Thyroid Nodule Classification with the Thyroid Imaging Reporting and Data System. *Ultrasound Med Biol*. 2019 Aug;45(8):2040-2048.
8. Yoon J, Lee E, Kang SW, Han K, Park VY, Kwak JY. Implications of US radiomics signature for predicting malignancy in thyroid nodules with indeterminate cytology. *Eur Radiol*. 2021 Jul;31(7):5059-5067.

[CSI] Target Population and Outcome

- **Who will mainly benefit from solution**

1. Patients: Ultrasound scans with high sensitivity and specificity would expedite reassurance and reduce the referral rates of FNAs/surgeries
2. Radiologists/Clinicians: Save manpower, time and resources spent on the work-up and follow-up of thyroid nodules.
3. Healthcare processes: Facilitation of shorter turnaround/waiting time for patients, improving the efficiency of healthcare processes.

- **What should the proposed solution seek to achieve?**

The proposed solution should increase the specificity of risk stratification in ultrasound scans.

If we can refine ultrasonography of the thyroid by interpreting fine details obtained in videasonography, we can potentially overcome the issue of low specificity of ultrasonography in detecting thyroid cancers. This can save many patients worldwide from long-term follow-up of their thyroid nodules, reducing their fear of cancer and the need for invasive biopsy. Moreover, this strategy should be more cost-effective than the alternative approaches of advancing cytology by expensive molecular testing.

- **How should the proposed solution seek to benefit be measured?**

1. To determine the sensitivity and specificity of diagnosing thyroid cancer by a novel method of interpreting ultrasonography
2. To measure the referrals of FNAs before and after solution integration

- **Dr Li Hao's team and expertise**

A group of doctors from Tan Tock Seng Hospital is developing a database of thyroid nodules containing ultrasonographic images, cytology, histology and clinical data. We can use this database to test novel ideas that interested collaborators have. We can then conduct a clinical trial of the novel technology in our hospital over a short period of time because we perform over 7000 thyroid ultrasound scans a year. We will validate the performance of the new technology by measuring its sensitivity and specificity of diagnosing thyroid cancer in a prospective cohort of patients who will be followed up long-term. This will generate a wealth of local data that can be used to improve the value of care for thyroid nodules and reassure clinicians in Singapore who have so far been relying on guidelines from overseas. Due to the high volume of thyroid nodules we see, we are confident that we can translate innovative solutions efficiently into clinical practice for the benefit of Singaporeans and the world.

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Department(s): Pharmacy, Gastroenterology & Hepatology, Cardiology, Respiratory & Critical Care Med, Continuing and Community Care

Institution(s): Tan Tock Seng Hospital

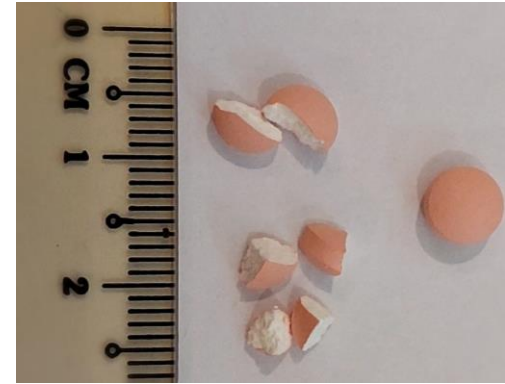
[CS2] A way to lower pill burden for patients with polypharmacy in order to reduce caregiving burden and improve adherence to reduce hospitalizations and healthcare costs

- There are limitation of traditional mass-made medicines as discrete strengths and dosage forms is finite and leads to burden of care. This is amplified in Singapore due to our small market
- Up to 70% of patients do not gain efficacy directly from medications dispensed and have to make modifications to them in one way or another or simply do not take them¹.
- Multiple medications are needed to treat common conditions such as myocardial infarction², tuberculosis³ or H. pylori infections⁴.
- Up to 14.5% of Singapore elderly are taking ≥ 5 medications⁵.
- Up to 60% of patients in Singapore are non-adherent to their medications and this risk is further increase 1.45 times if they are taking ≥ 5 medications (polypharmacy)^{5,6}.

1. www.pharmaceutical-journal.com/article/research/3d-printing-of-pharmaceuticals-and-the-role-of-pharmacy
2. N Engl J Med. 2022 Sep 15;387(11):967-977
3. Clin Infect Dis. 2016 Oct 1;63(7):e147-e195
4. Minerva Med. 2021 Apr;112(2):281-287
5. Proceedings of Singapore Healthcare. 2019;28(4):224-231
6. J Adv Nurs. 2021; 77(10): 4069-4080

[CS2] The Pain Points/ Issues

- As a result of limited oral dosage forms and 23% of TTSH inpatients have dysphagia and 13% are on a nasal-gastric tube, 58% of nurses spent up to 60 minutes a day to split, crush or dissolve oral meds
- To obtain correct dose, patients or caregiver have to split or cut current dosages leading up to dose deviation of 20-25% when hand-split and up to 15% when tablet cutters are used.^{1,2}
- To track the multiple daily medications, many patients use pillboxes, automated timers, charts or compliance packing to ensure their adherence. Often, pillboxes are filled by caregivers and compliance packing are done with additional costs from pharmacies.
- The need to take multiple medications daily affects patient experience and can lead to non-adherence.
- Non-adherence leads to increased morbidity, mortality as well as healthcare costs.
- Improved adherence leads to reduce hospitalization of 10.3 days per 1,000 follow-up days and cost savings of US\$ 65,464 in 3 years³
- All-cause annual cost of non-adherence was estimated to be US\$ 5,271– US\$52,341³.
- Annual costs due to non-adherence are significant in these disease groups; cardiovascular (US\$3,347-\$19,472), respiratory (US\$804- \$36,249)and gastrointestinal diseases are estimated to be (US\$5,566-US\$42,854)⁴.



1. JAMA. 2002;288(4):451-452. doi:10.1001/jama.288.4.446

2. Saudi Pharm J. 2014 Nov;22(5):454-9

3. Patient Prefer Adherence. 2016 Aug 16;10:1573-81

4. BMJ Open. 2018 Jan 21;8(1):e016982.

- Target population
 - Patients with polypharmacy and who are unable to manage their medications to maintain adherence
 - Patients who are currently taking medications that needs to be further split or crushed due to limited strength or dosage form being commercially not available in the market
- The proposed solution should enable patients and caregiver to better manage their medication use due to the limited dosage forms in the market.
- The immediate benefits should translate to better patient experience and adherence and lower care burden.
- Long term benefits will include improve disease management and reduce healthcare costs.

Name(s): Tiffany Chew, Dr. Liew Huiling

Department(s): Foot Care & Limb Design Centre (Podiatry Service), Endocrinology

Institution(s): Tan Tock Seng Hospital

[CS3] A better way to train healthcare workers to perform diabetic foot screening to reduce man hours needed for diabetic foot screening training.

[CS3] Observations and Current Practice

Notes:

- Describe disease – Background, incidence and/or prevalence.
- Illustrate current state/ practice.
 - What is Diabetic Foot Screening (DFS)?
 - Structured foot check for diabetic foot complications such as neurological, vascular, dermatological changes of his/her feet in a person with diabetes.
 - Why do we need to transform Diabetes Foot Screening Training?

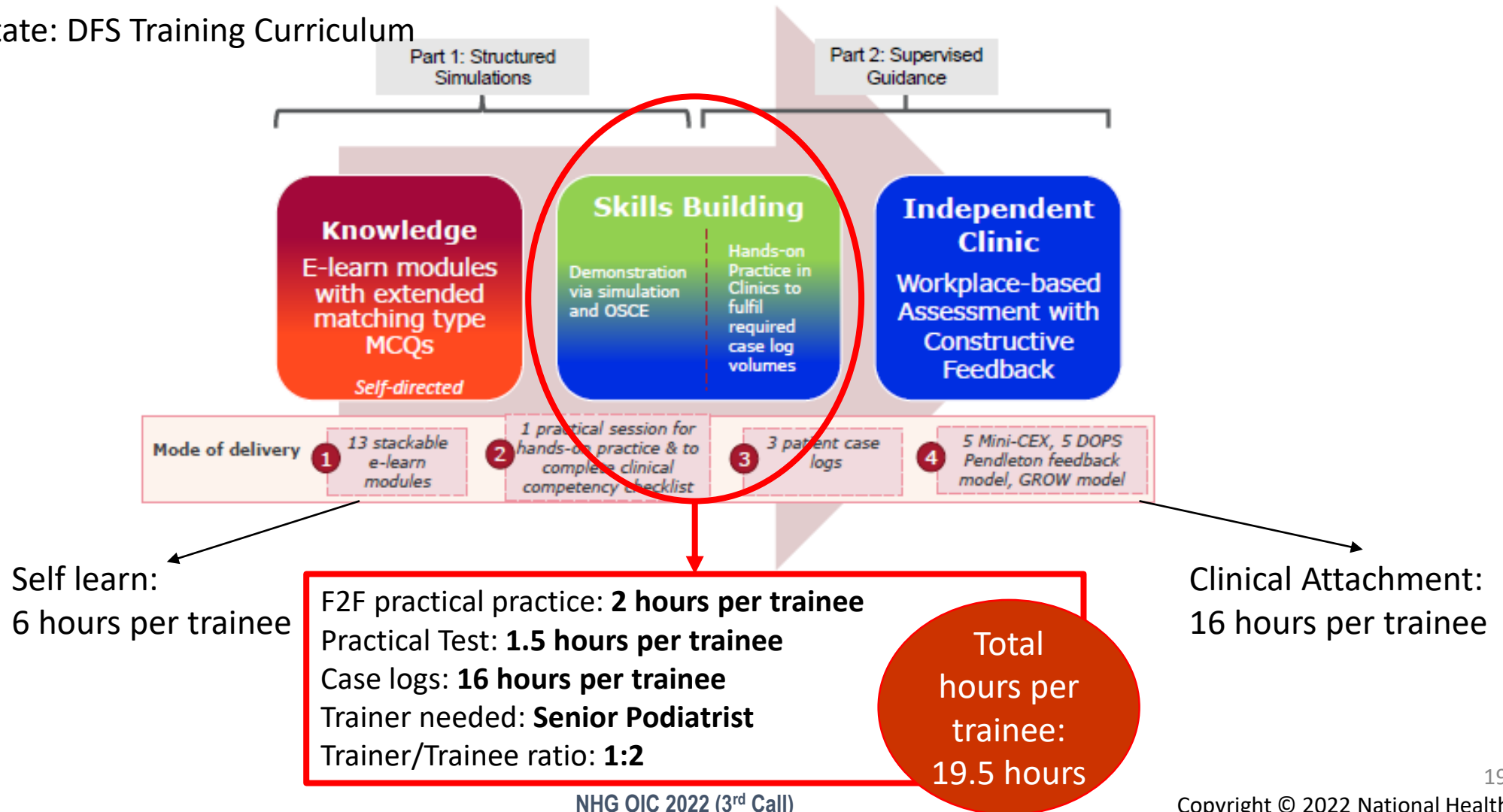


		Risk stratification		
		LOW RISK	MODERATE RISK	HIGH RISK
Risk-based management		None OR Simple callus	Thick callus requiring treatment OR Deformity with simple callus or thick callus requiring treatment OR One of: • Deformity • PAD • Neuropathy	Previous foot ulcer or amputation OR CKD stage 5 (eGFR <15 ml/min/1.73m ²) OR Callus with intradermal bleeding OR Two or more of: • Deformity or any callus • PAD • Neuropathy
		Refer to specialist or podiatry as needed		
		Assess at least once a year	Assess at least every six months	Assess at least every three to four months

[CS3] Observations and Current Practice

Notes:

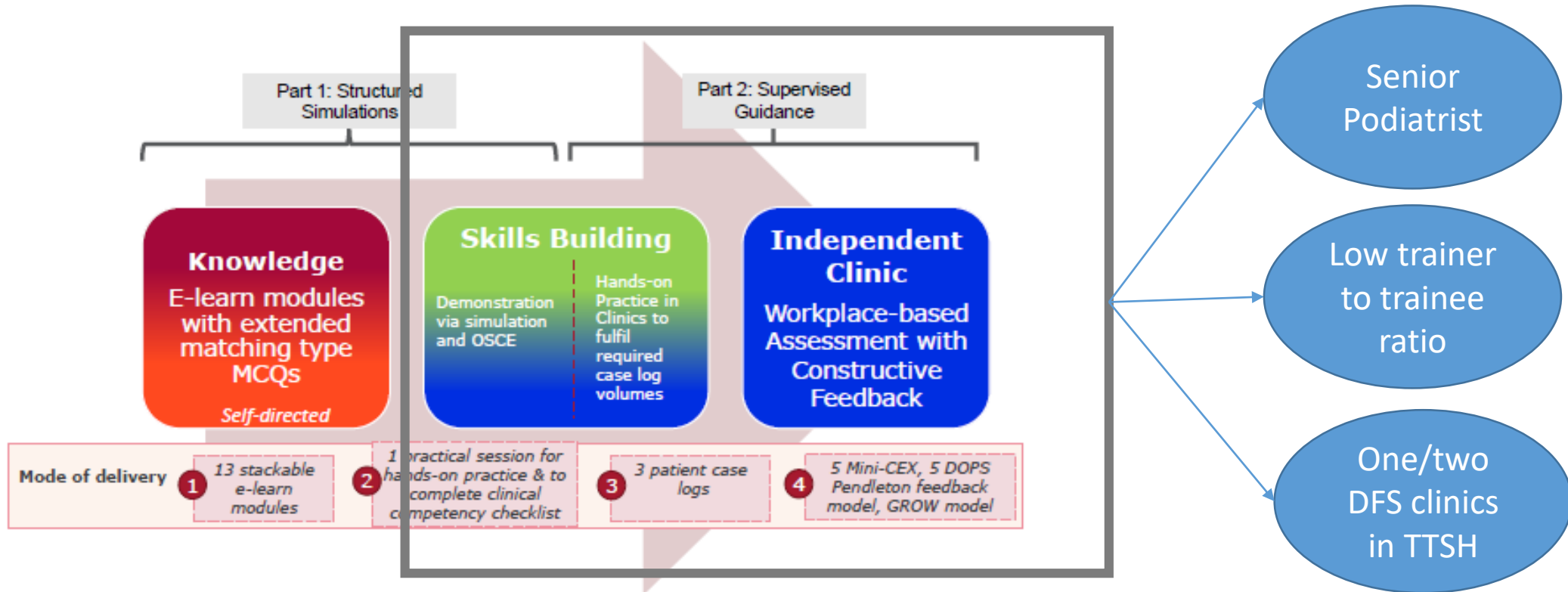
- Describe disease – Background, incidence and/or prevalence.
- Illustrate current state/ practice.
- Current State: DFS Training Curriculum



[CS3] The Pain Points/ Issues

Notes:

- Describe shortcomings/inefficiencies of current practice.
- What is clinical and/or economic impact of unmet need?



Diabetic Foot Screening Training is resource taxing (on a scarce resource), dependent on a small work force and clinic availability.

[CS3] Target Population and Outcome

Proposed Solution



[CS3] Target Population and Outcome

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
1. Trainee (Eg. Upskilling Nurses, training podiatry assistant new joiners) - **Increase** self-learn time
 - At learner’s own pace
 - Unlimited by clinic/trainer availability
 - Unlimited by patient availability
 2. Skill training provider – **Reduce** Trainer time (usually a senior podiatrist) from 39 hours to 16 hours – **60%** (Reduce need to close 2.5 days of snr podiatrist clinic)
 3. Population with Diabetes - **Spread** the curriculum; standard high quality self-learn DFS training across NHG or even nation wide that is sustainable, scalable and implementable.

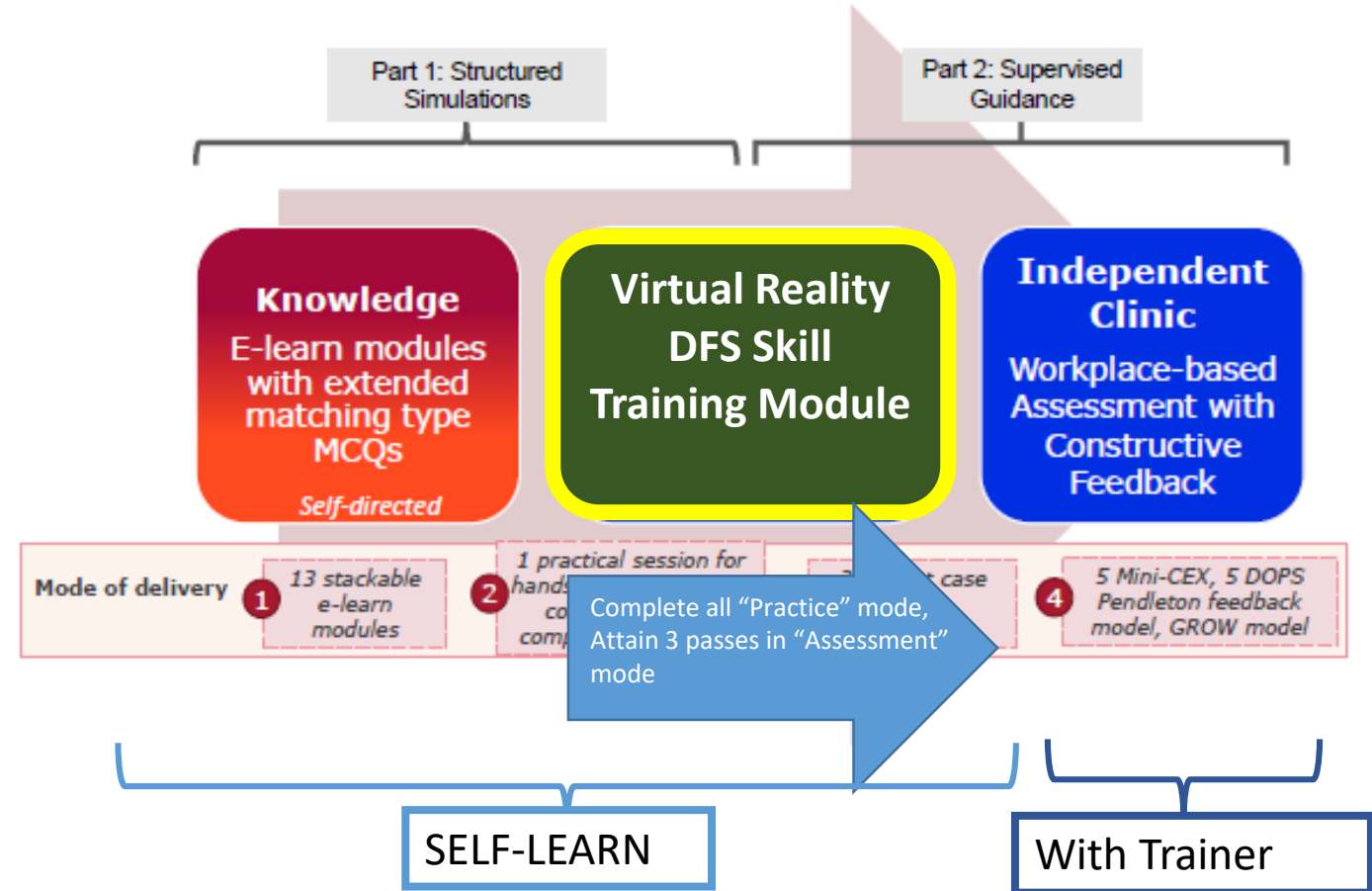
Primary outcome:

To assess and compare both student’s satisfaction/self-confidence using a modified National League for Nursing (NLN) student satisfaction and self-confidence in learning survey (NLN 2005) prior to starting independent clinical attachment for Workplace-based assessments.

Secondary outcomes:

1. To assess and compare time taken (hours) for both student to clear case logs and Workplace-based assessments with a blinded independent trainer.
2. To assess and compare cost-utility with the new modality. Quantitative data collection on self learn duration and trainer’s time

Proposed Solution



Name(s): Dr Ong Poo Lee

Department(s): Rehabilitation Medicine

Institution(s): Tan Tock Seng Hospital

[CS4] Using real-time tactile biofeedback wearable sensors on sensory impaired stroke patients in improving upper limb function during rehabilitation

Notes:

- Describe disease – Background, incidence and/or prevalence.
- Illustrate current state/ practice.

- Sensorimotor impairment of upper limb(UL) are common after stroke, leading to difficulty in activities of daily living
- Up to 85% of person with stroke has sensory impairment
- They may experience negative symptoms like numbness, or absence of sensation over affected area, inability to discriminate position of the limb in space, or recognize a held object by touch
- Or positive symptoms like tingling paresthesia or pins and needles sensation which can disturb their daily life

Carlsson, H., Rosén, B., Björkman, A. *et al.* SENSory re-learning of the UPPer limb (SENSUPP) after stroke: development and description of a novel intervention using the TIDieR checklist. *Trials* **22**, 430 (2021). <https://doi.org/10.1186/s13063-021-05375-6>

- The current approaches to sensory training for UL include passive and active sensory training
- Passive sensory training include electrical and thermal stimulation while active sensory training include active manual exploration in order to stimulate different sensory modalities
- Passive sensory training is more favorable from recent review while evidence for active sensory training is still limited and needs to be further explored

Notes:

- Describe shortcomings/inefficiencies of current practice.
 - What is clinical and/or economic impact of unmet need?
-
- Most of the focus in stroke rehabilitation is on motor function recovery, and sensory training of hand is often neglected in their rehabilitation
 - Sensory dysfunction is perceived to be less of a limitation as compared to motor weakness
 - Touch, proprioception, and discrimination ability provide decisive information for a flawless and controlled motor output.
 - When these sensory modalities get impaired, the poststroke motor recovery may further get complicated
 - Sensory impairment is shown to associate with reduced or prolonged recovery of motor function and contributing factor to development of a lesser spontaneous use of UL(learned non-use), resulting in decreased participation and QoL
 - Despite this, research into sensory impairment and recovery is limited, due to the heterogeneity of study population has rendered extensive variations in the prevalence. At present there are no set protocols or international guidelines that guide clinical practice for sensory rehabilitation

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
-
- Task-specific training including intermittent feedback is beneficial for improving motor function after stroke. Feedback can be in the form of vibration, tactile, pressure, thermal etc (tactile with pressure that provide different intensity preferred), mainly for training use, and could be useful for functional use at home as well
 - A solution using combination of passive and active sensory training using instant biofeedback wearable sensor during upper limb sensory re-training for post stroke survivors could potentially improve the motor power, overall functional status and QoL
 - A qualitative outcome measures and quantitative feedback can be obtained from both patients and clinicians during and post rehabilitation in subacute and chronic stroke survivors who suffered from sensory impairment

Name(s): Dr Ong Poo Lee

Department(s): Rehabilitation Medicine

Institution(s): Tan Tock Seng Hospital

[CS5] Enabling restricted weight bearing exercise on post orthopedic trauma patients to improve physical performance and early functional return

Notes:

- Describe disease – Background, incidence and/or prevalence.
 - Illustrate current state/ practice.
-
- The incidence of tibia fracture is 13 in 100,000 with male-to-female ratio of 3:1 locally.
 - According to the AO Principles of Fracture Management, postoperative management of (peri)- or intra-articular fractures of the lower extremities consists of non-weight bearing for 6–12 weeks, followed by partial weight bearing with a 25% increase in weight loading every week
 - Premature weight bearing increases stress on implant constructs, risk of fixation failure, loss of reduction and the need of revision surgery
 - As such, weight bearing rehabilitation is often cautious, with fear for secondary dislocation of the fracture or failure of mechanical construct
 - Furthermore, patients' compliance with non weight bearing or partial weight bearing regime has been found to be poor. Studies showed that patients actually exceeded the prescribed amount of partial weight bearing

References

Stinner DJ, Rivera JC, Smith CS, Weiss DB, Hymes RA, Matuszewski PE, Gary JL, Morshed S, Schmidt AH, Wilken JM, Archer KR, Bailey L, Kleihege J, McLaughlin KH, Thompson RE, Chung S, Remenapp C, MacKenzie EJ, Reider L; METRC. Early Advanced Weight-Bearing After Periarticular Fractures: A Randomized Trial Comparing Antigravity Treadmill Therapy Versus Standard of Care. *J Orthop Trauma*. 2022 Jan 1;36(Suppl 1):S8-S13. doi: 10.1097/BOT.0000000000002285. PMID: 34924513.

Permissive weight bearing in trauma patients with fracture of the lower extremities: prospective multicenter comparative cohort study

Pishtiwan H. S. *Kalmet*, Feb 2018 . doi: 10.1186/s12893-018-0341-3

Decruz J, Antony Rex RP, Khan SA. Epidemiology of inpatient tibia fractures in Singapore - A single centre experience. *Chin J Traumatol*. 2019 Apr;22(2):99-102. doi: 10.1016/j.cjtee.2019.01.004. Epub 2019 Feb 27. PMID: 30962125; PMCID: PMC6488744.

Notes:

- Describe shortcomings/inefficiencies of current practice.
 - What is clinical and/or economic impact of unmet need?
-
- Growing evidence suggests the muscle atrophy resulting from restricted weight bearing has deleterious effect on bone healing and overall limb function
 - Reduced limb loading for prolonged duration leads to decreases in bone mass and strength as well as cartilage degradation and joint stiffness
 - As a result, these patient often have longer return to function and overall worse outcomes than other orthopedic injuries indicating a need for improved clinical management

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
-
- Patients who suffered from orthopedic injuries over lower limb (e.g. distal femur, or tibial fracture) requiring restricted weight bearing for a period of duration (6-12 weeks) will benefit from early rehabilitation using proposed solution to reduce risk of deconditioning.
 - A robotic device or equipment that allow early physical exercises and joint movement with capability of controlled weight bearing to injured limb, should enable early rehabilitation in this population with aim of improvement in muscle strength, physical activity and early return to function in long term
 - A feasibility study should be done to assess device's safety follow by cost and clinical effectiveness evaluation

Name(s): Dr Ong Poo Lee

Department(s): Rehabilitation Medicine

Institution(s): Tan Tock Seng Hospital

[CS6] Mitigating sedentary behaviour among hospitalized elderly and patients with disability to shorten sedentary period and increase physical activities.

Notes:

- Describe disease – Background, incidence and/or prevalence.
- Illustrate current state/ practice.
 - During hospitalization, patients were spending more time engaged in sedentary behaviour (SB) and were less physically active than after discharge at home.
 - This is even more prominent in stroke patients and older adults who spent up to 76% and 96% daily with sitting or lying down.
 - Sedentary behaviour has been associated with poor health outcome such as physical and cognitive declined, reduced quality of life, depression and frailty, risk of premature death, mortality, length of hospital stay, and hospital readmission rate.
 - Early referral to physiotherapist and nursing intervention has been attempted to mitigate the SB, however they were unable to reduce the high prevalence of SB in the hospital significantly due to manpower and resources constraint.

Jasper, U.S., Yadav, L., Jadcak, A.D. *et al.* Sedentary behaviour in hospitalised older people: a scoping review protocol. *Syst Rev* 9, 36 (2020). <https://doi.org/10.1186/s13643-020-01290-0>
Sjöholm A, Skarin M, Churilov L, Nilsson M, Bernhardt J, Lindén T. Sedentary behaviour and physical activity of people with stroke in rehabilitation hospitals. *Stroke Res Treat.* 2014;2014:591897. doi: 10.1155/2014/591897. Epub 2014 Mar 19. PMID: 24772368; PMCID: PMC3977466.

Notes:

- Describe shortcomings/inefficiencies of current practice.
 - What is clinical and/or economic impact of unmet need?
-
- Most patients with functional issue or disability will receive one session of physiotherapy and/or occupational therapy up to 45mins within a day.
 - In principle, increase in physical activity (PA) will minimize SB and immobility related complications. This couple with high intensity of therapy will usually lead to better functional outcomes.
 - Patient generally dependent on nursing support and their own initiative to perform self exercises and PA at their free time
 - Each additional hour spent sedentary has been proposed to be associated with a progressive rise in mortality risk
 - It is vital to explore the causes of SB (e.g. fall risks, disease nature) especially in older adults and disabled patients, and to inform practice, research and interventions.

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
-
- Early rehabilitation for elderly and patient with disability is beneficial for recovery and favourable outcome:
 - Clinically, likely more than 50% in rehab ward (patients with good cognition) will benefit from the proposed solution. (Purely advising patient to increase PA may not address SB based on studies)
 - Activities that interrupt period of SB could include sit-to-stand, walking to lounge room to socialise with other patients and walking to restroom rather than using a commode.
 - Understanding the perspectives of stakeholders and end-users regarding interventions on ubiquitous health issues is critical to reducing SB among hospitalised older people successfully.

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
-
- We propose using sensors or gamification device could potentially interrupt SB among hospitalized patient. This can be in inpatient wards in acute hospitals, subacute rehab wards, community hospitals and/or nursing homes.
 - Sensors or gaming device should be designed in a way that do not take up significant space, so patients can perform on their own bed or chair.
 - Ideally, the exercises can be self-administered for those capable after training by therapists.
 - Level of physical activities and sedentary period can be measured using sensors.
 - Functional outcomes can be measured by Modified Barthel Index (MBI) or Functional Independence Measure score (FIM).
 - Exercise training can also be coupled with accelerometer-feedback to increase physical activities among these population

Name(s): Dr Michael Yam

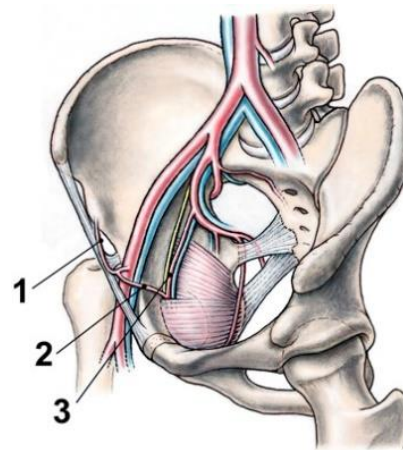
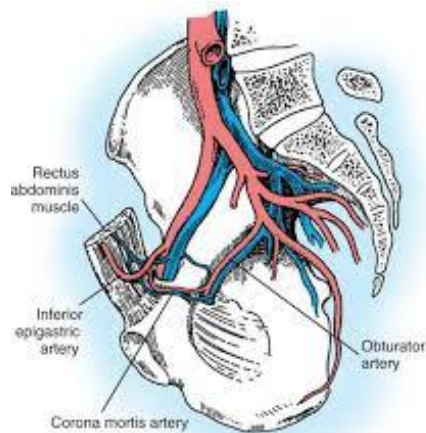
Department(s): Orthopaedics Surgery

Institution(s): Tan Tock Seng Hospital

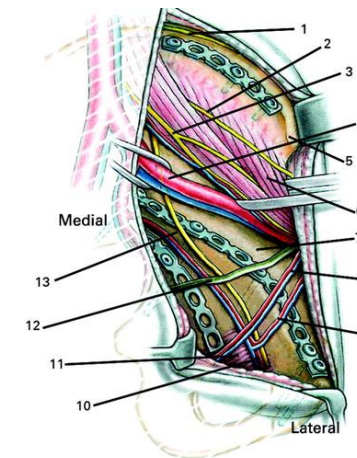
[CS7] An augmented reality solution to provide patient specific surgical visualisation for patients, students and surgeons to achieve better understanding and safer surgery

Notes:

- Describe disease – Background, incidence and/or prevalence.
 - Illustrate current state/ practice.
-
- Surgical planning is often taught utilising 2D pictures, X rays, CT images
 - The surgeon then integrates these images into his/her head, coming up with a 3D image for planning of surgical steps
 - Surgical models and pictures from educational sources are generic and not patient specific (Not relevant to the current case)

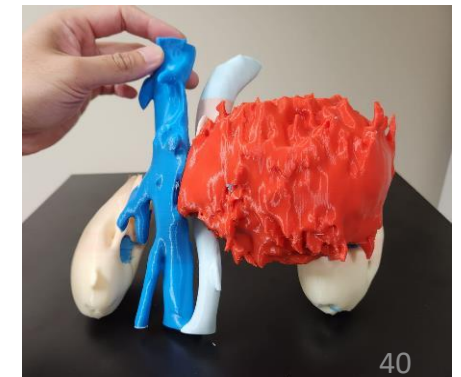


NHG OIC 2022 (3rd Call)



Notes:

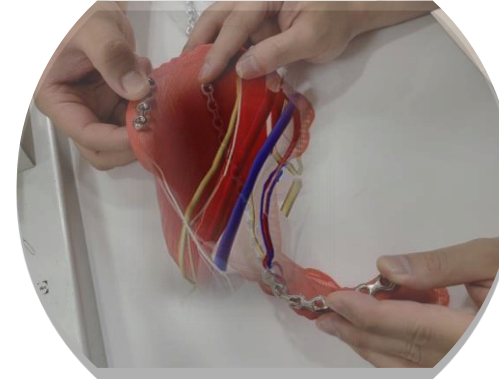
- Describe shortcomings/inefficiencies of current practice.
 - What is clinical and/or economic impact of unmet need?
-
- This can cause significant gaps in learning and planning until the surgeon is able to practice the surgery on real patients.
 - Patients/students/residents are unable to visualise the relevant anatomy to understand the condition and the surgery.
 - There is a lack of a patient specific tool for better anatomical understanding as well as surgical planning. This leads to poor patient/student/resident/surgeon understanding of the condition, causing miscommunication, differences in expectation, gaps in surgical training and inadequate preparation for surgery which may lead to poor outcomes.



[CS7] Target Population and Outcome

Notes:

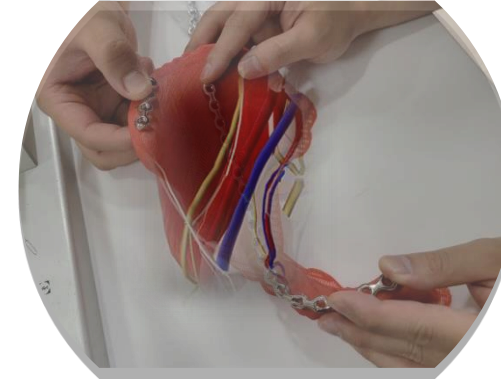
- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
- Target population: Patients, Students, Residents, Surgeons
 - Patients: Better understanding, satisfaction, expectations
 - Students: Better understanding
 - Residents: Able to visualize better before practice
 - Surgeons: Better planning and execution
 - Creation of an augmented reality (AR) program that may overlay anatomy onto a patient specific 3D printed model with tracking features and dynamic adaptation to enhance surgical planning. The AR program should ideally be accurate and implementable for clinical usage.



[CS7] Target Population and Outcome

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
- This would allow patient specific planning/understanding via the 3D model, at the same time overlaying critical anatomy onto the 3D printed model, facilitating understanding of the surgery, dangers to structures, visualization of anatomy, and planning of surgical approach and even a dry run of the surgery before the actual surgery takes place.
 - How benefit will be measured:
 - Pre and post surveys for Patients/Students/Residents: Understanding, Confidence, Satisfaction, Knowledge retention, learning
 - Pre and post surveys for Surgeons: Understanding, confidence, surgical time, blood loss



Name(s): Dr Aung Myint Oo @ Ye Jian Guo

Department(s): General Surgery

Institution(s): Tan Tock Seng Hospital

[CS8] A way to achieve haemostasis and clean operative field during laparoscopic procedures in order to relieve stress of surgeons and achieve good surgical outcomes

Notes:

- Describe disease – Background, incidence and/or prevalence.
- Illustrate current state/ practice.

Background of laparoscopic procedures

Nearly 15 million laparoscopic procedures were performed every year globally and the US alone contributed 32% of the volume and increasing yearly. The overall laparoscopy and endoscopy devices market was worth 18.39 billion and is growing with compound annual growth rate (CAGR) of 4.8% in the forecast period, 2018-2025 according to the research and markets report published in September 2018.

Current state/practice

During the laparoscopic surgery bleeding can obscure the operative field and thus the surgeon may not be able to continue surgery safely. Gauze and surgical sponges can be used to clean the operative field, and also can achieve haemostasis/ slow down the bleeding by compression. These gauze and surgical sponges can also be used to press, retract the delicate tissue, vessels protecting from injury by laparoscopic instruments.

Notes:

- Describe shortcomings/inefficiencies of current practice.
- What is clinical and/or economic impact of unmet need?

Shortcoming/Inefficiencies of current practice

There are commercially available surgical sponge namely Laparosponge 10 System, Endoractor and Endosupport system, Ekymed STAR system etc. However these systems have their pros and cons for example endractor and endosystem needs small incision to remove the sponge and also need to be careful during removal to prevent from breaking of the sponge. Laparosponge and EkyMed STAR system need to use the special introducer and retriever.

Clinical Impact of unmet need

There is thus the risk of retained sponge or broken sponge during the retrieval which can lead to adverse outcomes. An all-in-one multipurpose sponge system to address all the issues with the current commercially available sponge systems, improving clinical outcomes and post-operative recovery.

[CS8] Target Population and Outcome

Notes:

- **Who** will mainly benefit from solution?
- **What** should the proposed solution seek to achieve?
- **How** will benefit be measured?

Who will mainly benefit from the solution?

Patients undergoing laparoscopic procedures: Good surgical outcomes with better post-operative recovery

Surgeons performing laparoscopic procedures: Haemostasis, organs retraction without injuring the organs being retracted, clean operative field are very important to achieve the good surgical outcomes – These are the most stressful elements that could be resolved with a multi-purpose surgical sponge.

What should the proposed solution seek to achieve?

Company that can develop and the all in one multipurpose haemostatic sponge system for minimally invasive surgeries. The sponge system should ideally clean the operative field, slow/stop bleeding and be readily removed after the procedure.

Possible parameters to measure outcomes

1. Ease of sponge removal (e.g. without incisions, without specialised instrument)
2. Haemostatic ability of new sponge system
3. Integration new sponge system to surgical protocols
4. Qualitative survey from surgeons on new sponge system vs. old sponge system

Name(s): Dr Saleem Ahmed and Dr Danson Yeo

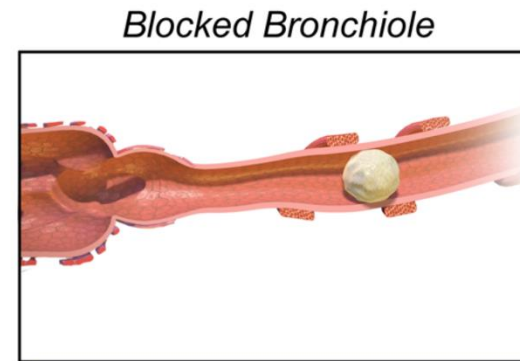
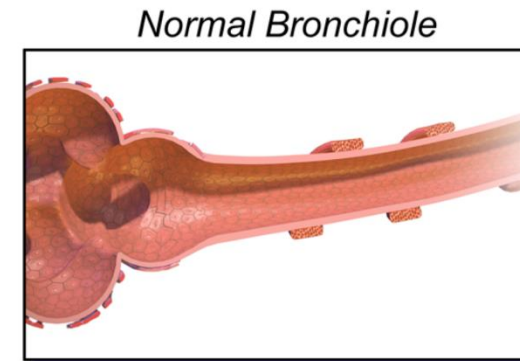
Department(s): General Surgery

Institution(s): Tan Tock Seng Hospital

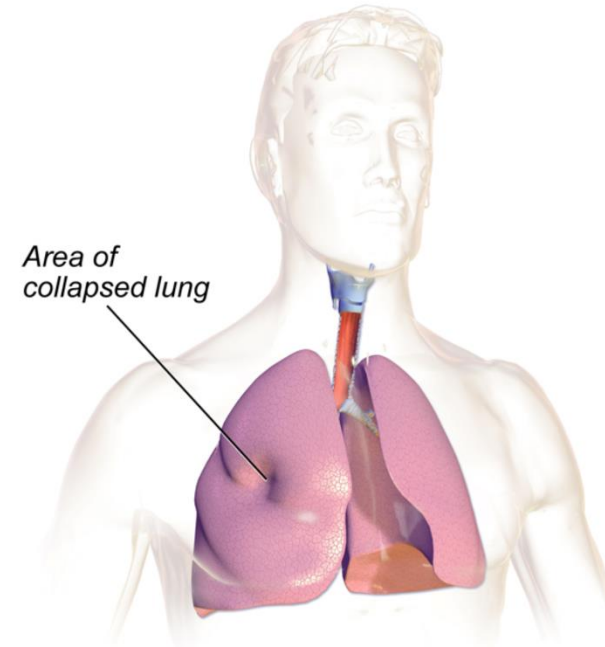
[CS9] A way to monitor the compliance and technique of using incentive spirometer for patients undergoing major abdominal or thoracic surgery in order to prevent post-surgery atelectasis & pneumonia

Notes:

- Describe disease – Background, incidence and/or prevalence.
 - Illustrate current state/ practice.
-
- Pulmonary complications can occur in up to 80% of patients after surgery- this is due to general anaesthesia and post-operative pain impairing the ability to take deep breaths.
 - Atelectasis is the collapse of one or more parts of the lung
 - Most common postoperative pulmonary complication following thoracic or abdominal surgery
 - Manifest as fever or hypoxemia and dyspnoea
 - Ambulation and performing deep breathing exercises is the best way to reduce the risk of atelectasis
 - Patients should use an incentive spirometry after surgery, and sometimes before surgery as well.



Atelectasis



Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
-
- The proposed solution seeks to allow healthcare providers to monitor the technique and compliance of patients performing incentive spirometry

 - Patients undergoing major abdominal or thoracic surgery will benefit from this solution

Name(s): SNC Ho Miew Ling, ADN Nancy Ang, SNM Aitiqah, SNM Chia Yeow Peng, SM Han Tiew Peng, Assistant Supervisor Alvin Goh

Department(s): Nursing, Central Sterile Supply Department

Institution(s): Tan Tock Seng Hospital

[CS10] A way to optimise the quality assurance in CSSD for the sterilisation of Reusable Medical Devices in order to reduce the incidence of rejected loads.

Notes:

- Describe disease – Background, incidence and/or prevalence.
 - Illustrate current state/ practice.
-
- All the re-useable medical devices (RMD) for TTSH are reprocessed at Central Sterile Sterilisation Department (CSSD) and these include all the RMD for Operating Theatres, Dental clinic, Inpatient ward, Outpatient, Ambulatory, NCID and many more.
 - The RMD includes variety of sets and loose instrument that comes in different sizes and quantities.
 - RMD need to be received, sorted, and manual washed prior to loading into washer disinfectant, visually inspected for cleanliness and functionality before packing, sterilisation, quality check before storage or distribution to users.
 - All these are performed by staff that are subjected to inconsistent practices and human error.

Notes:

- Describe shortcomings/inefficiencies of current practice.
 - What is clinical and/or economic impact of unmet need?
-
- **Shortage of manpower:** as the work at CSSD are repetitive, laborious and not attractive thus CSSD has difficulty in attracting and retaining staff.
 - **An average of 60 consignment sets per day (Monday to Saturday):** to wash, pack, sterilise and distribute. Each set ranged from 9kg to 11kg.
 - **Rejection of sets:** due to cleanliness, incomplete sets, no internal chemical indicators in the set.
 - **Only male staff can do sterilisation:** as the load is too heavy for a female staff to push the load into the steriliser. Each sterilisation lad consists of two trolley loads of instruments and sets. The maximum weight of a set is 11kg.
 - **Possible risk faced by staff:** are sharp injuries from sharp instrument during sorting; burnt from contact with the hot surface of steam steriliser, fall due to water on floor, back injury from handling of heavy sets.

Notes:

- Describe shortcomings/inefficiencies of current practice.
- What is clinical and/or economic impact of unmet need?

- **Operational workflow for RMDs:**

Receive RMDs > sort > wash > disinfect > **inspect** > pack > sterilise > **inspect/quality check** > distribution

- **Identified needs in workflow:**

1. Incidence of rejected lots – Automation at quality assurance stage to minimize rejected loads.
2. Manual wash, disinfection and sterilisation of big batches – Chemical indicators (E.g. autoclave tape) at checkpoints to measure/indicate cleanliness
3. Heavy workload and safety concerns – Robots to help with transportation and loading

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
-
- **Who** will mainly benefit from solution?
 - Patient's safety and users are assured of consistent sterilised and functioning reusable medical devices.
 - CSSD staffs have checkpoints for cleanliness reassurance before load rejection.
 - **What** should the proposed solution seek to achieve?
 - Consistent quality assurance of the products produced by CSSD with automation.
 - Re- design jobs to raise productivity and job longevity.
 - Increase productive with limited manpower.
 - **How** will benefit be measured?
 - Reduce rejection rate from 1% to zero by user.
 - Reduce time taken to reprocess the reusable medical devices reprocessed.
 - Increase in numbers of loads performed by the steam sterilisers.

Name(s): Dr Tay Jun Yang

Department(s): Infectious Diseases

Institution(s): Tan Tock Seng Hospital

[CS11] A way to address monitoring of treatment adherence for people with tuberculosis in order to achieve treatment completion while reducing the need for in person DOT services.

Notes:

- Describe disease – Background, incidence and/or prevalence.
 - Illustrate current state/ practice.
-
- In Singapore, the incidence rate of tuberculosis among Singapore residents has been about 30 – 40 per 100,000. In 2021, incidence rate among Singapore residents was 32.8 per 100,000.
 - Mycobacterium tuberculosis spreads via airborne transmission. The treatment of tuberculosis is of public health concern. Traditionally, this consists of 6 months of TB treatment. Failure to complete treatment may result in further transmission, relapse and/or emergence of drug resistant strains.
 - Direct observed therapy (DOT) has been the mainstay of treatment monitoring. This involves patients going to the polyclinic daily to be observed to be taking the pills.

Notes:

- Describe shortcomings/inefficiencies of current practice.
 - What is clinical and/or economic impact of unmet need?
-
- For DOT, patients have to travel daily to polyclinics at a fixed period of time to be observed to be taking pills. Polyclinics need to avail nursing staff for the fixed period (usually in the morning) to observe these patients taking the pills.
 - For patients with mobility issues, the alternatives of DOT are Video DOT (VDOT), Outreach DOT (ODOT) and Asynchronous VDOT (ADOT):

VDOT

Patients take meds
over zoom call

ODOT

Nurses observe
patients taking their
meds at home

ADOT

Patients record videos
of them taking meds
(Not available in Singapore)

Notes:

- Describe shortcomings/inefficiencies of current practice.
 - What is clinical and/or economic impact of unmet need?
-
- The treatment options are labour intensive, with one patient to one healthcare provider. Yet treatment monitoring is essential to prevent further transmission, relapse and emergence of drug resistant strains.
 - The impact of this treatment monitoring modality greatly inconveniences patients and takes up valuable manpower resources in polyclinics across Singapore.

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
-
- People with tuberculosis and healthcare systems providing DOT services.
 - Proposed solution should result in convenience for both patients and healthcare system to monitor and verify treatment adherence. ADOT is a promising approach if patient compliancy can remain high.
 - Benefits measurements (polyclinics can be engaged as controls)
 - **Qualitative** – patient feedback on convenience of new treatment monitoring modality versus that of DOT
 - **Quantitative** – treatment completion rate of patients (approximately 90%) on new treatment monitoring modality, healthcare resources saved from reduced need for DOT services.

Name(s): Dr Ting Yonghan¹, Dr Glen Ong Chern Yue¹, Dr Jordan Sim Zheng Ting¹, Dr Phua Chee Kiang², Dr Yap Kim Hoong², Dr Lee Chuen Peng², Prof John Abishneganaden², Dr Andrew Li Yunkai², Dr Edmund Lim Jun Hao², Dr Mathew Sachin Philip²

Department(s): Diagnostic Radiology¹ and Department of Respiratory And Critical Care Medicine²

Institution(s): Tan Tock Seng Hospital

[CS12] The project aims to reduce the manpower hours required to report LDCT for lung cancer screening, while maintaining accuracy. This would help to extend LDCT screening of lung cancer in the never-smokers.

Notes:

- Describe disease – Background, incidence and/or prevalence.
 - Illustrate current state/ practice.
-
- Globally, lung cancer is the leading cause of cancer-related death, especially among men. Compared with Western countries, Asia-Pacific countries, particularly Singapore, are showing alarming disparities in lung cancer patterns. Data from 2011 shows that 47.7% of lung cancers in Singapore are detected among never-smokers, compared to 10%–15% in Western countries.
 - Singapore does not currently have any lung cancer screening programmes in place at the moment. Current recommendations suggest that high-risk individuals undergo targeted screening using low-dose CT thorax (LDCT) who have these factors:
 - Adults aged 55-80 years
 - 30 pack-year smoking history (For example: a pack a day for 30 years, 2 packs a day for 15 years)
 - Current smokers
 - Smokers who quit within the past 15 years
 - Detection of lung cancer on LDCT is a labour intensive and tedious task, as it requires detection of small nodules in a large set of images. In a frequently used dataset (a subset of the lung cancer screening program from 1996 to 1999 in Nagano), the original manual misdetection rate was 76% (38 of 50 nodules were missed).
-
- Lung Cancer: Performance of Automated Lung Nodule Detection Applied to Cancers Missed in a CT Screening Program I. Samuel G. Armato, F. Li, M. L. Giger, H. MacMahon, S. Sone and K. Doi Radiology 2002 Vol. 225 Issue 3 Pages 685-692

Notes:

- Describe shortcomings/inefficiencies of current practice.
 - What is clinical and/or economic impact of unmet need?
-
- The majority of lung cancers are discovered after symptoms appear, when it may be too late to treat or cure them. Screening is intended to accomplish the following:
 - Detect cancer at an early stage when it is easier to treat and cure
 - Decrease cancer-related mortality
 - LDCT screening can then be applied selectively to never-smokers for the detection of early lung cancer with the development of additional biomarkers.
 - With increasing adoption of LDCT for screening of lung cancer and the general volume of imaging performed versus the relatively slower rate at which radiologists are being trained, augmentation of existing manpower to report these LDCT should be considered.

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
-
- Based on the results of the National Lung Screening Trial (NLST), over the course of about seven years, there are approximately three fewer deaths per 1,000 people screened with LDCT than with chest X-ray (17.6 versus 20.7 respectively).
 - The NLST showed that lung cancer screening could be cost-effective; it is estimated that screening can save about USD 81,000 per quality-adjusted life-year (QALY) gained over non-screening.
 - There are currently a number of solutions available on the market for the automated detection of nodules. The use of these solutions has been shown to improve lung cancer detection sensitivity and false positive rates.
 - The hypothesis of the project is that a commercially available AI solution for pulmonary detection and characterisation on LDCT will reduce the manpower hours for interpretation by 20% without significant (<10%) loss of accuracy.
 - During the Lung Nodule Analysis 2016 (LUNA16) challenge, the best AI solution reached a sensitivity of 97.2% at the expense of 1 false positive per scan on average.

Schreuder A, Scholten ET, van Ginneken B, Jacobs C. Artificial intelligence for detection and characterization of pulmonary nodules in lung cancer CT screening: ready for practice? *Transl Lung Cancer Res.* 2021 May;10(5):2378-2388. doi: 10.21037/tlcr-2020-lcs-06. PMID: 34164285; PMCID: PMC8182724.

Name(s): Dr Jacob Oh Yoong Leong

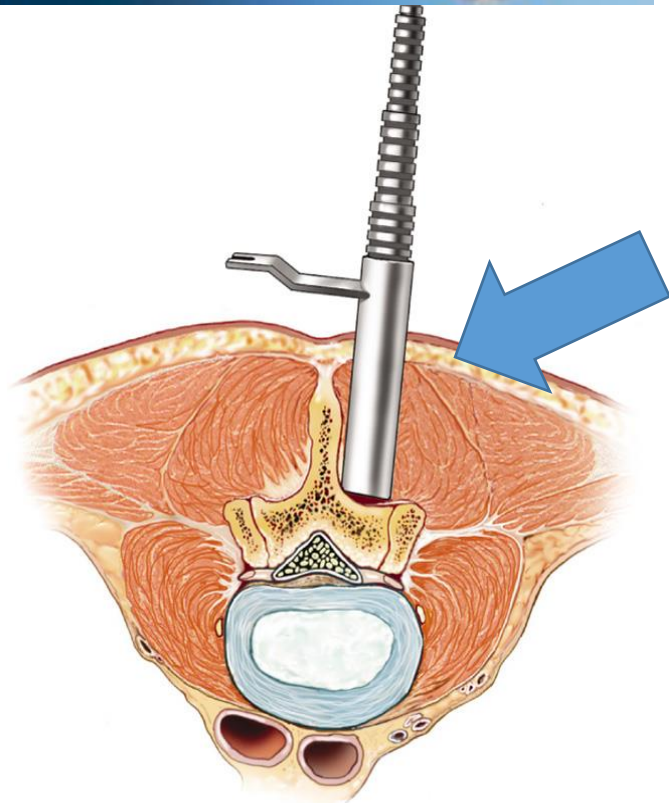
Department(s): Orthopaedic Surgery

Institution(s): Tan Tock Seng Hospital

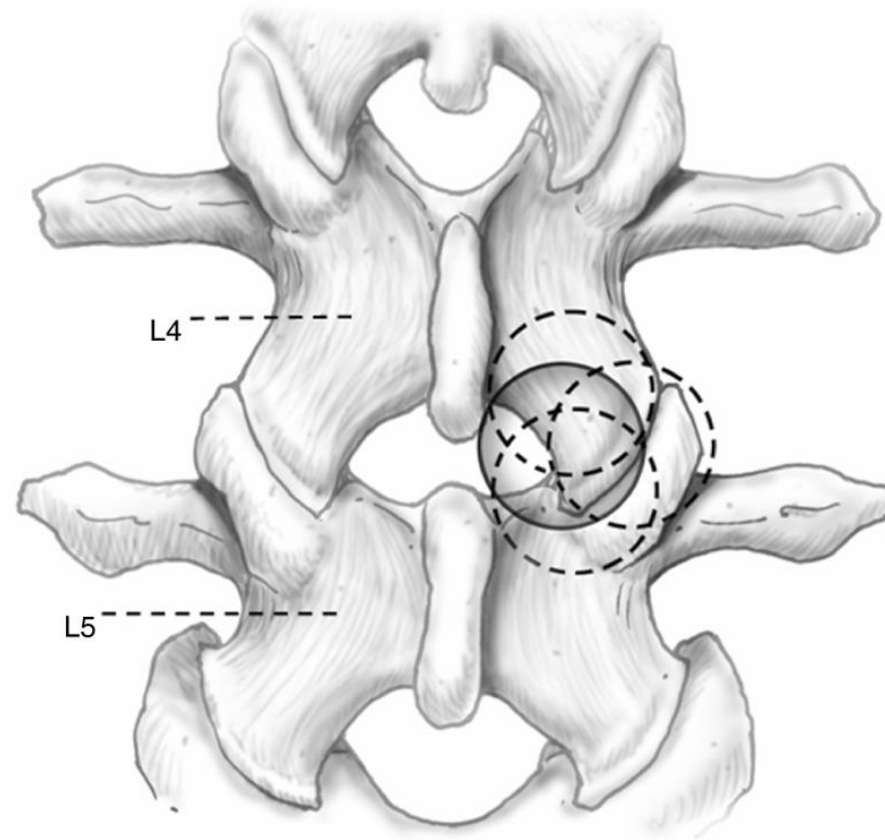
[CS13] A way to increase the precision of retractor placement for patients undergoing spinal decompression surgery in order to achieve shorter OT duration and reduction in surgeons' exposure to x-ray

Notes:

- Describe disease – Background, incidence and/or prevalence.
 - Illustrate current state/ practice.
-
- During spine surgery, robotic arm holds key surgical instrumentation in place for the surgeon. The robotic guidance helps surgeon execute the custom surgical plan with precision through micro incision.
 - During a spinal decompression procedure, a special retractor system (Metrx tubes see photo in next slide, blue arrow) is used to help the surgeon gain access to the intended surgical site.
 - We want to use the robot to **target and guide** us to this area, and also create a **attachment to fix** the retractor (orange arrow)
- Prevalence about 50-100 cases per year, and this will help reduce surgical time (by 20%) and xrays (20%).

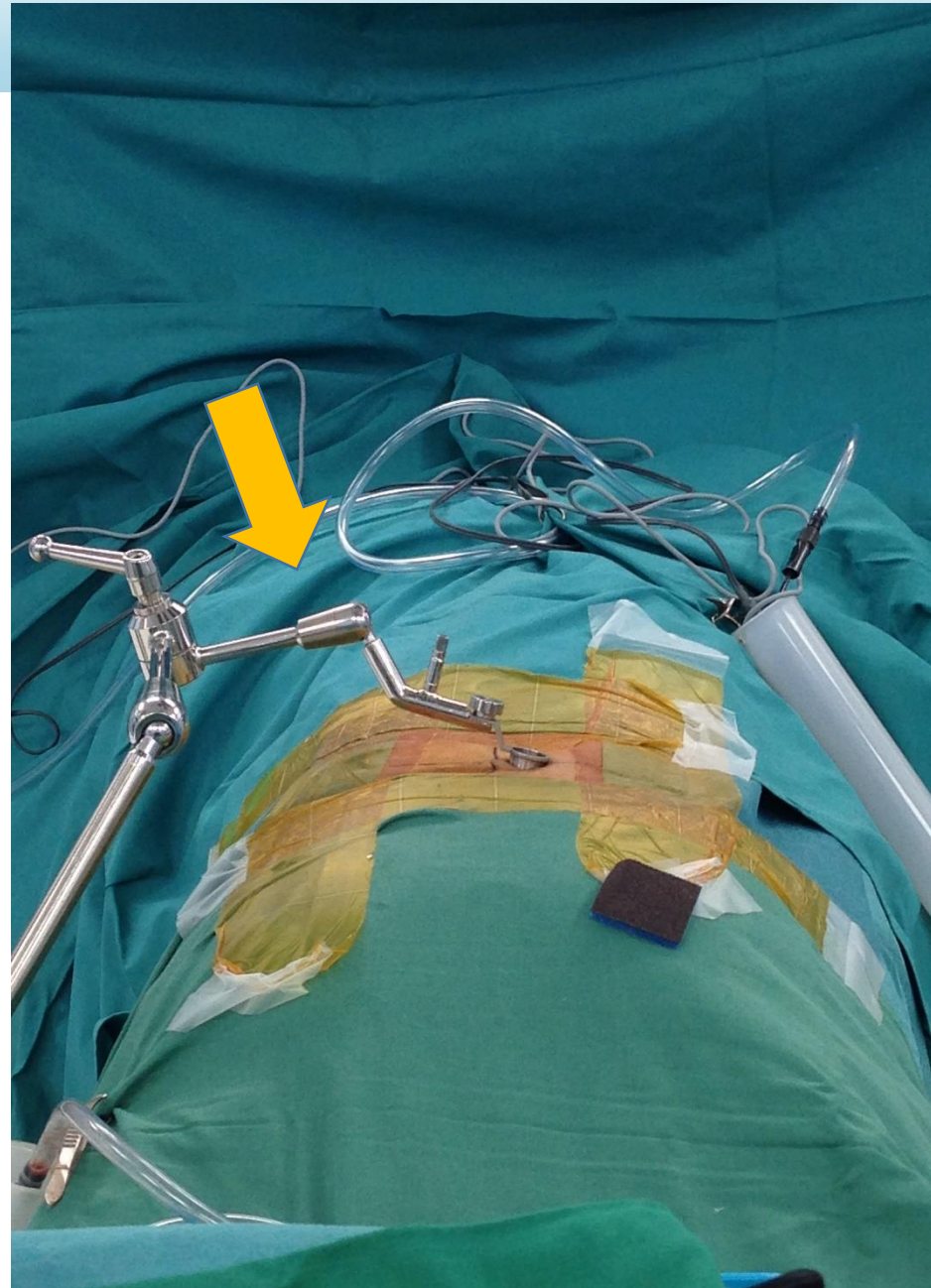
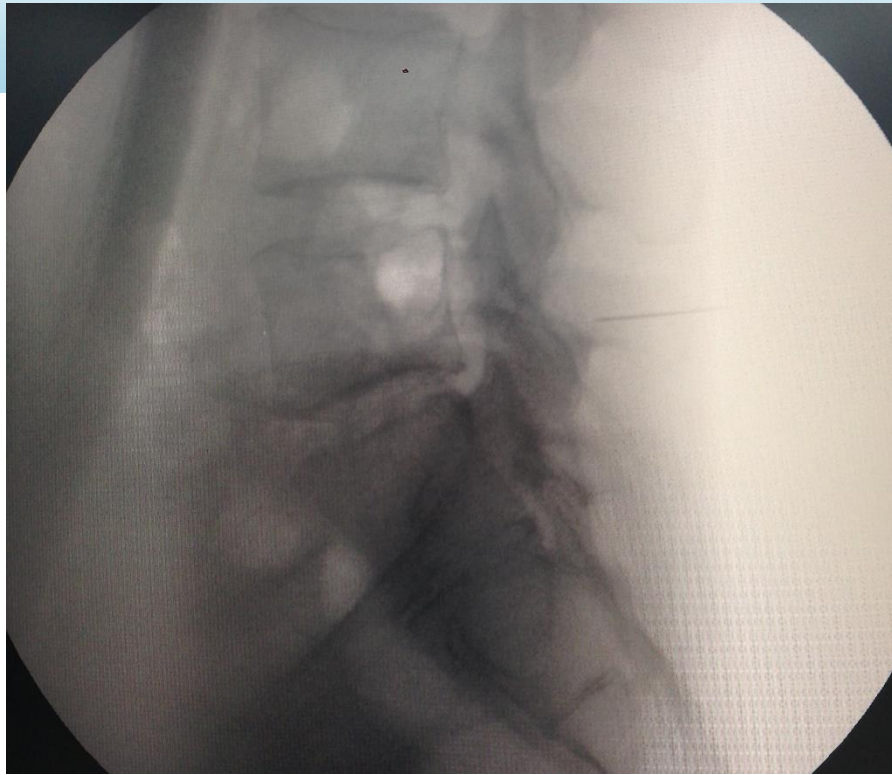


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Notes:

- Describe shortcomings/inefficiencies of current practice.
- What is clinical and/or economic impact of unmet need?

Inefficiencies of current practice

- Time spent to position and re-position the robot arm
- Multiple iterations between positioning and checking against x-ray scans to confirm position.

Clinical impact of unmet need

- To improve OT efficiency and reduce radiation

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
-
- Target population
 - Surgeons who perform spinal decompression procedure
 - Stakeholders involvement
 - Patients: Decreased OT time from X hours to Y hours
 - Surgeons: Decreased exposure to fluoroscopy from 30 minutes to 20 minutes
 - Payors: More cost-effective treatment from shorter hospitalization, and patients do not need to pay for extra set of screw for failed procedures
 - Device makers: the new attachment to be compatible with most robot arms, and attachment could be a new consumable for the robots
 - Outcome parameters pre and post intervention:
 - Reduction in OT time by 20% and Radiation to OT staff
 - Number of x-ray scans
 - Comparison of surgical cost
 - Qualitative feedback from surgeons on the new surgical procedure

Name(s): Gary Cheok

Department(s): Physiotherapy

Institution(s): National Healthcare Group Polyclinics

[CS14] An electronic portal to improve experience of patients with musculoskeletal pain when inputting outcome measures, undergoing patient education and evaluating physiotherapy services

Notes:

- Describe disease – Background, incidence and/or prevalence.
- Illustrate current state/ practice.
 - Musculoskeletal pain affects everyone
 - It is estimated that up to 80% of individuals would experience an episode of low backpain at some point throughout lifetime
 - Currently, MOH has implemented One Rehab framework throughout all public healthcare institutions; This requires all PHIs to use and track similar outcome measures (EQ5D (generic quality of life measure) and PSFS (patient specific functional scale)).
 - The outcome measures would track improvements in patient's quality of life and functional abilities
 - Education on patient's condition is done via face to face communication and is not standardized.
 - Evaluation of physiotherapy service is not done regularly and patient's experience measures are not captured

Notes:

- Describe shortcomings/inefficiencies of current practice.
- What is clinical and/or economic impact of unmet need?
 - Currently, EQ5D and PSFS questionnaires are administered personally by therapy assistants and the data is keyed in manually by therapy assistants
 - The questionnaires are lengthy and some patients have difficulty comprehending the questionnaires, resulting in inaccurate outcomes captured (e.g. for PSFS the patient may select a different activity during another visit and this voids the data for comparison)
 - Education on patient conditions is done face to face with minimal visualization of their musculoskeletal condition and lack of standardization.
 - Patients do not evaluate the quality of physiotherapy service and their experiential outcomes are not captured.
 - **The economic and clinical impacts:**
 - Therapy assistants spend more time doing administrative work to obtain data
 - Therapy assistants have lesser clinical time spent with patients and this could adversely affect clinical outcomes of patients
 - Patients often find the questionnaires lengthy, difficult to comprehend and this could affect the accuracy of clinical data captured
 - Patients do not undergo standardized education on their conditions and may still have poor understanding of their conditions
 - Patients currently do not evaluate the physiotherapy service and it is unknown whether the service is meeting patient's experiential needs

[CS14] Target Population and Outcome

Notes:

- **Who** will mainly benefit from solution?
- **What** should the proposed solution seek to achieve?
- **How** will benefit be measured?
 - Therapists, Therapy assistants and patients
 - **We propose creating a one-stop robotic portal for multiple purposes:**
 1. Capturing One Rehab Outcome Measures
 2. Delivery of educational videos specific for patient conditions
 3. Capturing patient's evaluation of physiotherapy service and experiential outcomes
 - **From an innovation perspective:**
 - The questionnaires can be delivered with video/game cues so patients can better understand the questions.
 - Patients can return to the robotic portal to revisit educational topics on their conditions and have a video-visualization of their musculoskeletal condition.
 - Patients can electronically evaluate the physiotherapy service they have received.
 - **The solution seeks to achieve:**
 - Better patient experience in filling outcome measures
 - Improved accuracy of data
 - Portability of data to EPIC system so therapy assistant's time can be saved for doing other clinical work
 - Improved health literacy of patients regarding their own conditions
 - Capturing of patient's feedback and evaluation of physiotherapy service
 - **Benefit can be measured:**
 - in terms of time saved by therapy assistants and therapists when administering those questionnaires
 - accuracy of data
 - amount of time patient contact time spent by therapy assistants
 - patient's health literacy/ understanding of their condition
 - patient's experience in doing the modified questionnaires and overall experience of physiotherapy service
 - Data of patient's experiential outcomes can be captured

Name(s): Dr Tor Phern Chern

Department(s): Mood & Anxiety (Neurostimulation)

Institution(s): Institute of Mental Health

[CS15] A way to increase the effectiveness of transcranial magnetic stimulation for patients with major depressive disorder in order to achieve shorter treatment duration, higher response rates and higher quality of life.

Notes:

- Describe disease – Background, incidence and/or prevalence.
 - Illustrate current state/ practice.
-
- Major depressive disorder is a prevalent¹ (approximately 1 in 20 in Singapore) and disabling^{2,3} psychiatric condition with a significant treatment resistant (TRD) subpopulation.
 - The economic burden of depression in the Asia Pacific region and Singapore⁵ is high and up to 50% of indirect costs were associated with lost productivity and unemployment.
 - The mean annual cost of treatment for depression in Singapore is USD 7,638.⁶ The current standard of care for depression remains suboptimal with a large proportion of patients not responding satisfactorily and are classified as treatment-resistant depression (TRD).⁷
 - Current treatment for TRD is either more medication treatment or neurostimulation (transcranial magnetic stimulation/TMS or electroconvulsive therapy/ECT)

Notes:

- Describe shortcomings/inefficiencies of current practice.
- What is clinical and/or economic impact of unmet need?
 - Intermittent theta burst stimulation (iTBS) is an approved form of non-invasive magnetic stimulation (TMS) treatment for TRD. It has high tolerability and patient acceptability.
 - However, response rates with iTBS are still suboptimal at 25.1% to 46.6%⁸. This could be attributed to the brain functional connectivity that is different for every individual, hence a one-size-fits-all (prescription of standard iTBS frequency) approach is not optimal.
 - The limited existing gold standard treatment for TRD is electroconvulsive therapy (ECT). However, it is challenging to use due to low tolerability⁴ and suboptimal response rates (50-70%⁹) and require several weeks for treatment⁹.
 - **Recent innovations (SAINT protocol) pioneered by Stanford University¹⁰** in the process of iTBS delivery can dramatically increase TRD response rates (from 25.1%-46.6% to 80-90%) in less time (6 weeks to 1 week).
 - The SAINT protocol has been US FDA approved 6th Sep 2022 consisting of:
 - Individual neuronavigated treatment based on resting functional connectivity of fMRI
 - Accelerated intermittent theta burst (iTBS) (i.e. multiple rather than single treatments a day)
 - Treatment of depression is estimated to give a 5.7-to-1 benefit-to-cost ratio.¹¹

[CS15] Target Population and Outcome

Notes:

- **Who** will mainly benefit from solution?
- **What** should the proposed solution seek to achieve?
- **How** will benefit be measured?

- **For interest, a precision medicine treatment for depression consist of:**
 1. A system to ingest fMRI (to map individual brain functional connectomics)
 2. Advanced computational analytics on fMRI
 3. Output the algorithm to precision robot arm to target iTBS treatment
- Target population
 - Patients with treatment resistant depression (failing 1-2 rounds of pharmacotherapy for depression)
- Stakeholders involvement
 - Patients: Decreased illness time from 6 weeks to 1 week
 - Treatment Facility: Decreased hospitalization time from 6 weeks to 1 week
 - Payor: More cost-effective treatment from shorter hospitalization and cheaper treatment (TMS is approved as cost effective treatment by MOH ACE in Jan 2022¹²)
- Outcome parameters pre and post intervention:
 - Response rate defined by $\geq 50\%$ improvement of the depression rating score (MADRS)
 - Cost effectiveness and Subjective quality of life assessed via self-reported EQ-5D
 - Patients' functioning will be assessed by the self-rated Sheehan Disability Scale (SDS)
 - Patients' global cognitive functioning assessed by the Montreal Cognitive Assessment (MoCA)

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2. Ho RC, Mak K-K, Chua AN, Ho CS, Mak A. The effect of severity of depressive disorder on economic burden in a university hospital in Singapore. *Expert review of pharmacoeconomics & outcomes research*. 2013;13(4):549-559.
3. Subramaniam M, Abdin E, Vaingankar J, et al. Tracking the mental health of a nation: prevalence and correlates of mental disorders in the second Singapore mental health study. *Epidemiology and psychiatric sciences*. 2020;29.
4. Sackeim HA, Aaronson ST, Bunker MT, et al. The assessment of resistance to antidepressant treatment: rationale for the antidepressant treatment history form: short form (ATHF-SF). *Journal of psychiatric research*. 2019;113:125-136.
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Name(s): Ms Lai Mun Wai, Dr Eyvonne Sim (PhD) and Dr Shiek Abdullah Bin Ismail (PhD)

Department(s): Rehabilitation Services

Institution(s): Khoo Teck Puat Hospital

[CS16] A way to complement existing basic vestibular training for junior PTs in order to improve training efficiency and PTs' confidence in vestibular-related on-call duties.

Dizziness

- Dizziness affect 15% to 20% of adults yearly
- Of these, about 25 percent are related to vestibular disorders (Neuhauser, 2016)

Dizziness and vestibular physiotherapy

- Patients with dizziness are often referred for vestibular physiotherapy assessment
- Vestibular rehabilitation therapy is an advanced area of practice in physiotherapy
- Junior physiotherapists (PTs) need to be trained to manage patients with dizziness

Current Basic Vestibular Rehabilitation Training Practice

- It is conducted biannually for junior PTs to prepare them for both weekday and weekend on-call duties
- Basic vestibular rehabilitation training forms part of this training to equip the PTs with the relevant knowledge to assess and treat patients with dizziness.
- The training consists of:
 - A 3-hour theory and practical session
 - 5 one-on-one mentoring sessions whereby the newly trained PTs see patients with a vestibular-trained mentor within 6-8 weeks

Current practice

Basic vestibular rehabilitation training is conducted in-person. This basic training is to be completed within two months.

The training includes:

- A 3-hour theory and practical session
- 5 one-on-one mentoring sessions whereby the junior PTs see patients with a vestibular-trained mentor within 6-8 weeks to complete their preceptorship

Shortcomings of current practice

- Dependent on availability of vestibular-trained mentors
- Space constraint: only maximum 4 PTs per training session
- Time constraint in view of clinical load > limited training time
- Junior PTs are unable to apply/ practice their newly acquired knowledge and skills in a timely manner

Impact of unmet needs

- Junior PTs needed extended time to complete their vestibular preceptorship
- Junior PTs do not feel confident in managing patients with dizziness
- Patients may be subjected to repeated assessment if PTs require consultation with vestibular-trained mentor when in doubt
- A smaller available pool of on-call ready PTs

Target Population

- Junior PTs who are undergoing Basic Vestibular rehabilitation training

Stakeholders involved

- Efficiency of hospital processes
- Junior PTs who are newly train in vestibular rehabilitation
- Vestibular-trained mentors
- Patients with dizziness who are referred for PT

Target Outcome

- Improvement in Junior PTs' exposure and confidence in vestibular rehabilitation
- All Junior PTs to be competent in the skills taught during the basic vestibular training without extension required
- To have an adequate pool of vestibular-trained PTs for on-call duties

Outcome Measurement

- Pre- and post- training confidence scores
- Track the number of vestibular-trained and ready PTs per 6-month rotation period
- Comparison of time taken to complete the basic vestibular training in old versus new training curriculum

Name(s): Dr Tan Chee Hian

Department(s): -

Institution(s): National Skin Centre

[CS17] A way to improve sun protection practices for patients who has been diagnosed with at least 1 skin cancer in order to achieve secondary prevention of skin cancer

Notes:

- Describe disease – Background, incidence and/or prevalence.
 - Illustrate current state/ practice.
-
- Skin cancer is the 6th most common cancer in males, and 7th most common cancer in females in Singapore.
 - The most common cause is that of prolonged, cumulative ultraviolet ray (UVR) exposure. In order to prevent skin cancer development, one should seek shade or use devices to protect against sun. This include sunblock creams, and UVR-blocking clothes or umbrella.
 - Sun protection is essential even on cloudy days or when indoors as the UVR could penetrate the clouds and/or glass.
 - The ultraviolet index (UVI) is an international standard index that describes the level of solar UVR on the earth's surface. The index ranges from 0 to >11. A higher index value indicates a greater potential for harmful effects to the skin and the eyes.

Notes:

- Describe shortcomings/inefficiencies of current practice.
 - What is clinical and/or economic impact of unmet need?
-
- For effective sun protection, one would need to re-apply sufficient sunscreen creams every 4 hours and this may vary according to the type of activities one engages in. For example, one should apply sunscreen more frequently when one engages in outdoor water activities.
 - Prolonged use of fabric and umbrella may be subjected to wear and tear and this may reduce its sun protective effects.
 - Sun protection should be continued even while indoors and on cloudy days, as UVR can penetrate glass and clouds.
 - At this juncture, there is no good way to determine if a person needs sun protection at a specific location, nor is there any good way to determine if sun protection has been adequately applied.

Notes:

- **Who** will mainly benefit from solution?
 - **What** should the proposed solution seek to achieve?
 - **How** will benefit be measured?
-
- We propose to develop a portable device that could accurately measure the UVR index at a specific location. In addition, the device would be able to assess if adequate sun protection is employed.
 - In general, anyone would be able to benefit from this device. For a start, the target population would be patients who have had 1 or more skin cancers diagnosed as this group of patients would be at risk of developing new skin cancers.
 - Benefits can be measured as follows:
 - Improvement in the use of sun protection e.g. increase frequency of use of sun protection devices
 - Increase awareness in sun protection amongst our patients e.g. survey before and after use of device
 - Reduction in skin cancer

Name(s): Dr Lambert Low, Dr Lee Soon Hong

Department(s): National Addiction Management Service (NAMS)

Institution(s): Institute of Mental Health

[CS18] A way to reduce alcohol intoxication for patients with alcohol use disorder in order to reduce the rate of presentations to the emergency services while intoxicated.

Notes:

- Describe disease – Background, incidence and/or prevalence.
- Illustrate current state/ practice.

Alcohol Use Disorder

Based on the Singapore Mental Health Study, a national wide, cross sectional epidemiological survey initiated in 2016, lifetime prevalence of alcohol abuse is 4.1% compared to Singapore Mental Health Study done in 2010 of 3.1%

Frequent alcohol use is also associated with increase medical problems, such as liver cirrhosis, alcoholic encephalopathy, frequent falls, and increased risk of suicidality.

Alcoholics that become drunk also often come to the emergency services disinhibited and in various kinds crisis– be it aggression or suicidality only to demand discharge from Emergency Services when sober. This takes up a lot of resources in the acute emergency settings, which results in longer waiting time at the emergency services, and wasting of resources.

Notes:

- Describe shortcomings/inefficiencies of current practice.
- What is clinical and/or economic impact of unmet need?

Shortcomings/inefficiencies of current practice

Crisis that is faced in the emergency services are made significant because of the dis-inhibition brought about by intoxication. Many intoxicated patients are no longer suicidal/aggressive when they become sober, which means that often the emergency services will have to wait until they regain lucidity or admit them for a short while only to discharge them shortly after when they become lucid.

This is not judicious use of resources, and even if there is a stressor triggering the drinking cycle, no interventions can be done when patient is intoxicated as well

What is clinical and/or economic impact of unmet need?

Unmet clinical need is to prevent patients with known alcohol use disorder from becoming intoxicated, leading to acute presentations in the emergency services, for disinhibited behaviour presenting as aggression or suicidality.

Notes:

- Describe shortcomings/inefficiencies of current practice.
- What is clinical and/or economic impact of unmet need?

Clinical workflow

Patient drinks for various reasons(distress, social situations, help with sleep) → Once start drinking, unable to regulate amount drunk → Drunk at ED → Stay in ED until lucidity (no longer suicidal/aggressive), and while drunk, no reasonable intervention can be done until patient regains lucidity (leading to poor use of ED resources) → Typically referral is made to National Addictions Management Services(NAMS) outpatient clinic for continued outpatient support.

Identified Need

Identified need here is that ED services are hogged up dealing with intoxicated patients who may otherwise be able to be managed as outpatient at NAMS

Notes:

- **Who** will mainly benefit from solution?
- **What** should the proposed solution seek to achieve?
- **How** will benefit be measured?

Who will mainly benefit

Healthier community: People with alcohol use disorders who have difficulties abstaining from alcohol

Hospital processes: Efficient use of manpower and resources with lesser time spent on intoxicated patients in the Emergency Services.

What should the proposed solution seek to achieve?

Reduction in intoxication rates, assessed by number of Emergency Service visits due to intoxication

How will benefit be measured?

Benefit will be measured based on a reduction in frequency of Emergency Room presentations as a result of alcohol intoxication. This will be a proxy to assess for a reduction in the number of alcohol intoxication episodes for patients with alcohol use disorders.