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Development of a dysphagia cup to improve patients' fluid intake and reduce caregiver burden

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ABSTRACT

Ensuring that the elderly drink adequate fluids to meet their recommended daily allowance is often a challenge, especially among the elderly in hospitals and long-term care settings. The complex interplay of biological, medical and psychosocial factors that cause the elderly to become dehydrated is difficult to tackle especially in care settings where there is a staff shortage and heavy workload. The team realised that 90% of the elderly inpatients in the general ward of a teaching hospital in Singapore were not drinking enough to meet their needs, despite the hot and humid weather. Reasons which contributed to inadequate fluid intake included human resources, environmental, patient and system factors. Strategies were put in place to improve fluid intake but were not successful, due to staff shortage and time constraints. The team ended up innovating and producing a dysphagia cup to improve fluid intake, promote independence among patients while encouraging them to drink more, improve nursing efficiency, reduce caregiver burden and reduce aspiration risk. The cup was able to meet all the expectations with good feedback from the care team, patients and their families.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Dehydration is common among elderly patients in hospitals and nursing homes and carries with it a high risk of morbidity and mortality. However, there is little literature or publications on methods to reduce dehydration risk among the elderly.

WHAT THIS STUDY ADDS

⇒ This quality improvement project aims to improve fluid intake among elderly inpatients and increase nursing productivity. Various strategies such as scheduled fluid rounds were employed, but these methods failed due to staff shortages within the hospital. A dysphagia cup was created to improve patients' access to fluids and increase nursing productivity by enabling patients to feed themselves independently. Overall, this innovation was successful in increasing fluid intake as well as overall patient, nursing and caregiver satisfaction.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Improving nursing education on dehydration and increasing accessibility to fluids have proven to be key stepping stones in reducing dehydration risk. The efficacy of the dysphagia cup in helping to improve oral intake can pave the way to help other groups of patients with dysphagia improve and maintain adequate fluid intake, and lower dehydration risk.

PROBLEM

In clinical practice, dehydration refers to the loss of body water, with or without salt, at a rate greater than the body can replace.[1] In Singapore's tropical climate, dehydration is common, especially among the elderly who have hypodipsia and disabilities. Dehydration often goes undetected and undiagnosed in the elderly, especially in institutional settings such as hospitals and nursing homes.

Poor fluid intake among the elderly can be due to multiple reasons. First, the physiological changes due to ageing result in reduced homeostatic capacity and an impaired ability to maintain electrolyte balances. The elderly also have reduced thirst sensation and impaired renal function, which results in reduced water conservation capacity.[2] Other factors associated with dehydration risk include dysphagia,[3] cognitive impairment and functional decline resulting in difficulties with eating and drinking.[4]

While dehydration remains one of the most common fluids and electrolyte problems among the elderly, in the setting of acute illness, clinical assessment of hydration status is unreliable and difficult. Coupled with vague clinical signs, dehydration is often overlooked.[5] Complications of dehydration include worsening of medical conditions, increased costs to both individuals and the healthcare system, as well as a diminished quality of life.[6] Dehydration may also lead to other medical complications such as acute kidney injury, delirium, constipation and orthostatic hypotension, which can cause giddiness and falls.

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Changi General Hospital (CGH) is a 1066-bedded teaching hospital located in the East of Singapore. At any one time, >60% of beds are occupied by elderly individuals>65 years old. A prior study carried out in CGH found that 90% of elderly inpatients did not consume the recommended daily fluid allowance during their stay in an acute geriatric ward, even among the independent elderly. The factors that contributed to poor water intake included cognitive issues, functional dependency and dysphagia.[7]

As such, a quality improvement project was initiated to examine factors causing poor fluid intake and to find ways to improve the situation. The main aims of the project were to: (1) increase the number of patients who can consume the recommended daily allowance of water in the pilot geriatric wards by at least 50% and (2) improve nursing productivity by 50% when it comes to assisting patients with fluid intake. The team simultaneously took on projects looking at ways to improve water intake among the inpatients, including the innovation of a dysphagia cup. The outcomes of the project were measured pre-implementation and post- implementation, among 20 patients over 16 months.

BACKGROUND

In 2018, a study was conducted across three acute geriatric wards in CGH[7] with a total of 99 patients over a 1-month study period. Patients admitted with feeding tubes were excluded from the study. The study aimed to investigate whether the elderly inpatients in acute geriatric wards consumed adequate fluids during their hospitalisation stay. The study found that 90% of the elderly inpatients did not consume the recommended daily fluid allowance of 1.6 L/day for females and 2.0 L/day for males as recommended by the ESPEN guidelines.[8 9] (There are no local published data.) The mean amount of water consumed daily was 1030 mL (range of 500–2200 mL) and only 10% of the patients met the lower limit of daily recommended water consumption. Problem analysis conducted after that study revealed several contributing factors towards poor oral fluid intake (figure 1), which broadly were classified under patient factors, environmental factors and staffing limitations.

Several other studies have also been conducted over the years that have highlighted similar issues of low fluid intake among the elderly worldwide. The various studies published recruited elderly patients from hospitals and long-term care settings. Risk factors found to be associated with dehydration risk and poor fluid intake included staff factors such as availability of staff to assist during meal times, cognitive impairment of patients, increasing age, dysphagia and functional dependency. Social factors such as dining alone and being around unfamiliar dining areas and cutlery also contributed to poor intake. On the other hand, serving meals in a communal dining area, having trained staff to assist patients, decorations resembling patients' homes such as table cloths and allowing residents to choose their favourite beverages did show improvement in overall intake.[4 10–13]

There were also a wide variety of methods used to assess dehydration. However, the diagnostic accuracy remains inconsistent and clinical assessment of dehydration remains complex. Despite this, an overall consensus remains among the different studies - that maintaining

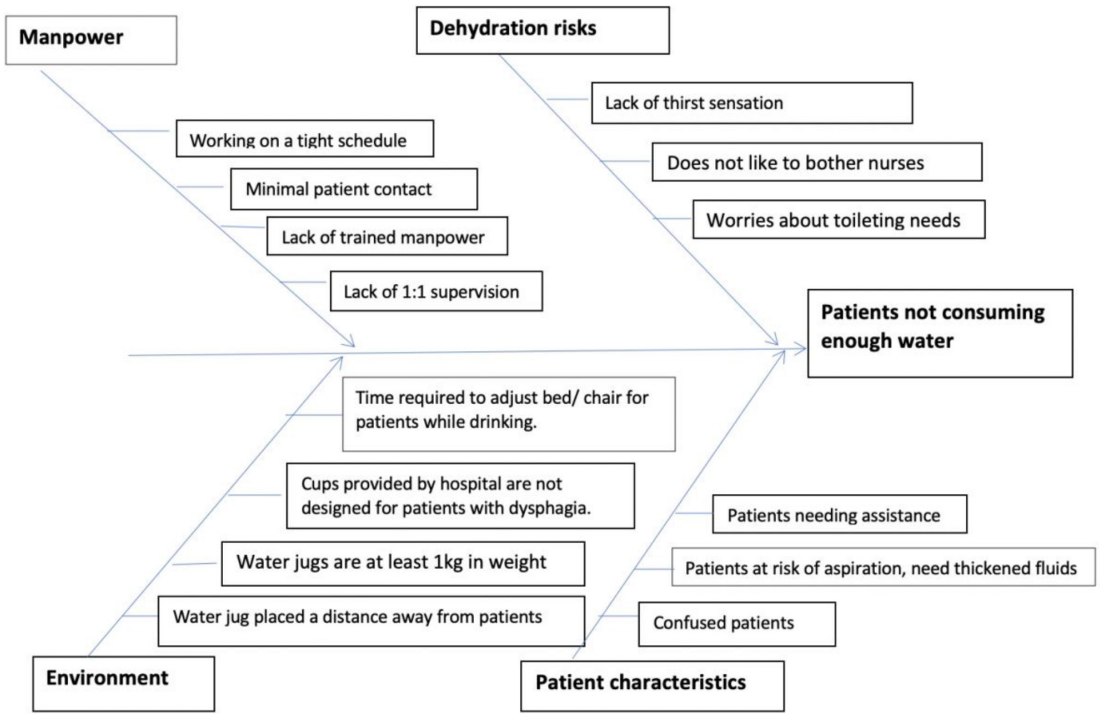

Figure 1 Fishbone chart showing factors contributing towards low oral fluid intake.

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adequate oral hydration is essential for the elderly, especially among those who are hospitalised and those with a background of multiple comorbidities. Insufficient fluid consumption among elderly patients is associated with myriad complications such as worsening of their medical conditions and increased morbidity and mortality.

Design

A project team was formed consisting of a senior geriatrician, gerontology-trained nursing staff as well as allied health professionals such as occupational therapists and speech therapists who had special interests in gerontology. The project aimed to seek out ways to improve fluid intake among elderly patients admitted to acute geriatric wards.

Strategies

A pilot project 'scheduled fluid rounds' was started to help improve hydration among the elderly. The pilot was carried out for 6 months. During this pilot, 2 acute geriatric wards with 64 beds in total were involved. Nurses on duty scheduled themselves to serve fluids to patients at 2-hourly intervals. However, due to shortages in staffing, especially in light of the COVID-19 pandemic, the nurses and hospital staff were all heavily inundated. This resulted in a low take-up rate of the project and limited overall success. The nurses were inconsistent with data collection since staff were deployed to cover COVID-19 patients in either the hospital or in community step-down care facilities. The project team realised that due to the ongoing pandemic, staffing issues were not going to be resolved in a short-to-medium-term basis, and unpredictability of workforce allocation within the hospital was also to be expected. As such, a new method had to be devised to help minimise workforce utilisation and yet still be successful in helping to achieve the project aim of better hydration for the patients.

The team regrouped to explore other options to improve fluid intake while saving nurses' time, among elderly inpatients and decided to analyse the main steps involved (figure 2) in serving fluids to the patients. The drinking cups in the wards were ordinary drinking cups of 150 mL in capacity, which require 1:1 supervision while the patient drank from the cup to reduce aspiration risk. The drinking cups in the wards do not have a measuring gauge, which can make the fluid thickening process time-consuming as getting the fluids to the prescribed consistency is a hit-and-miss process.

The team found that there were two key steps involved in the process of serving the patients' fluids whereby nursing time could be saved. The first step was in the time consumed trying to get drinking fluids to the prescribed consistency, and the second step was in having to assist patients to drink by actively encouraging them and holding the cups for them. As such, the team decided to explore developing a dysphagia cup to allow both nurses and caregivers to save the time needed to thicken fluids and to improve ease of administering fluids to patients under their care. In addition, if the cup could enable patients to help themselves to have a drink intermittently, this would also free up nurses to continue with their work.

'The Happy H to O Team' was formed to innovate and produce a dysphagia cup. The aims of this strategy were to (1) to increase the number of patients meeting their daily fluid allowance by at least 50% in the pilot wards and (2) improve nursing productivity by 50% when it comes to assisting patients with fluid intake.

In terms of idea generation, prioritised solutions were brainstormed by the team, and were then tested and implemented. The team ranked and scored generated ideas based on the following factors: feasibility of implementation, acceptability, applicability and effectiveness. When the dysphagia cup's design was developed and finalised, plan–do–study–act (PDSA) methodology was adopted during the implantation process, and the pilot of this new solution was rolled out in two geriatric wards. Figure 3 depicts the design of the cup and figure 4 depicts an ordinary drinking cup found in the wards.

The dysphagia cup was designed with ergonomics in mind and it aimed to help accommodate patients of all ages at varying levels of independence who require assistance for drinking. The team hoped to produce a cup which was user-friendly, suitable for all age groups and easy to clean. Key design features also included having a non-slip base, being made of durable material, and having a water-tight seal. The design should, with its use, provide the advantage of being time-saving for caregivers while also minimising aspiration risk for its users. The team managed to engage a commercial firm which specialised in manufacturing medical equipment to produce a 3D print for the dysphagia cup. The hospital's department of procurement engaged an external vendor with

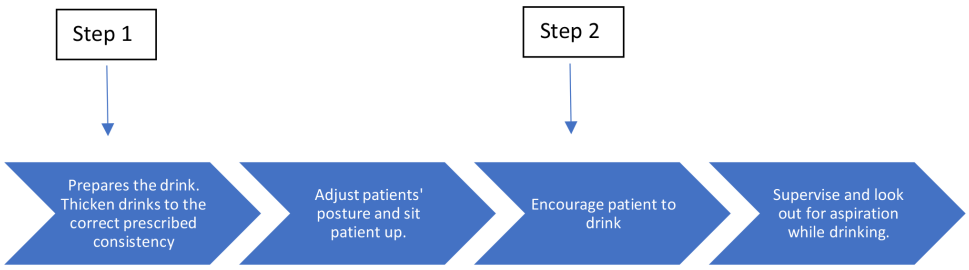

Figure 2 Steps involved in getting patients a drink.

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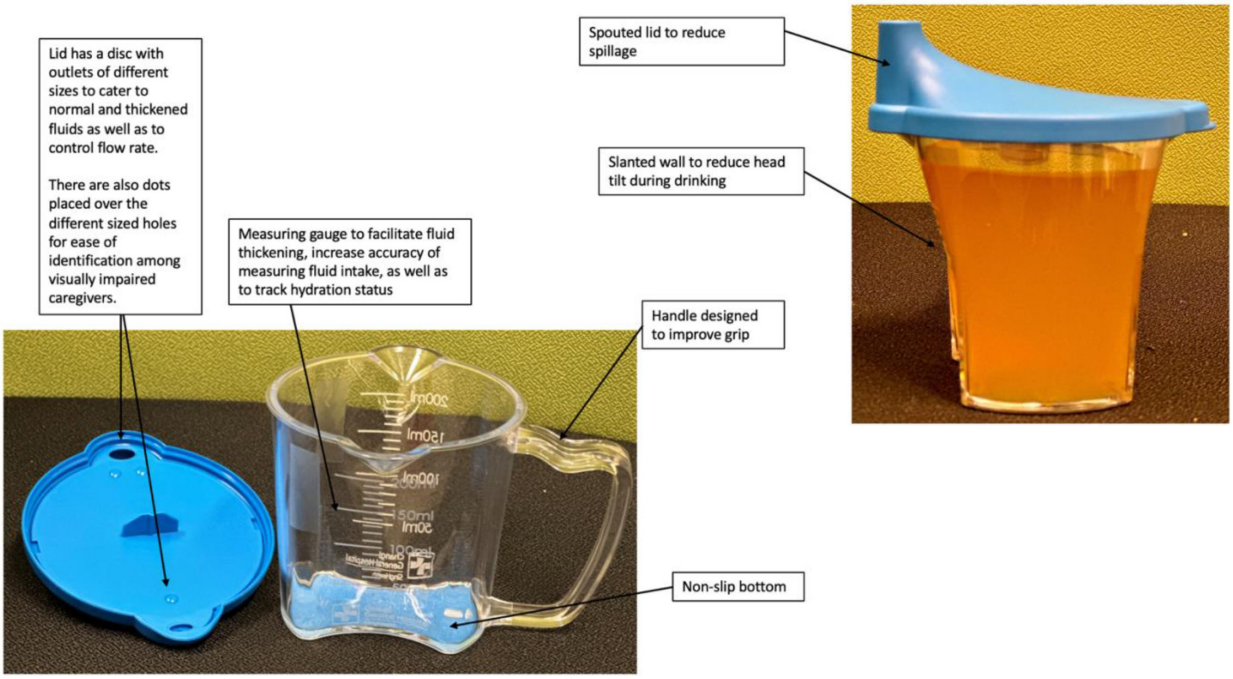

Figure 3 Design of the dysphagia cup.

experience in engineering and manufacturing medical devices for this project. The lifespan of the cup was estimated to be at least 5 years.

The cup was also developed with inputs from occupational therapists and speech therapists. As shown in figure 3, the cup has an ambidextrous handle shaped for easy grip. There is a measurement scale at the side of the cup as well to help facilitate the fluid thickening process, which usually takes 5–15 min for a conventional cup. The spout was designed to reduce spillage and, the cup's walls are slopped to help reduce the need to tilt the head back too far during drinking, which could in itself increase aspiration risk as excessive head tilt during drinking opens the airways. The cup's lid has an inner disc, which has two outlets of different sizes to cater for normal as well as thickened fluids. These features are also useful in helping to control flow rates and ensure safety for patients with oropharyngeal dysphagia.

Dynamic testing was done at every stage of development. Feedback from staff, elderly patients and their families were actively sought and all feedback was taken into consideration during subsequent modifications. The cup took about 9 months to develop.

The first PDSA cycle commenced on 1 August 2020, for 3 months. The nursing process in assisting fluid intake was reviewed and training sessions for the ward nurses were held before the final introduction and implementation of the dysphagia cup. A new workflow was introduced to help facilitate the fluid intake process. In addition, the speech therapists also helped to assess and identify

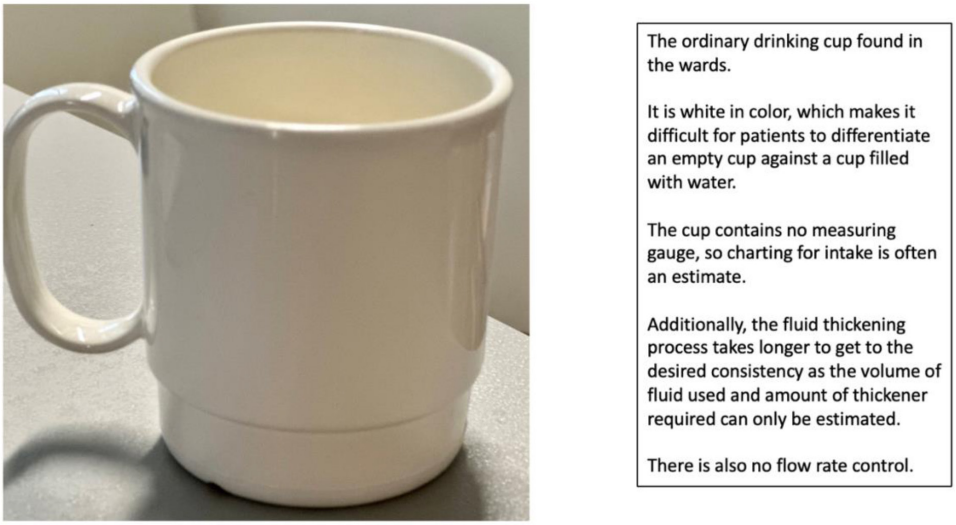

Figure 4 Ordinary drinking cup found in the wards.

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suitable patients to try out the dysphagia cup. Patients and their families were informed of the indications for the cup and consent was taken before the cups were issued to the patients. On discharge, caregiver training was also provided on how to use the cup at home.

The first PDSA cycle identified problems of losing/misplacing the inner disc of the cup's lid during washing and forgetting to insert the inner disc. The nurses were educated on the care of the cups and pictorial reminders were put up on the patients' cardiac tables for the patients who were given the cup.

The second PDSA cycle commenced on 25 June 2021. There was a delay from the first PDSA cycle due to a severe staffing shortage during the pandemic. The tests of change process were similar to the first cycle, and the dysphagia cup was newly included as part of the ward orientation for new nurses.

Measurement

During the implementation, real-time studies were conducted to compare the time taken for the patients to have a drink from the dysphagia cup versus the time taken for them to have a drink via the conventional method of serving patients' fluids.

The nurses' documentation of oral fluid intake was reviewed at the pre-implementation and post-implementation stages by a neutral party. The review occurred on patients' discharge from the hospital. Random audits were conducted to review nursing productivity whereby nursing time-saving was tracked through daily inpatient nursing records.

The team designed two separate survey forms to assess satisfaction levels from the nurses, patients and their families regarding the use of the dysphagia cup. The survey forms were given out at the point of patients' discharge from the hospital and handed to the nursing staff, patients and their families.

The team assumed a null hypothesis that water intake should remain the same with or without the dysphagia cup since various factors have impact on fluid consumption. The team assumed nursing productivity remained the same using the dysphagia cup since the care staff still had to position the patient, prepare the fluids as well as provide supervision. Since the dysphagia cup had several additional features and parts compared to the conventional drinking cup used in the wards, the team assumed that satisfaction levels might be poor among the staff and the patients/families.

For PDSA cycle 2, the team also did random checks on the cups to see if parts were lost or misplaced.

RESULTS

There were 20 patients from pilot wards who were issued the cup. The data collection commenced from August 2020 to September 2020. The project was suspended in October 2020 due to various hospital restrictions in response to the COVID-19 pandemic. The restrictions were gradually lifted as the COVID-19 situation stabilised in Singapore towards the middle of 2021, and data collection resumed from June 2021 to September 2021.

Results collected showed a 62% improvement in the total daily amount of fluid consumed. The amount of fluid consumed by the patients was retrieved through prospective intake/output chart reviews. The measured fluid consumed per day included drinks such as water, tea, coffee, sweetened drinks, fruit juices and oral nutritional supplements. The first choice of fluid offered was water. However, some patients did not like the taste of plain water. The team, therefore, explored other types of beverages available, preferably to the patients' liking, to improve overall fluid consumption. It was found that the type of fluids offered did not make any difference in the amount of fluid consumed pre-implementation and post-implementation of the dysphagia cup, since the patients were offered the same choices of fluid to drink.

Comparing the total daily fluid consumption pre- and post-implementation of the dysphagia cup, the increase in the amount of daily fluid intake ranged from 70 to 520 mL in these 20 patients, as compared to their daily fluid intake pre-implementation of dysphagia cup. The mean increase in volume consumed was 269.8 mL for the 20 patients in the study. This was equivalent to an improvement in total daily fluid intake by 62.25%. Overall, the mean total daily fluid intake was 703.4 mL per day.

Of note, 80% of patients were able to use the cup and drink independently. Among the patients given the cup, 75% of them demonstrated an overall increase in fluid intake, compared to before the implementation of the dysphagia cup where only 11% of elderly inpatients drank enough fluid to meet their recommended daily water allowance. The improvement in fluid intake was duplicated in the second PDSA cycle.

Real-time studies showed significant savings in nurses' time in preparing the patient at every step of fluid preparation including thickening fluids, positioning the patients, encouraging them and supervising them while drinking. Nursing productivity improved by 67%. Assuming the whole hospital of 1000 beds had access to the dysphagia cup, with suitable patients given the cup to use, the hospital would be able to save 14.11 full-time equivalent of nursing workforce annually.

Positive feedback and great satisfaction were collected from 90% of the patients and their caregivers/families, as well as from 95% of the ward nurses. The satisfaction levels were identical in PDSA cycles 1 and 2.

Lessons and limitations

Overall, 'The Happy H to O Team' was successful in raising awareness of the importance of fluid intake among the elderly, as well as on the various factors which contributed to the problem. The production of the dysphagia cup was helpful for patients, nurses and patients' families.

For one, the cup was effective in reducing aspiration risk among its users due to its design features that helped to regulate the flow rate and reduce patients' head tilt. In

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addition, with the variegated measurement scales at the sides of the cup, nurses and caregivers were able to save time in preparing thickened fluids as they could effectively measure out the thickener and mix fluid to the desired consistency. This could potentially help reduce caregiver burden as it enables thickened fluids to be prepared in a shorter amount of time and reduces the need to repeatedly prepare the thickened fluid drinks.

With its increased ease of use, the cup also actively encourages patients to drink on and off during the day, in addition to giving patients the independence to drink on their own as the cup could be placed by the bedside. In institutions and hospitals, tight staffing coupled with busy work schedules can have a large impact on patient care. As such, any workflow processes that help to improve productivity and time-saving will translate into better job satisfaction, reduce care burden and enhance overall patient care.

Some challenges of this project included the time taken to gain cooperation from the ward nurses, encouraging responsibility, maintaining adherence to the use of the cup, as well as gaining buy-in from patients and their families. Getting patients' families for caregiver training was challenging as the pandemic had imposed limitations on visitors coming into the hospital. However, the dysphagia cup was eventually well received by the ward teams in both inpatient wards, and usage of the cup gradually became the norm. Perhaps a video recording of the steps on washing, drying, and assembling the cup may save the care team's time on caregiver training and can also be a source that patients' families to refer to after discharge from the hospital.

Limitations of the project included its small sample size and the prolonged time frame of execution, as a result of human resources limitations in the hospital due to the COVID-19 pandemic. Since the pandemic is now gradually quietening down, the study team is moving to involve the other wards in the hospital for more widespread use.

CONCLUSION

Moving forward, it would be prudent to continue to investigate and monitor the outcomes and implementation of the dysphagia cup to help ensure the sustainability of this project. It would be ideal to continue to expand the userbase of the dysphagia cup to improve generalisability, which would enable the project team to assess the full breadth of the efficacy and utility of the dysphagia cup when it comes to improving and maintaining oral intake among the elderly.

The dysphagia cup has the potential for use in other general medical and surgical wards as well, to improve oral intake among patients both young and old. Potential groups that may benefit from the cup include younger patients with neurological conditions (such as cerebral palsy and neurodegenerative disorders) and patients under the care of otorhinolaryngologists for oropharyngeal cancers with oropharyngeal dysphagia. The cup is also suitable for persons without dysphagia on thin fluids.

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Contributors SSHK was involved in data collection, data entry and the main preparation of the manuscript. SA was involved in literature search. YQL and XJC were involved in providing expert advice and input for the design of the prototype. FL and SS were involved in data collection, educating the nurses and setting up workflow. ABTK was involved in survey design, results collection and funding coordination. SCL was the lead and supervisor of the project. Guarantor, SCL.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants. This study was a pilot for a quality improvement project, therefore the ethics committee exempted our study. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as online supplemental information.

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