

## **Project Title**

Give Intravenous Morphine Bolus a BRAKE

## **Project Lead and Members**

Project Lead: Yasmin Ng Yen Yen

Project Members: Dr Sim Guek Gwee, Elaine Leong Yin Leng, Vernon Chen Yi Liang

## **Organisation(s) Involved**

Changi General Hospital

## **Healthcare Family Group(s) Involved in this Project**

Healthcare Administration, Medical

## **Applicable Specialty or Discipline**

Pharmacy Operations, Emergency Medicine

## **Project Period**

Start date: August 2017

Completed date: June 2020

## **Aim(s)**

To improve patient safety by developing a Syringe Brake, a disposable dosage flow restrictor to control the amount of medication delivered, with the aim to reduce the rate of IV morphine bolus errors in A&E patient care areas by 50%

## **Background**

See poster appended/ below

## **Methods**

See poster appended/ below

## Results

See poster appended/ below

## Lessons Learnt

See poster appended/ below

## Conclusion

Syringe Brake is an innovative novel invention as there is no safety device for bolus administration in the current market. It is designed to build in pauses and prevent accidental morphine overdose caused by user unfamiliarity or autopilot administration. It acts as a disposable dosage flow restrictor to control the amount of IV Morphine delivered. Through the stopping mechanism of the device, it can prevent the wrong morphine dose from being delivered. It can also allow the drug to be prepared by another person, freeing the doctor to attend to the patient's more pressing needs.

With the step of discarding excess morphine dose eliminated, Syringe Brake promotes patient safety by allowing the doctor to slowly titrate up the CD without feeling the pressure to initiate on a higher dose. It saves time and improves process efficiency for patients who requires additional doses, as it obviates the need for retrieval, documentation, and preparation of the CD repeatedly, resulting in more timely administration.

## Additional Information

Syringe Brake has been integrated into the routine workflow of giving IV morphine bolus in CGH A&E department since Sep 2018 and the practice has spread to CGH inpatient wards from August 2020

The use of Syringe Brake has also spread to SKH and SGH and has been in use at least since Dec 2020.

The IV morphine bolus administration issues were also encountered by emergency departments from other institutions. We looked for like-minded partners from SGH and SKH if there were interested to test the use of Syringe Brake for 3 months. Each

institution would then adapt the use of the device and ensure that it will be compatible to their local workflow. After 3 months of trial, 75% of SGH and SKH respondents were willing to use Syringe Brake and satisfied with the use of Syringe Brake to prevent medication error based on a user survey. Syringe Brake use is currently implemented in SKH and SGH emergency departments.

Within CGH, the adoption and spread to the inpatient wards was postponed due to COVID-19 pandemic. Currently the implementation of Syringe Brake for IV morphine bolus has scaled up to all inpatient wards except the operating theatre where the context of use is different.

### **Project Category**

Care & Process Redesign

Value-Based Care, Risk Management, Adverse Outcome Reduction

### **Keywords**

Intravenous Morphine Bolus, Medication Error, Controlled Drug

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# Give Intravenous Morphine Bolus a BRAKE

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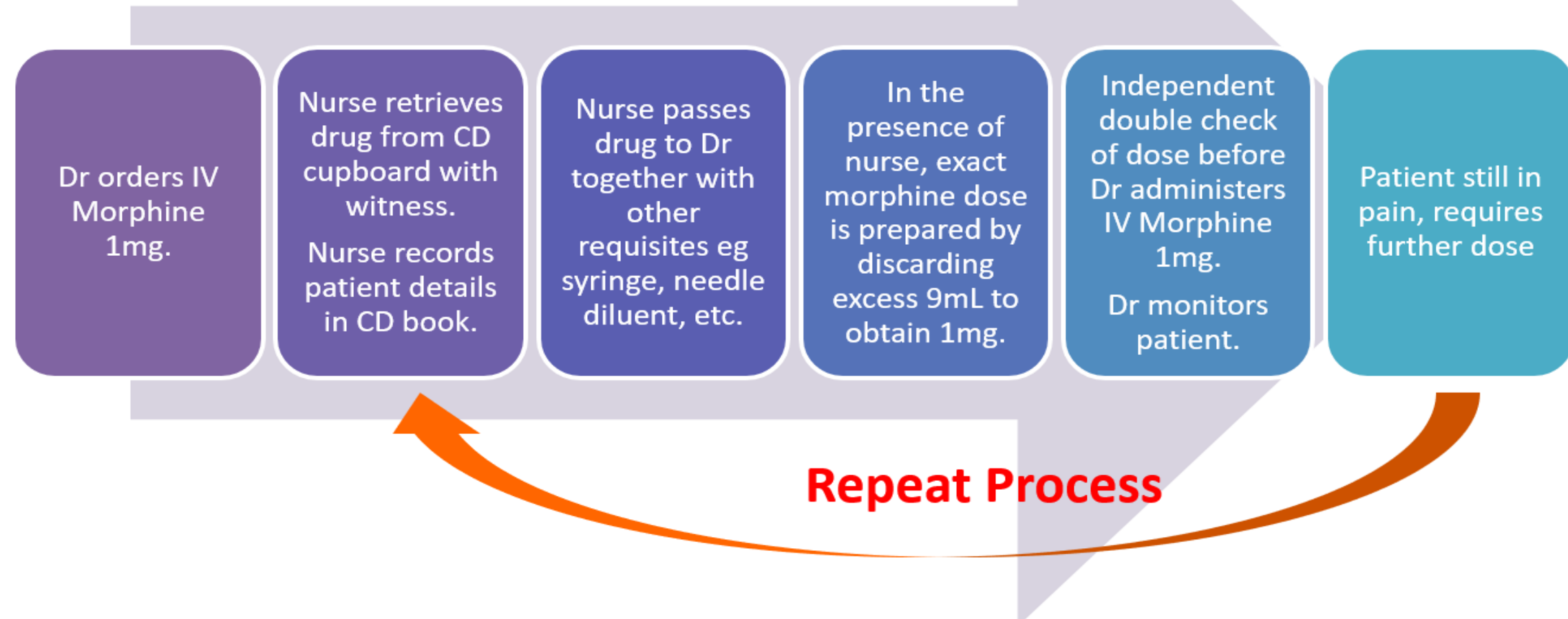
Changi General Hospital  
SingHealth

## 1. Background and Aim

Morphine is a high alert medication that bears a heightened risk of causing significant patient harm when it is used in error. There are no commercially available ready-to-administer morphine preparations suitable for intravenous (IV) push administration in Singapore.

Using a more concentrated solution such as Morphine 10mg/mL potentially increases the risk of an overdose as the medication is usually given in titrated doses of 1 to 2 mg. The full 10-mg dose is rarely given all at once as it can result in serious or life-threatening respiratory depression.

The previous workflow required the user to prepare the medication himself and to discard the excess morphine in the presence of a witness to obtain the intended exact dose as a fail-safe. However, this made the process more tedious when a controlled drug (CD) such as morphine is involved when patient required additional doses. This is because time is needed to procure the CD from the locked CD cupboard, document it in the CD register, and prepare and purge the excess medication repeatedly.



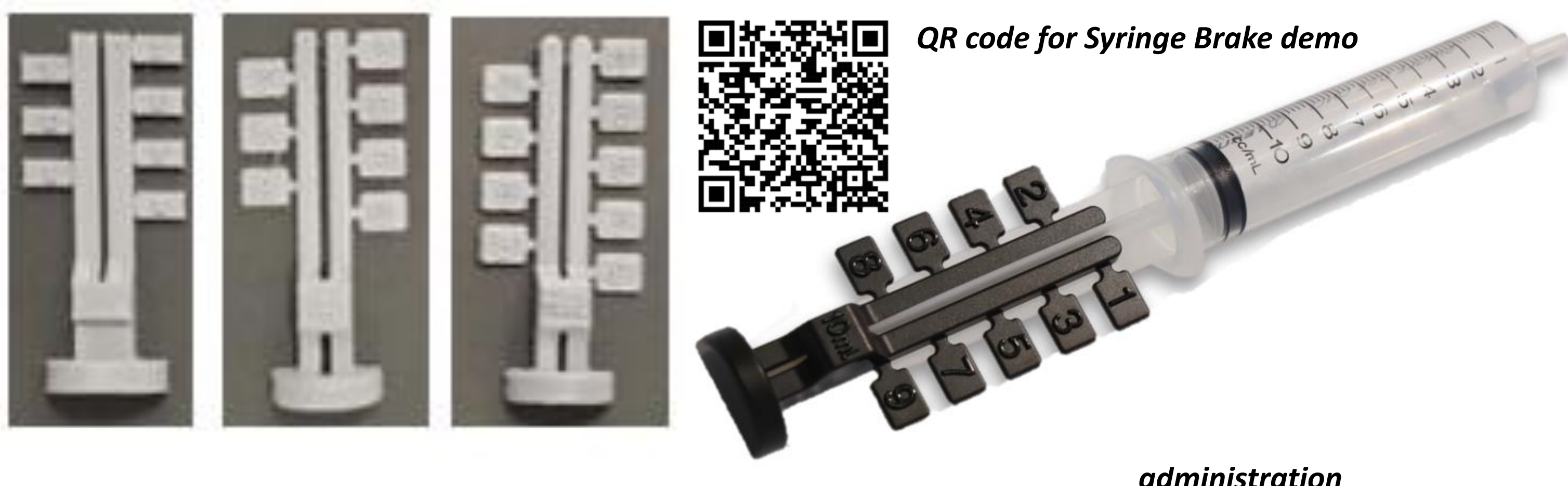
To improve patient safety, CGH in collaboration with the SUTD developed Syringe Brake, a disposable dosage flow restrictor to control the amount of medication delivered, with the aim to reduce the rate of IV morphine bolus errors in A&E patient care areas by 50%.

## 2. Strategy for Change

A multidisciplinary root cause analysis workgroup was formally appointed by the medical audit committee to look into past IV morphine errors and its prevention. Accidental overdose of the entire 10mg/10mL in the syringe were found to occur due to distraction, perceptual human error, miscommunication and unfamiliarity with morphine administration.

### Invest Resources in Improvement & Use Constraints (Aug 2017 to Feb 2018)

We collaborated with the Singapore University of Technology and Design (SUTD) to develop Syringe Brake, a disposable flow restrictor that can be attached to a 10mL syringe to control the amount of drug delivered and to save time for patients who required additional morphine doses. Syringe Brake went through multiple design iterations e.g. changing the number of tabs, introducing embossed numbers on the tabs, making the appendages of the tabs broader, changing the colour of the device etc



administration

### Stakeholder Engagement and Pilot (March 2018 to April 2018)

Workflow of incorporating Syringe Brake prototype into IV morphine administration workflow was discussed. Doctors and nurses in ED were briefed on the new workflow. A short preliminary survey was conducted subsequently to find out user acceptance after the small test of change.

### Funding (Jun 2018 – Jul 2018)

With positive response from the small test, there was a need to apply for funding to refine and manufacture Syringe Brake for longer period of testing. This would also allow more users to experience first-hand its use for a more complete evaluation. The project was submitted to the centralised institutional review board of SingHealth and was exempted from a formal review.

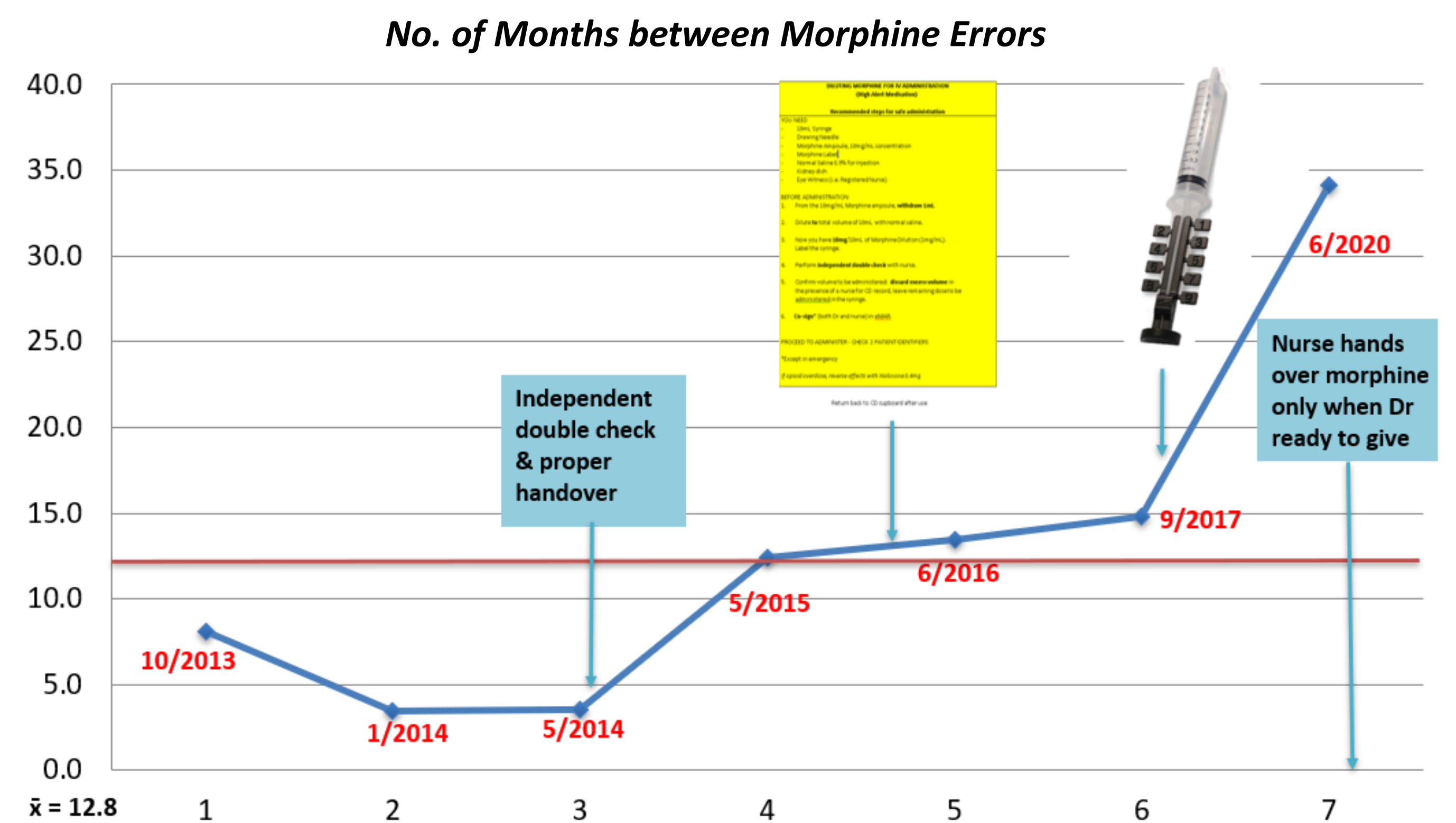
### Large Scale Testing (Sep 2018 – Dec 2018)

During the prototype refinement, A&E doctor and nurse representatives were engaged for feedback how the design could be further improved. A department meeting was subsequently held with ED doctors and nurses. Product demonstration video was produced to guide user on its use. The final product was tested for 3 months. User experience and perception of its safety effectiveness were explored through a survey questionnaire. Outcome measures of morphine errors continued to be tracked. Upon evaluation, the Syringe Brake workflow was formalised with positive feedback from stakeholders.

## 3. Results

### Outcome Measure

With the introduction of Syringe Brake, the average IV morphine bolus error-free period has improved from 5 months (2013 to 2014) to 21 months (2016 to 2020) compared to previous years. The longest time between errors was 34.1 months. The most recent error occurred in June 2020 due to non-compliance with Syringe Brake use.



### Balancing Measure

Overall, 80.1% (145/181) of respondents were satisfied with the use of Syringe Brake to prevent medication error (4.05±0.82). Our survey results showed that the top 3 features of Syringe Brake were ease of setting the desired volume to be administered (90.1%; 4.19±0.69), allows the drug to be titrated safely (87.3%; 4.26±0.73) and ease of fit onto syringe (80.8%; 4.07±0.72). There was no change in IV morphine bolus orders due to Syringe Brake Implementation.

### Response of Participants towards Syringe Brake

Survey Statements	n	Disagree (%)	Neutral (%)	Agree (%)	Mean ±SD
<b>Ease of use</b>					
1 It is easy to fit Syringe Brake onto the syringe.	182	3 (1.6%)	32 (17.6%)	147 (80.8%)	4.07±0.72
2 It is easy to set the desired volume to be administered.	181	4 (2.2%)	14 (7.7%)	163 (90.1%)	4.19±0.69
3 It is difficult to learn how to use Syringe Brake. (reverse)	182	18 (9.9%)	29 (15.9%)	135 (74.2%)	4.01±1.02
<b>Safety aspects</b>					
4 Syringe Brake allows drug to be titrated safely.	181	4 (2.2%)	19 (10.5%)	158 (87.3%)	4.26±0.73
5 Syringe Brake gives user the confidence to avoid overdosing patient.	179	6 (3.4%)	30 (16.8%)	143 (79.9%)	4.13±0.81
6 Using Syringe Brake can prevent medication error when user does not realise diluted morphine (10mg/10mL) 1mg equates 1mL.	182	9 (4.9%)	27 (14.8%)	146 (80.2%)	4.08±0.84
7 Syringe Brake can prevent wrong dose administration arising from miscommunication when drug is prepared and administered by different person.	182	12 (6.6%)	45 (24.7%)	125 (68.7%)	3.85±0.91
<b>Efficiency</b>					
8 For process that requires excess dose to be discarded before administration e.g. discards 9mL when only 1mg required, Syringe Brake saves time by removing the necessity to discard excess morphine.	182	14 (7.7%)	35 (19.2%)	133 (73.1%)	3.91±0.90
<b>Acceptance</b>					
9 I am willing to use Syringe Brake.	182	6 (3.3%)	30 (16.5%)	146 (80.2%)	4.08±0.82
10 I prefer using Syringe Brake compared to previous workflow.	182	10 (5.5%)	46 (25.3%)	126 (69.2%)	3.90±0.91
11 Overall, I am satisfied with the use of Syringe Brake to prevent medication error.	181	7 (3.9%)	29 (16.0%)	145 (80.1%)	4.05±0.82

## 4. Effects of Change & Conclusion

Syringe Brake is designed to build in pauses and prevent accidental morphine overdose caused by user unfamiliarity or autopilot administration. It allows the drug to be prepared by another person, freeing the doctor to attend to the patient's more pressing needs. With the step of discarding excess morphine dose being eliminated, it promotes patient safety by allowing the doctor to slowly titrate up the CD without feeling the pressure to initiate on a higher dose. It saves time for patients who require additional doses, as it obviates the need for retrieval, documentation, and preparation of the CD repeatedly, resulting in more timely administration.

With the multiple interventions, A&E patient care areas went nearly 3 years (34.1 months) without an IV morphine bolus error (>50% improvement). Syringe Brake is now used in CGH inpatient wards and its use has also spread to AH, SGH and SKH.

## 5. What We Learnt

- Co-design and direct involvement with those most affected by the change resulted in better change ideas, smoother implementation, and high adoption rates.
- Co-design adopters and opinion leaders were engaged to help influence others and to produce sustained use. This was important as IV morphine errors occurs at a low rate and the effects of change can only be observed many months later.
- Unit champions are essential to consistently drive the change in practice. This was especially important during the early stages of implementation when we scaled up to all inpatient wards.

