NATIONAL GUIDELINES ON THE USE OF SMART INFUSION PUMP SETS DURING THE COVID-19 PANDEMIC

2020

ACKNOWLEDGEMENTS

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Table 1. Composition of the National Medication Safety Committee, July 2017 – July 2021

Name	Institution	Designation
Members		
Adj A/Prof Augustine Tee (Chairperson)	CGH	Chief, Department of Medicine; Deputy Chairman Medical Board (Medical Disciplines), CGH
Mr Wu Tuck Seng	NUH	Director, Pharmacy Department
Dr Chua Mei Chien	KKH	Head and Senior Consultant, Department of Neonatology
Dr Loh Seow Siang	KTPH	Senior Consultant, Accident & Emergency Department
Dr Kurumbian Chandran	NTFGH	Director of Endocrinology; Co-chair of the Medication safety committee
A/Prof Ng Heng Joo	SGH	Senior Consultant, Department of Haematology; Director of Patient Safety
Ms Angelina Tan Hui Min	SKGH	Head, Pharmacy Department
Dr Tan Sze-Chin	TTSH	Consultant, Department of Rheumatology, Allergy and Immunology; Chair of the Medication Safety Team
Ms Soh Lay Beng	IMH	Head, Pharmacy Department
Dr Liew Mei Fong	AH	Director, Intensive Care Unit
Dr Ang Mei Kim	NCC	Senior Consultant, Division of Medical Oncology
Prof Ding Zee Pin/	NHC	Senior Consultant, Department of Cardiology; Chairperson, Pharmacy & Therapeutics Committee
Mr Li Kaihui Benny	NSC	Manager (Pharmacy Quality & Safety)

Name	Institution	Designation
Dr Marcus Ang	SNEC	Consultant, Corneal and External Eye Disease Department
Ms Chua Hui Min	NCIS	Senior Clinical Pharmacist
Asst. Prof Yeo Wee Tiong	NUHCS	Consultant, Department of Cardiology
Dr Peter Moey	SHP	Director, Pasir Ris Polyclinic; Chair Pharmaceutical & Therapeutics Committee
Dr Valerie Teo	NHGP	Associate Consultant Family Physician; Deputy Head, Ang Mo Kio Polyclinic; Chairperson, Medication Management and Usage Committee
Dr Tan Wei Beng	NUP	Member, Medication Management and Utilisation Committee
Ms Quek Hui Chen	JCH	Head, Pharmacy Department
Dr Aye Khine Thwin	YCH	Staff Physician; Chairperson, Medication Safety Review Workgroup
Dr Patrick Chia	IHiS	Director, Clinical Informatics Group
A/Prof Lita Chew	MOH	Ex-Chief Pharmacist (2019)
Secretariat		
Dr Adelina Young	MOH	Deputy Director (Patient Safety & Quality Improvement Branch), Clinical Quality Performance & Value Division
Ms Luisa Tan	MOH	Assistant Director (Patient Safety & Quality Improvement Branch, Clinical Quality Performance & Value Division
Ms Liu Pei	MOH	Senior Manager (Patient Safety & Quality Improvement Branch), Clinical Quality Performance & Value Division

Table 2. List of Nursing Leads and Pharmacists from public hospitals

Name	Institution	Designation
Ms Ng Gaik Nai	SingHealth	Deputy Group Chief Nurse
Ms Hoi Shu Yin	Tan Tock Seng Hospital	Deputy Director of Nursing
Ms Velusamy Poomkothammal	Khoo Teck Puat Hospital	Deputy Director of Nursing
Ms Ang Shin Yuh	Singapore General Hospital	Deputy Director of Nursing
Ms Ng Sow Chun	National University Hospital	Deputy Director of Nursing
Dr Chan Hong Ngee	Singapore General Hospital	Senior Principal Clinical Pharmacist
Dr Wang Aiwen	Singapore General Hospital	Principal Clinical Pharmacist

This document summarises key recommendations from international literature relevant to the conservation of smart infusion pumps and dedicated administration sets during COVID-19 pandemic situation. The information may be updated as new recommendations become available.

Background

Smart infusion pumps are used widely today to help reduce medication errors across inpatient and outpatient care settings. They have built-in dose error reduction systems that include defined drug libraries, dosing limits and other clinical advisories integrated within. With such propensity to reduce errors, the utilization of smart infusion pumps is most critical in the administration of high alert medications (HAMs).

With the current COVID-19 pandemic, it is anticipated that there would be a significant increase in the number of critically ill patients admitted to hospitals. To ensure that smart infusion pumps and dedicated administration sets remain sufficient, there is a need to prioritise the use of smart infusion pumps for certain medications and patient profiles.

Two-Pronged Approach to Conservation of Resources

A two-pronged approach can be taken to manage the adequacy of smart infusion pumps and dedicated administration sets:

(i) Clinical Perspective – to identify medications which are best administered using smart infusion pumps to guide prioritization, and to identify alternative drug delivery routes which remain safe and appropriate for certain drugs or patient profiles.

(ii) Resource Management Perspective – to evaluate measures such as creating an inventory of available infusion pumps within the hospital, and reviewing internal pump usage policies (and contingency plans) to ensure sufficient supplies.

The subsequent sections elaborate on each of these measures.

Conservation Measures from a Clinical Perspective

1. Identify medications requiring the use of smart infusion pumps, including related indications for usage.

Institutions should include applicable High Alert Medications (HAMs) in this list, as well as drugs that need continuous and careful titration (e.g. blood thinners, sedatives). Indications for the usage of each drug should also be included in consultation amongst pharmacy, medical and nursing colleagues.

The Institute for Safe Medication Practices (ISMP) recommends considering relevant patient factors in coming up with these indications, to ensure medication and patient safety. These include the age of patient (e.g. neonates/infants may not be suited to use any form of infusion pumps), mental state of patient, clinical condition/other comorbidities (e.g. patients may have underlying conditions which require careful titration of fluid), infusion rate criteria and vascular access criteria (e.g. fragile veins, pain/discomfort caused by central lines). Where feasible, institutions may also come up with a priority list based off the larger list, for the more important HAMs and critical care settings.

2. Identifying alternative drug delivery routes

2.1 *Switching to non-IV drug administration routes*

To minimize non-essential use of smart infusion pumps, patients should be assessed for feasibility of switching to alternative non-IV drug administration routes as far as possible. For instance, patients who are conscious, able to swallow and whose medical conditions allow, can be considered for switching from IV to oral therapies. For example, in the treatment of metastatic colorectal cancer, oral administration of fluoropyrimidines offers an alternative to conventional treatment involving IV infusion of 5-flurouracil.

Other than oral therapy, institutions may also consider administering drugs via intramuscular (IM) injection where appropriate.

2.2 *Utilisation of IV push mechanism*

To conserve administration sets required for infusions, institutions may also consider administering medications using an IV push instead of a secondary infusion where appropriate. Administration via secondary infusions require the use of an additional secondary IV medication tubing connected to the primary IV tubing. On the other hand, an IV push involves administration of medicine through a port into the primary IV tubing via a syringe without use of additional tubing, thereby conserving equipment.

In administering secondary medications via an IV push, compatibility with medications in the primary IV drip should be ensured. In situations of incompatibility, institutions could consider stopping the primary IV drip intermittently and flushing before and after the IV push, before restarting the primary IV drip. The timing and frequency of actual medication administration to the patient and the pharmacokinetics of the drug should also be considered when scheduling the administration of these medications, balancing the properties of the medications and compatibility concerns.

2.3 *Considering other IV alternatives to smart infusion pumps*

Where it is not appropriate to administer drugs through the oral, IM or IV push routes, some of the following alternatives may be considered for adult patients:

a. Gravity infusion. These may be used routinely for (i) infusion fluids given alone, and (ii) infusion fluids with a medicine added of which rate of administration

does not need to be tightly controlled to prevent adverse effects. Gravity infusions can be used for hydration, certain antibiotics and non-HAM drugs amongst others. However, they are not recommended for patients' whose medical conditions warrant the need for careful titration of fluid intake.

Without the convenience offered by infusion pumps, healthcare professionals would need to perform drop counting to ensure correct dosing and repeat the count upon changes in factors like bag height and the position of the patient's arm. If additional equipment is used to regulate flow (e.g. tubings with IV flow rate regulators, flow control clamps etc.), drop counting should still be performed to ensure accuracy of the flow rate.

Institutions may also wish to establish a list of medicines which may be added to infusions and given via gravity or may be given by intravenous bolus injection for ease of operationalisation. In coming up with the list, institutions may wish to take into consideration findings from international references (e.g. the Specialist Pharmacy Service of the NHS). Information contained in Product Information Leaflets (PILs) and inputs from internal pharmacy departments should also be taken in for relevance to the local context.

b. Subcutaneous infusion. Subcutaneous infusions involve administration into the subcutaneous space via needles typically inserted at the thighs, upper arms, chest or abdomen. It presents an option for parenteral delivery of medications and solutions for hydration or nutrition for some patients. It can be used most appropriately where patients do not need rapid fluid administration in large amounts (e.g. for palliative care patients or in urgent care clinics for patients with less acute conditions).

   More than one subcutaneous infusion can be administered each time, and as the procedure is relatively straightforward, the requirement for personnel training and supervision is usually less stringent than for IV infusions.

c. Other alternatives. In addition to the above, other mechanical methods of drug administration which can be considered include elastomeric devices such as elastomeric pumps connected to IV tubings and volumetric burettes infusion sets. Drop counting should concurrently also be performed to ensure accurate dosing in using these devices. As these tend to be more costly and require additional manpower to operate, institutions may wish to take into consideration cost efficiency of such options in the longer term.

For neonatal and paediatric patients, the above alternatives may not be suitable as this patient group typically requires a smaller volume of drugs. This may not be compatible with minimum volume requirements of some of the equipment associated with the above alternatives. Neonates and paediatric patients are also more prone to uncontrolled movements, which may affect the infusion rate when using gravity infusions. An alternative would be to use syringe pumps, which are better suited for infusion volumes <50ml and are less affected by patient movement.

Factors affecting efficacy of administration via alternative delivery routes

Institutional and patient context

When assessing alternative drug administration routes, existing literature recommends considering four principles: safety, efficacy, patient preference, and pharmacoeconomics.

For safety and efficacy, clinicians should avoid routes which are contraindicated for the unique drug or particular patient profile. In addition to prescribing information, clinicians could reference international literature for suggestions to ensure safety and efficacy in administering the drug via any route.

In instances where safety and efficacy prove equivalent across two administration routes, clinicians should next consider patient preference to enhance adherence to the treatment regimen and maximise patient satisfaction.

Pharmacoeconomic assessment should also be done to take into consideration the institutional context of manpower or resource limitations, which is an especially pertinent concern during this pandemic period.

Staff competency and manpower

Another factor which may affect the execution of alternative drug delivery routes would be staff competencies. Training and educational resources should be made accessible for frontline personnel to familiarise themselves with alternative drug administration operation protocols, should they need to be utilised. Potential solutions can include the following:

- Publishing clear instructions and troubleshooting guides on your intranet where clinicians and frontline personnel may quickly access them.
- Training supervisors in each area of the hospital/facility who are available to provide assistance/emergency consultation for each shift. Such supervisors should ideally be easily contactable by staff should emergencies arise.

Conservation Measures from a Resource Management Perspective

1. Create an inventory of all available pumps within each institution

In addition to smart infusion pumps, hospital operations and nursing departments within institutions should work together to keep track of the types and number of all available pumps, and related administration add-ons (including regular infusion pumps and syringe pumps). The usage of pumps is dependent on the availability of administration sets, IV diluents, consumables – all of which would need to be coordinated. There needs to be clear documentation on who is responsible for maintaining the inventory, and the tracking process for movement of inventory stock. This would allow for a greater awareness of resource constraints to facilitate planning and deployment, which could serve to inform procurement decisions where required.

In procuring additional infusion pumps, institutions should consider bringing in pump models which are already in mainstream use to avoid confusion between the existing and new operational protocols. If new pumps need to be brought in, before they are put into mainstream use, biomedical staff should be consulted for calibration of the devices and other necessary preparatory work. Old and new pumps should also not be used together as the administrative sets and additional tubings may not be compatible. Education and training of staff should also be in place to ensure competency in operating these pumps, as recommended in MOH's 2019 guidelines on the safe use of infusion pumps.

2. Establish pump utilization rates and review internal usage policy for administration sets

It may also be useful for institutions to revisit their internal policies on the stipulated usage period for related administration sets, to assess whether there is a case to move towards extending usage period to conserve resources. Necessary approvals for any change in policy should be sought from the relevant internal authorities where appropriate, depending on each institution's practice. International guidance on recommended usage and manufacturers' instructions should be taken into consideration in deciding on policy changes, and the recommendations for extended usage should also consider other factors such as infusion type (blood products, fat emulsions or specific drugs) and type of usage (e.g. intermittent infusions).

Institutions may also wish to seek Pharmacy's inputs on the drug/infusion list where tubings are required for daily or frequent change (e.g. total parenteral nutrition, inotropes).

In revising internal usage policies, institutions should also establish the utilisation rates of the different kinds of pumps to inform forward planning of pump availability and prioritisation. Particularly for the more critical settings (e.g. Intensive Care Units, High Dependency wards), care managers should consider coming up with surge utilisation rates to better support the planning process.

Factors affecting the efficacy of resource management measures

Maintenance of existing inventory of supplies

To ensure that the above measures can be effectively implemented, institutions should ensure that there is a regular maintenance cycle in place for existing equipment to ensure optimal functioning and reduce the need for repairs. There would thus be reduced risk of encountering faulty smart infusion pumps. This may affect available inventory size, which is critical during the current pandemic situation.

Having a clear back-up plan and engaging vendors in the process

Institutions should devise a back-up plan for managing instances of acute equipment failure and shortage, which should comprise clear and implementable strategies. It would also be useful for institutions to work with equipment vendors in coming up with their back-up plan. This would include working with them to ensure the sufficiency of spare parts for repair, establishing availability of options to loan/purchase pumps at short notice, and the provision of services for emergency on-site trouble shooting and repairs. Institutions may also wish to maintain more than one brand type of smart infusion pumps within any site to reduce the risk of disruption to continuity.

Conclusion

The available literature provides substantial solutions and alternatives to facilitate prioritization of resources in anticipation of shortages during this pandemic period. Institutions should prepare for this likely scenario by reviewing their use of infusion pumps, and the conservation strategies that will best maintain the safety of patients and the quality of care.

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