



SUSQI PROJECT REPORT

Thinking Outside the Bag: Ketorolac IV Direct Administration at South Health Campus Emergency Department

Start date of Project: April 8, 2024

Date of Report: June 28, 2024

Team Members:

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Background:

It is estimated that medical supplies are responsible for almost 15% of carbon emissions related to the delivery of Health Care. Much of the footprint of medicines and supplies is attributed to their packaging and administration technique. Some administration routes (e.g. IV) require more single use consumables and equipment than others (e.g. oral). Variations to IV administration practice can also influence the consumables required to administer, and may at times unnecessarily increase cost, carbon emissions and time of administration. One example of this is the use of mini bag administration.

Administering intravenous (IV) medication directly or through a mini bag presents distinct considerations for healthcare professionals. Direct IV administration involves injecting medication directly into the vein, offering rapid delivery and immediate onset of action. Conversely, administering medication through a mini bag involves diluting the medication in a small volume of IV fluid, typically 50 to 100 milliliters, before infusing it into the patient's bloodstream. This method allows for slower infusion rates. Mini bags can be particularly useful for administering medications requiring dilution, however, the overuse of mini bags can lead to unnecessary resource use.

The Emergency Department at South Health Campus (SHC) experienced an increase in mini bag ordering during the 2023 calendar year. Medication mixing in mini bags contribute to non-value added activities such as motion waste and overprocessing. The use of mini bags utilized to administer medications that could be safely given directly IV results in unnecessary medical supplies usage, increased nursing resources and contributes to avoidable carbon emissions.

Previous research has shown that direct administration of IV medication decreases nursing workload, reduces time from order to administration and results in significant cost savings (Brady, R et al., 2024). Moreover, administering drugs directly into the vein allows for rapid onset of action and simplifies the process by eliminating the need for dilution.



Ketorolac is the 4th highest intravenous medication administered at SHC ED. Direct IV administration of medications presents a compelling option for nurses in the emergency department seeking fast, precise, and reliable pain relief for their patients. Given the minimal impact on Pharmacy's workflow, the volume of orders, the familiarity of SHC ED nurses with this medication and the great potential for replication, it was decided that Ketorolac would be the focus of this project.

Specific Aims:

This project aims to decrease the usage of mini bags and IV lines by encouraging ketorolac IV direct administration at the South Health Campus Emergency Department.

Methods:

This project was conducted in the South Health Campus Emergency Department and included a change in the default ordering setup for ketorolac in the Electronic Health Record (EHR) which took effect on May 15, 2024.

'Studying the System':

Upon studying our system, we conducted a process mapping exercise which revealed opportunities to streamline the process by administering ketorolac direct IV. This change aimed to reduce unnecessary steps with benefits across social, financial, and environmental resources. The process review also showed that, while provincial guidelines endorse the safe administration of ketorolac undiluted over 15 seconds, our electronic system defaults the order to dilute the medication in a mini bag.

See Appendix A for pre-implementation process map.

Stakeholder Engagement:

Pharmacy was early identified as a pivotal stakeholder in our project. To ensure effective collaboration, we arranged meetings to outline the project's objectives and rationale. We aimed to gather essential information about the current setup of medication orders in the EHR system and sought to understand both the capabilities and limitations of the existing system, including what aspects could be modified and what constraints needed consideration. We discovered that Pharmacy could adjust the EHR order setup to specify the correct administration route without prompting the method of administration. This modification empowers nurses to decide how the medication should be administered.

The Contract, Procurement & Supply Management (CPSM) team was contacted and tasked with measuring and tracking the ordering quantities of mini bags, along with providing price information. We collaborated with the Reporting and Analytics team to assist with generating reports that could provide meaningful data related to this project.

It was identified that the EHR order change would have implications across the entire site, given the integrated nature of the EHR setup. Consequently, we proactively engaged with other units through their respective managers to ensure awareness of this adjustment. Our communication included explanation of the change's scope, emphasizing that units have the flexibility to revert the order, if necessary.



The ED nurses were involved in daily huddles when we shared relevant updates about the project's scope, goals, and potential benefits. We collaborated with bedside nurses to obtain measurements regarding the process analysis, such as average time of medication preparation prior implementation. To foster engagement, we designed posters for frontline staff, highlighting concrete information on expected financial, environmental, and social impacts. Educators and mentor nurses were early identified as key resources to provide education, guidance and support as needed.

Measurement:

To measure success of this project multiple data points were captured prior to and after making improvements to the ketorolac administration process. Data was captured through ED nurse surveys, patient experience testimonials, mini bag ordering reports, and electronic health record ketorolac administration reports. The pre-implementation and post-implementation period reported consisted of April 14 to May 14 and May 15 to June 14, 2024.

Patient and clinical outcomes:

The time of STAT Ketorolac order to administration time and time of physician assessment to discharge time was obtained through use of Connect Care Benchmark report in collaboration with Reporting and Analytics Support Services.

Population outcomes:

A survey was conducted of Emergency Department nurses to identify the impact of the process change. Accessibility of IV pumps in the ED was identified as a potential ED population improvement. Eliminating the use of IV pumps in the ketorolac administration process allows for increased IV pump availability for other patients receiving critical care medications requiring more precise administration practices. This shift in practice indirectly affects other ED patients' ability to obtain timely critical care medication administration in the ED.

Although multiple factors can contribute to ED patient length of stay, this data was monitored as our team felt the decreased workload coupled with improved pain management would likely decrease length of ED stay for patients receiving ketorolac. ED length of stay was monitored as a potential measurement of ED population improvement as reduction in LOS will reduce ED overcrowding.

Environmental sustainability:

The number of Ketorolac administrations in the Emergency Department was obtained through the use of Connect Care Cogito Slicer Dicer with support from Pharmacy Services and Connect Care Data Analyst Team. Each Ketorolac administration post implementation represents a medical supply and equipment reduction of a mini bag, an IV line, a disinfectant wipe, an IV pole and pump.

A process-based life cycle assessment methodology was used to estimate the carbon footprint of the IV line, disinfectant wipe and IV pump energy.

For the IV line and the disinfectant wipe, the analysis included GHG emissions associated with raw material extraction, packaging raw materials, transport and disposal. Weights and material types of



the items were completed by the team and converted into GHG emissions using emission factors taken from the Inventory of Carbon and Energy (ICE) database (Circular Ecology, 2019). Transport GHG emissions were based on distances from location of manufacturer to hospital site, transport conversion factors were taken from the 2024 GHG Emission Factors Hub published by US EPA. For waste disposal, it was assumed all items were disposed of in landfill waste, AHS specific waste conversion factors were used. However, AHS disposal carbon conversion factors do not include emissions associated with transporting the waste to the landfill site, therefore this was added in separately.

For the IV pump energy, kWh per administration was estimated based on manufacturer specification. Energy consumption per administration was converted into GHG emissions using the conversion factor for Alberta's electricity grid taken from the 2024 Canadian Emission Factors and Reference Values database.

The GHG emissions associated with the mini bag were taken from a 2023 paper by Touw et al. Transport emissions were adapted to suit the Canadian setting.

Total CO₂e savings have been translated into the equivalent of kilometers driven using an emission factor of 0.259 kgCO₂e/km for an average passenger vehicle calculated from the Canadian vehicles database (Government of Canada, n.d.).

Economic sustainability:

Medical supply cost was obtained from the South Health Campus Supply Management and Procurement team to capture the financial impact of the elimination of supplies.

Social sustainability:

Nursing time was measured through observational timing of the pre-implementation process and post implementation process from time of order recognition to time of medication administration completion to quantify estimated workload reduction.

Patient Experience/Testimonials were conducted by the Calgary Zone Patient & Family Centered Care team to gain insight on the impact of utilizing IV poles and IV lines to administer medications in the ED.

Results:

Patient and clinical outcomes:

The elimination of an IV pole and pump was identified by patients as an action which was viewed as improving overall patient experience. Furthermore, patient testimonials highlighted that patients feel their needs are being met without the need of excessive supply usage and in a more timely manner. These testimonials also highlighted the sense of restriction on patients movement and mobility. By removing these obstacles to mobility and movement, we can mitigate the risk of deconditioning, thereby potentially reducing hospital stays (Claytor et al., 2020).

See Appendix B for a sample of responses from four patients recounting their experience with IVs lines and poles in the ED.



Providing ketorolac IV direct over 15 seconds may reduce the medication onset time by approximately 19 minutes. Although onset pain relief was not specifically measured during this project, the reduction of time of administration to pain onset could be reflected in the time of medication order to administration time and the time of assessment by a physician to discharge time. The average physician assessment to discharge time was reduced by 6% and the average medication order to medication administration time was reduced by 14% when comparing a one month pre-implementation and post-implementation period. Ultimately, patients are receiving pain relief medication quicker as staff are able to administer medication sooner. See Appendix C.

Despite the reduction in average medication order to administration time and physician assessment to discharge time, there was no reduction to patient length of stay for discharged patients which received STAT ketorolac. This could be attributed to overall department acuity and increased wait times.

In collaboration with the Patient Safety site leader, it was found that no patient safety incidents were reported regarding ketorolac post process improvement implementation. These reports will continue to be monitored over the next 6 months to ensure the change has not introduced unintended safety concerns related to ketorolac administration across the South Health Campus.

Population outcomes:

By eliminating steps in the ketorolac administration process, an average reduction of 5 minutes of nursing time was measured through timed observations of the ketorolac administration process. With the number of ketorolac administrations in the ED during the period of May 15th to June 14th being 292 this equates to a reduction of 1,460 nursing minutes. Anecdotally, it can be implied that reduction of nursing time positively impacts patient care as nursing hours can be utilized with other patients or tasks.

Environmental and economic sustainability:

Table 1: kgCO2e per Ketorolac dosage with change to administration method.

Items per administration	kgCO2e / item
Mini bag	0.130
IV line	0.212
Disinfectant wipe	0.020
Pump energy	0.001
TOTAL	0.363

The total cost of all supplies needed for one administration of ketorolac is \$6.64.

During the post-implementation period, 292 Ketorolac medication administrations occurred at South Health Campus Emergency Department. Assuming 100% of doses administered were



previously given in line with Connect Care settings to use a mini bag, our projected annual medical supplies saving is \$23,266.56 and 1,271.95 kgCO₂e per year, equivalent to driving 4,911 km.

These savings are attributed to reduced procurement (supply chain) and disposal of medical items, and reduced energy usage from pumps.

The medical supplies and equipment during the administration process reduces carbon emission produced through landfill disposal, supply transportation and supply production. Additionally, the reduction of IV pump usage reduces electricity consumption for a period of approximately 20 minutes previously utilized to administer the medication via mini bag infusion.

Furthermore, supply ordering reports provided by South Health Campus Supply Management and Procurement team revealed a 25% reduction in mini bags ordering in the ED during the post-implementation period. Site-wide ordering of the mini bags was not monitored, however, due to the site wide EHR order change it is likely that a decrease in usage of mini bags was experienced in other departments.

Social sustainability:

Of the 15 ED nurses who completed the health care provider survey, the totality of nurses indicated they were comfortable administering Ketorolac IV direct. The majority of nurses indicated the change in process positively impacted patient experience and decreased the nurse workload.

Discussion:

The administration of ketorolac via direct IV injection rather than using mini bags has implications across social, environmental, and financial dimensions in healthcare settings.

During initial discussions, the vast majority of nurses supported administering ketorolac IV directly. It quickly became evident that this change had strong backing from the nursing staff, who were enthusiastic about this approach. While some senior nurses were confident in overriding instructions for IV ketorolac administration, others felt obligated to strictly adhere to the orders, occasionally leading to team conflict. Recognizing the negative impact of this situation, it became a priority to revise the order setup to empower providers in deciding the administration method.

Exploring the possibility of adjusting the order setup in the EHR system unraveled a challenge. Even though the scope of this project was initially intended to ED only, all units would be impacted by the ordering change. Hence, we had to engage all unit managers for awareness. There was no resistance from these stakeholders; conversely, one unit manager expressed their satisfaction with the project.

A balancing measure was conducted through the use of RLS report search utilizing the term ketorolac to identify the impact of the change to EHR order throughout South Health Campus.

Although multiple factors can also contribute to the physician assessment to discharge time, this data was monitored as our team felt the decreased workload coupled with improved pain



management would likely decrease length of ED stay once seen by a physician for patients' receiving ketorolac.

Measurement of the success of this project can be quantified in reduction of nursing time, carbon emissions and supply cost. However, the number of mini bags alone could not accurately measure success of this project due to multiple departmental factors contributing to mini bag use.

Although the scope of this project did not encompass altering the practice of scanning medication prior to administration, the streamlined administration process led to a positive unintended result of increased scanning compliance rate. Scanning medications is crucial in healthcare settings to ensure accurate administration, reduce errors, and maintain patient safety by verifying the correct medication, dosage, and patient information. See Appendix D for scanning compliance rate for ketorolac.

It is important to acknowledge some limitations to our data and projected savings. We know there were variations on the nursing staff confidence and comfort levels prior to this change and, consequently, their administration practice. Therefore, the results and projected savings may be an overestimation.

To ensure lasting change, we focused on the reinforcement building block of Change Management. Engaging staff and involving stakeholders in early stages was crucial, but we continue to celebrate our success daily. We added clear messages and articulated the goals and benefits of the change on our Quality Improvement (QI) board, providing regular updates to keep the message consistent and visible. The advanced mentors in the department were identified as key components to embrace the change and ensure broad awareness and support. We continue to monitor and revise data that is meaningful to this project. Aligning the EHR order to the administration method was also essential to sustain the new practice. Through a staff survey, potential next steps were identified to maintain engagement, but implementation is being carefully planned as to not overwhelm staff or stakeholders and avoid change saturation.

When sharing the process change with other ED nurses they identified value in expanding this project to other Urgent Care Centres and Emergency Departments. One urgent care center nurse indicated there was high use of mini bags, while another ED leader sought information regarding the process of changing the EHR medication order at their site. Future opportunities to showcase this project is a key strategy to replicate at other departments and sites.

This project would be relevant to many other areas, including Urgent Care Centers, Intensive Care Units and Emergency Departments across the zone and province. To spread this initiative to other settings, similar projects could explore the IV administration of other medications commonly used in acute care settings, such as antibiotics. Replicating this project to the most common antibiotic administered at SHC ED (ceftriaxone) would provide an additional estimated annual medical supplies savings of \$35,053.20 and 1,916.64 kgCO₂e per year.

Overall, expanding this project to other departments or sites should involve collaboration with stakeholders like pharmacy, clinical nurse educators and IT analysts to develop comprehensive guidelines and training programs. Key next steps could include conducting pilot studies in different



hospital units to evaluate feasibility, efficacy, and safety, followed by education and training sessions for healthcare staff to ensure consistent implementation and adherence to protocols.

Conclusions:

Although we initially identified the potential for this project to improve emergency department length of stay for patients receiving ketorolac, upon monitoring this data we identified that the true impact of the change affected the physician assessment to discharge time. Obtaining the updated data provided reassurance of the potential of this project to expand to other medications to impact a larger ED population.

Engaging the pharmacy department early was pivotal in successfully implementing the EHR order and fostering collaborative partnerships for expanding medication management. A critical factor in our success was selecting a medication with straightforward administration, which garnered strong support from bedside nurses. Notably, we observed enhanced safety in medication administration, an unexpected improvement that we are eager to share with the pharmacy team. By disseminating these findings, we aim to raise awareness and facilitate the extension of this approach to other IV medications.

The significant and broad ramifications that one change can have in so many different areas is encouraging and inspiring. Ultimately, this initiative underscored the opportunities to integrate sustainability and incorporate South Health Campus pillars of Collaborative Practice, Innovation, Patient and Family Centered Care and Wellness into operational practices. It also demonstrated the potential to extend the concept of sustainable and safe medication administration beyond its initial scope to encompass other medications, emergency departments, units and potentially the entire province.

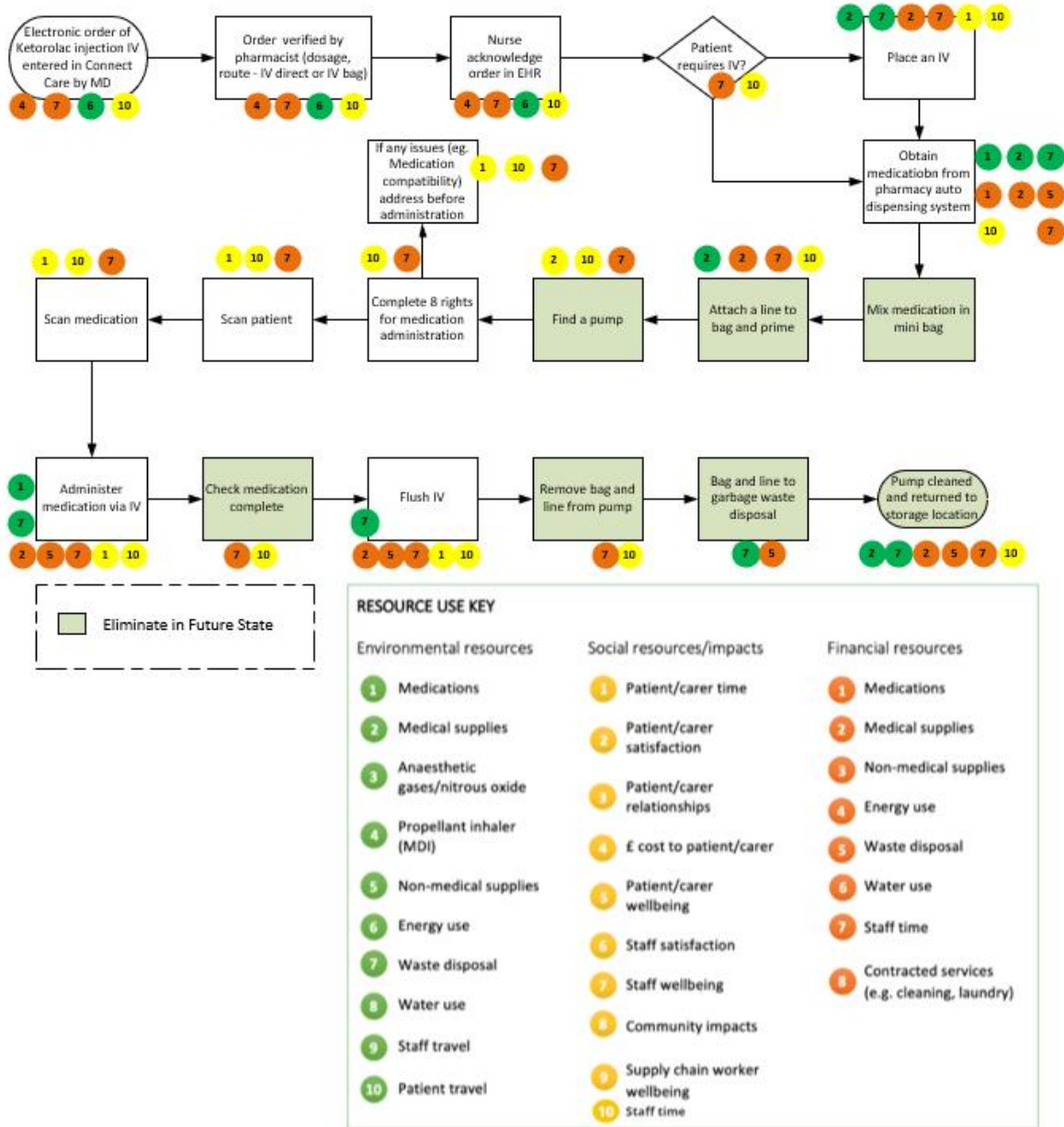
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Appendices
Appendix A

Ketorolac Administration SHC ED – April 2024



Appendix B

Patient Experience

Feedback provided from ED patients through collaboration with the **Patient and Family Centered Care Team**.

"I feel being attached to an IV set up/pole makes you **feel trapped** I think **IV poles are cumbersome and awkward**."

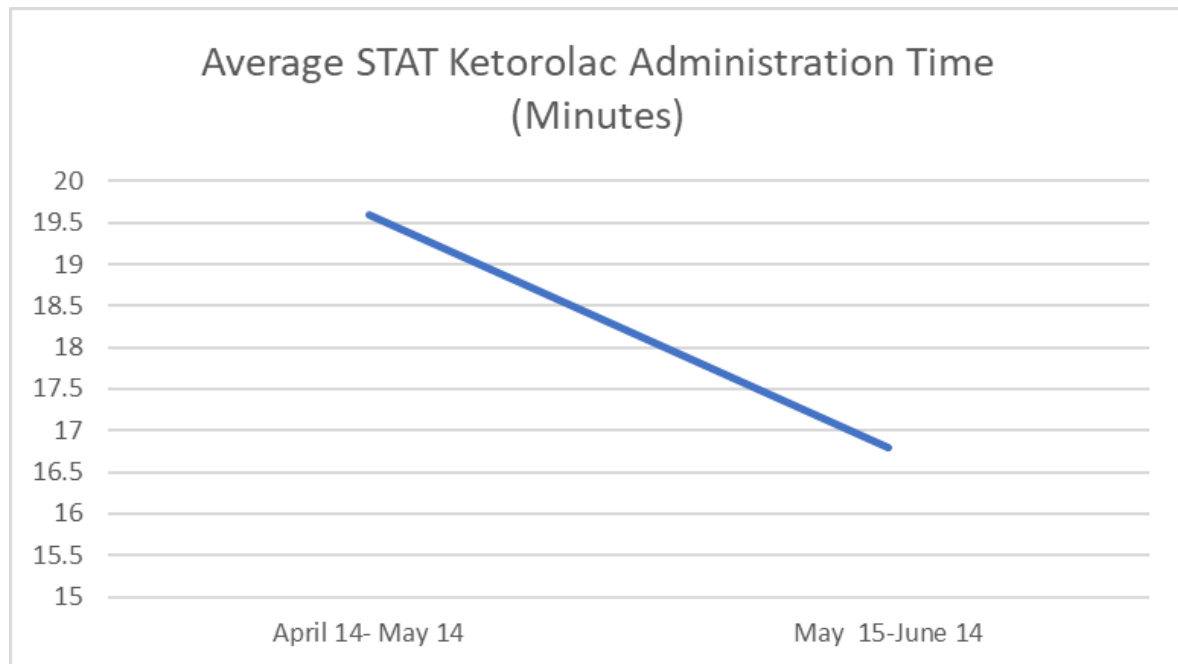
"Lots of **garbage is generated** from care in the ED- I can see all of the packaging and the actual tubing all being thrown away- it's a lot of waste, you can see the garbage cans full of stuff like this"

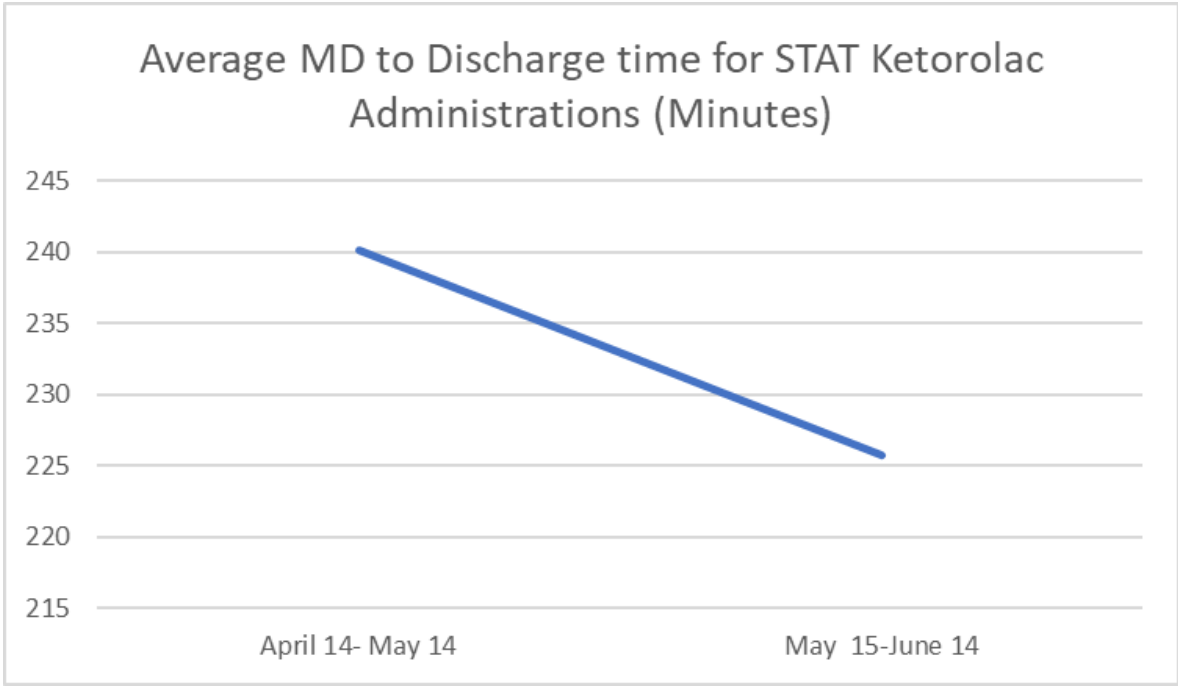
"If there was some way of **administering some medications faster**- I would have to spend less time in the chaotic environment of the ED, if I was able to have a shorter visit, it might free up space for others to receive care."

"Had some **difficulty turning and repositioning in bed**, felt that they always had to be mindful of where the IV and the tubing was so as not to dislodge it with movement."

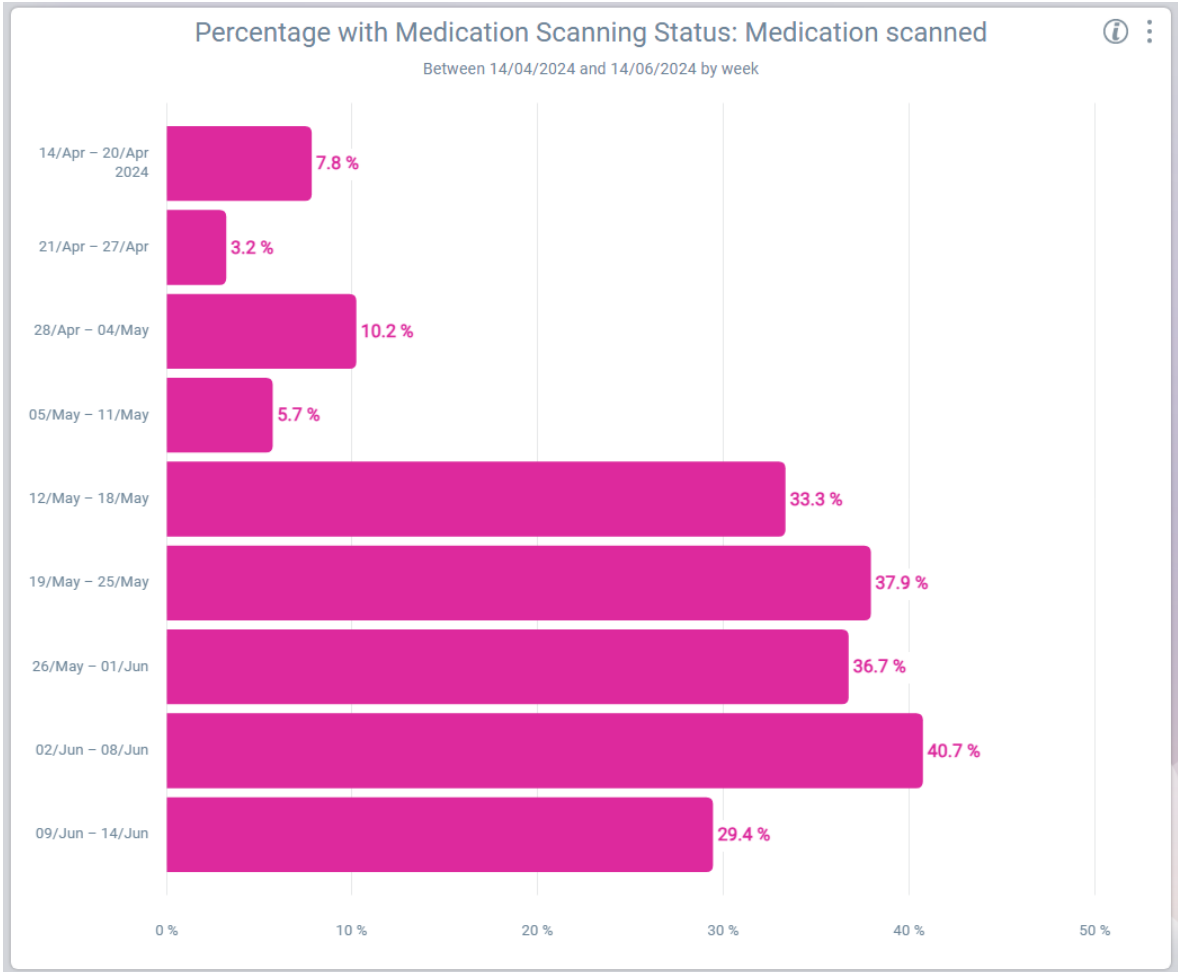
"**Mobility was a challenge**, when already not feeling well, difficult to maneuver the IV tubing and pole."

Appendix C





Appendix D



Critical success factors

Please select one or two of the below factors that you believe were most essential to ensure the success of your project changes.

People	Process	Resources	Context
<input type="checkbox"/> Patient involvement and/or appropriate information for patients - to raise awareness and understanding of intervention <input checked="" type="checkbox"/> Staff engagement <input type="checkbox"/> MDT / Cross-department communication <input type="checkbox"/> Skills and capability of staff <input checked="" type="checkbox"/> Team/service agreement that there is a problem and changes are suitable to trial (Knowledge and understanding of the issue) <input type="checkbox"/> Support from senior organisational or system leaders	<input checked="" type="checkbox"/> clear guidance / evidence / policy to support the intervention. <input type="checkbox"/> Incentivisation of the strategy – e.g., QOF in general practice <input type="checkbox"/> systematic and coordinated approach <input type="checkbox"/> clear, measurable targets <input type="checkbox"/> long-term strategy for sustaining and embedding change developed in planning phase <input type="checkbox"/> integrating the intervention into the natural workflow, team functions, technology systems, and incentive structures of the team/service/organisation	<input type="checkbox"/> Dedicated time <input type="checkbox"/> QI training / information resources and organisation process / support <input checked="" type="checkbox"/> Infrastructure capable of providing teams with information, data and equipment needed <input type="checkbox"/> Research / evidence of change successfully implemented elsewhere <input type="checkbox"/> Financial investment	<input type="checkbox"/> aims aligned with wider service, organisational or system goals. <input type="checkbox"/> Links to patient benefits / clinical outcomes <input checked="" type="checkbox"/> Links to staff benefits <input type="checkbox"/> 'Permission' given through the organisational context, capacity and positive change culture.