



## SUSQI PROJECT REPORT Kapsule Kids

# KAPSULE KIDS

**Start date of Project:** September 2023

### Team Members:

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### Background:

Liquid medication is the default prescribed formulation in paediatrics due to the assumption that it is easier to administer in children. Whilst this may be true especially for patients who have enteral feeding tubes, there are several setbacks to relying on liquid formulations of medicines. With the state of our current climate, there is a number of shortages of raw materials. This is particularly true for liquid formulations of medicines and therefore, if a patient can swallow tablets, this can open up more options to ensure patients are still able to take potentially lifesaving medications.

Liquid formulations are often more costly than tablets due to the extra packaging and excipients involved in their manufacturing. For similar reasons, liquid formulations are less environmentally sustainable than using tablets. This is due to the extra packaging required for liquid formulations of medicines but also due to the amount of wastage surrounding stability of liquid formulations once opened. Often patients do not finish a bottle of medication before the expiry once opened, therefore the remainder of the bottle is wasted. Liquid formulations can also be available in different strengths, which can lead to increased risk of dosage errors. This is often seen in patients whose care is transferred between hospital to community. Tablets and capsules are generally a safer formulation as their added excipients rarely contribute towards side effects or reactions. Excipients found in liquid medication that are needed to ensure stability and palatability can include ethanol, sorbitol, large amounts of sucrose, benzoates and parabens, all of which can have additional side effects.

Previous evidence has shown children from as young as three years old are able to swallow tablets and capsules. Training patients on methods of swallowing allows for safe administration of tablets and capsules in the paediatric population. Pill School has been successfully implemented in the Evelina London Children's Hospital with over 90% of children being discharged on pills. It has also been successfully implemented at the Great North Children's Hospital, Newcastle through their KidzMed project with £46 588 of medication costs saved over a year.

At Great Ormond Street Hospital, we attempted to initiate a similar project to train patients post heart and lung transplants to take tablets. As transplants consist of lifelong medication, we found this to be a suited area to transition patients to tablets and capsules wherever possible. Therefore, this project was undertaken on our cardiac wards.



### Specific Aims:

The aim of this project was to encourage and empower children to take tablets and capsules, reducing the usage of liquid medication in paediatrics.

### Methods:

This project was conducted on the Cardiac ward at Great Ormond Street Hospital between October 2023 and April 2024 with training conducted at the patient's bedside.

We decided to focus on our heart and/or lung transplant patients as this is a smaller cohort of patients (average of approximately 20 per year) where our improvement ideas could be tested. This cohort of patients also remain on some medications (e.g. tacrolimus and mycophenolate mofetil (MMF)) lifelong. Often there is a perception that young children are not safe to swallow tablets, and so they may not transition until 12-13 years of age. There is therefore potential significant savings per patient from a financial and environmental perspective.

Transplant medications that were included in this project consisted of tacrolimus, mycophenolate mofetil (MMF), paracetamol and co-trimoxazole.

#### Inclusion Criteria:

- Patients between the ages of 4 to 18 years of age.
- Patients who have had a heart and/or lung transplant.
- Patients with suitable dosing to allow for solid dosage forms to be administered.

#### Exclusion Criteria:

- Patients/carers with learning disabilities.
- Patients with swallowing difficulties.
- Patients with enteral feeding tubes.

Eligible patients were identified by the ward pharmacist, medicines management technician (MMT), ward nurses and clinicians. As the patient would be on the cardiac intensive care unit (CICU) prior to stepping down to the cardiac ward, the CICU pharmacist would also identify any eligible patients to hand down. This allowed for early initiation of training.

Training was conducted by the ward pharmacist and ward MMT using techniques outlined on the KidzMed training platform, Evelina's Pill School protocol and through development of our own pill information booklet for patients (Appendix 1). Ward clinicians and nurses were advised to flag suitable patients to the Kapsule kids team to facilitate the training early during admission.

The Cardiac Ward pharmacist would have a discussion as soon as they stepped down from CICU to explain the aims of Kapsule kids to the patient and their parents/carers. Upon agreeing to participate, the patient's take home medicines were prescribed as tablets and dispensed to the ward soon after to facilitate early training in the controlled environment of the ward prior to discharge.

Patients and parents were provided with a booklet made of the shapes, sizes and appearance of tablets and capsules of the medication they would be converted to, so they were better informed of what to expect. They were also redirected to the Newcastle KidzMed resources and videos to demonstrate the techniques on how to swallow tablets (Appendix 2).



Patients were encouraged to attempt taking tablets following this as an inpatient to ensure they were confident with the techniques.

**Measurement:**

**Patient outcomes:**

Verbal feedback was obtained before training was commenced and after on patients and their families thoughts and feelings of taking pills instead of using liquid medication.

**Environmental and economic sustainability:**

Costs for medications were obtained from the Electronic Prescribing System.

To estimate the carbon footprint of each medication and administration we did the following:

- Excluded the medication itself as it is inaccurate to compare medications based on cost. It was assumed the active ingredients are very similar as the same drug is being provided to each patient, however with a different formulation.
- Packaging
- Syringes
- Travel emissions were excluded as the information required was not shared by manufacturers. Therefore, the emissions per medication will be underestimated.

	unit	gCO2e	£
Modigraf 200mcg - Tacrolimus sachet	per sachet	6.03	1.43
Modigraf 1mg - Tacrolimus sachet	per sachet	6.08	7.31
Prograf 5mg - Tacrolimus capsule	per capsule	2.22	5.93
Prograf 1mg - Tacrolimus capsule	per capsule	2.21	1.60
Prograf 0.5mg - Tacrolimus capsule	per capsule	2.22	1.24
MMF suspension liquid (1 bottle 175ml)	per dose (2.5ml) assuming = 500mg tablet	4.12	1.65
MMF 500mg tablets	per tablet	2.02	0.12
MMF 250mg capsules	per 2 capsules	4.1	0.14
Co-trimox adult suspension (100ml) liquid	dose of 5ml assuming = 1 tablet	11.64	0.55



Co-trimox tablets (480mg)	per tablet	1.45	0.06
Paracetamol 200ml liquid	10ml per dose (= 500mg tablet)	18.88	0.29
Paracetamol 100ml bottle 120mg per 5mL liquid	20.83ml per dose (4.8 doses per bottle)	48.6	0.98
Paracetamol 500mg tablets	per tablet	1.22	0.015

**Social sustainability:**

Verbal feedback was obtained on the challenges patients and families face with their medication in terms of transport and availability of medications. Additional impacts are also described in the results section.

It was outside the scope of our project to measure social impacts on staff, however potential impacts have been outlined in the results section.

**Results:**

**Patient outcomes:**

Verbal feedback was obtained from patients on their thoughts and feelings towards switching to pills before and after training. When asking patients before training, we found it was often parents who had more concerns than the patient themselves and would be hesitant to try, due to perceptions that tablets are not appropriate or safe for small children. Some families would be concerned about choking risks. There is also sometimes an assumption that younger children do not have the capacity to contribute to the decisions made for them, which can often leave the children disenfranchised.

However, after having a discussion of the benefits of switching, they were usually willing to try in the controlled environment of the hospital prior to discharge.

**Environmental and economic sustainability:**

During this period (October 2023 - April 2024), we switched 5 heart transplant patients from liquids to tablets. This led to the following savings from a 6-week supply of discharge medications:

Patient 1:

- 250 capsules of Prograf 1mg capsules and 350 capsules of Prograf 0.5mg capsules for a dose of 3.5mg in the morning and 4mg at night. This equated to a saving of approximately 4.6 kgCO<sub>2</sub>e and £1,994.50.
- 300 capsules of 250mg MMF capsules for a dose of 750mg twice a day. This equated to a saving of 3.6 gCO<sub>2</sub>e and £226.50.
- 56 tablets of co-trimoxazole 480mg tablets at a dose of 1 tablet twice a day, three times a week. This equated to a saving of 570.5 gCO<sub>2</sub>e and £27.44.

In one year GOSH will save £19,248.6 and 39.9 kgCO<sub>2</sub>e from Prograf and MMF medicines for patient 1. £27.44 and 0.57 gCO<sub>2</sub>e will also be saved from co-trimoxazole on discharge, however ongoing savings will be realised in the local pharmacy and have therefore not been calculated.



Patient 2:

- 100 capsules of Prograf 5mg capsules, 100 capsules of Prograf 1mg capsules and 100 capsules of Prograf 0.5mg capsules for a dose of 4mg twice a day. This equated to a saving of approximately 4.2 kgCO<sub>2</sub>e and £3,795.
- 100 capsules of 250mg MMF capsules for a dose of 500mg twice a day. This equated to a saving of 1.2 gCO<sub>2</sub>e and £75.50.
- 28 tablets of co-trimoxazole 480mg tablets at a dose of half a tablet twice a day, three times a week. This equated to an approximate saving of 285.32 gCO<sub>2</sub>e and £13.72.

In one year GOSH will save £33,544.3 and 36.4 kgCO<sub>2</sub>e from Prograf and MMF medicines for patient 2. 0.28 kgCO<sub>2</sub>e and £13.72 will also be saved from co-trimoxazole on discharge, however ongoing savings will be realised in the local pharmacy and have therefore not been calculated.

Patient 3:

- 150 capsules of Prograf 1mg capsules for a dose of 2mg twice a day. This equated to a saving of approximately 570.6 gCO<sub>2</sub>e and £856.50.
- 300 capsules of 250mg MMF capsules for a dose of 750mg twice a day. This equated to a saving of 3.6 gCO<sub>2</sub>e and £226.50.
- 56 tablets of co-trimoxazole 480mg tablets at a dose of 1 tablet twice a day, three times a week. This equated to a saving of 570.5 gCO<sub>2</sub>e and £27.44.

In one year GOSH will save £9,386 and 4.97 kgCO<sub>2</sub>e from Prograf and MMF medicines for patient 3. 0.57 kgCO<sub>2</sub>e and £27.44 will also be saved from co-trimoxazole on discharge, however ongoing savings will be realised in the local pharmacy and have therefore not been calculated.

Patient 4:

- 350 capsules of Prograf 1mg capsules and 100 capsules of Prograf 0.5mg capsules for a dose of 2.5mg in the morning and 2mg at night. This equated to a saving of approximately 2.3 kgCO<sub>2</sub>e and £2,160.50.
- 200 capsules of 250mg MMF capsules for a dose of 250mg twice a day. This equated to a saving of 2.4 gCO<sub>2</sub>e and £151.
- 56 tablets of co-trimoxazole 480mg tablets at a dose of 1 tablet twice a day, three times a week. This equated to a saving of 570.5 gCO<sub>2</sub>e and £27.44.

In one year GOSH will save £20,033 and 19.95 kgCO<sub>2</sub>e from Prograf and MMF medicines for patient 4. 0.57 kgCO<sub>2</sub>e and £27.44 will also be saved from co-trimoxazole on discharge, however ongoing savings will be realised in the local pharmacy and have therefore not been calculated.

Patient 5:

- 150 capsules of Prograf 5mg capsules, 100 capsules of Prograf 1mg capsules and 150 capsules of Prograf 0.5mg capsules for a dose of 5.5mg twice a day. This equated to a saving of approximately 6.09 kgCO<sub>2</sub>e and £5,407.
- 28 tablets of co-trimoxazole 480mg tablets at a dose of 1 tablet twice a day, three times a week. This equated to an approximate saving of 285.32 gCO<sub>2</sub>e and £13.72.

In one year GOSH will save £46,860.6 and 52.78 kgCO<sub>2</sub>e from Prograf for patient 5. 0.28 kgCO<sub>2</sub>e and £13.72 will also be saved from co-trimoxazole on discharge, however ongoing savings will be realised in the local pharmacy and have therefore not been calculated.

**Summary:**

Discharge medications only: For 6 weeks of medications (Prograf, MMF and co-trimoxazole) for 5 patients, we have saved 21.12 kgCO<sub>2</sub>e and £15,002.76.

Hospital only medicines: Accounting for medicines (Prograf and MMF) that continue to be provided for GOSH, likely for many years or the patient's lifetime, we have saved £129,072 and 163 kgCO<sub>2</sub>e across a year for 5 patients (including 6 weeks discharge medicines).

**Total savings**

As a conservative estimate, we could transition 10 transplant patients per year. Using the above 5 patients' savings as an average, inclusive of one year supply of hospital only medicine (Prograf and MMF) and 6 weeks supply of co-trimoxazole, we will save approximately **£258,255** and **329 kgCO<sub>2</sub>e** per year, equivalent to driving 972 miles in an average car.

***Social sustainability:***

Patients and families appreciated the formulation of tablets compared to liquid was a lot easier to transport, especially when taking medication to school. Tablets are also more palatable than some of the liquid formulations. Parents and carers appreciated that they would no longer have to keep track of expiries once opened of liquid medication. This may reduce frequency of which families need to collect medications.

As well as these social impacts, switching the patients medications to tablets and or capsules allowed for the older children to take more control of their medication as they were able to make their own pill boxes at home. If they remained on liquids this would not have been feasible and may have diminished their independence. Switching formulations has contributed to improving long term independence for young adults which has a crucial positive impact.

Due to the current co-trimoxazole liquid shortage, training patients to take pills allowed them to receive essential medication post heart transplant to prevent any bacterial infections post-transplant especially since they would be on lifelong immunosuppressants.

There are benefits of this project to nursing staff on wards as drawing up liquid medications from a bottle is more time consuming than providing tablets. MMF liquid also carries teratogenic risks and pregnant staff must avoid making it up – our project reduces this being a potential barrier and risk.

For the pharmacy team undertaking this project, there were some positive impacts in that supporting children to feel empowered and gain a new skill is satisfying in your job role. However, the project came with a burden on staff time for an already very busy team.

**Discussion:**

Often parents and carers had the most anxiety at attempting to switch to pills in comparison to the patient themselves. However, through discussing the benefits of switching with the parents, explaining training will occur in a controlled environment, patients were often willing to try pills. A supplementary material of a



booklet of the medication, their appearance and size were created to better inform patients alongside showing a poster of the different swallowing techniques to assist the transition.

With some of the children involved, this resulted in greater adherence due to acceptability, palatability, and transportability. The Kapsule Kids programme also allows for a swifter transition to community and adult care for patients due to the availability of pills in comparison to liquid formulations of medicines. Patients who are able to swallow tablets are able to take control of their own care better.

In addition to the social aspect of the Kapsule Kids programme, switching to pills has also contributed to reduced dosing errors. By taking whole tablets in comparison to miniscule liquid volumes training patients and or carers takes less time and ensures the wrong doses aren't given.

There are some limitations to our data and projected savings. As shown in our above data, there is a lot of variation in medication prescriptions based on the patient. Therefore, our projected annual savings may be over or underestimated depending on the individual needs of future patients.

However, our savings may be underestimated in the following ways:

- We have not accounted for any tablets taken in replacement of liquid medications during the inpatient admission.
- We have not accounted for paracetamol, as we do not prescribe paracetamol on discharge, and savings beyond discharge will be realised in the local pharmacy and/or to the family.
- We have not included potential liquid medication waste on the wards due to frequent mislabelling issues, which means it is not possible to know when a medication was opened (leading to it being discarded).

Given the nature of transplant treatment, these children will remain on these medications for life and therefore savings to GOSH and local pharmacy will continue.

Co-trimoxazole, MMF, tacrolimus and paracetamol were chosen to focus this project on in particular as dosing for these medicines can be rounded to the nearest available tablet or capsule strength, however, this might not be the case for all medicines and therefore application of this project can prove difficult. Switching certain medicines might entail rendering the medication off label by crushing and dispersing tablets or opening capsules to obtain a part dose. When manipulating tablets and capsules, a new tablet would be required for each dose due to lack of stability data and therefore also result in medicines wastage. Manipulation of tablets and capsules of certain medicines is contraindicated with certain active ingredients due to teratogenic and carcinogenic risks. Next steps would be to incorporate other medicines which are easily rounded to a readily available pill strength. This could be for the same patient group (e.g. diuretics) or new patient cohorts. For example, we send a lot of surgical patients home on post of prophylaxis (co-amoxiclav) where rounding to 5ml of liquid is often needed. This is a like-for-like dosage to a 250mg tablet and would be a change applicable to a wider range of patients.

At Great Ormond Street Hospital, there are many heart and lung transplant clinics held for outpatient appointments. As many of the transplant medicines are hospital only medication, usually a resupply of medicine is tied in with appointments and therefore, clinics would be a good area to make further interventions, particularly for patients who have not been supported to transition to tablets while an inpatient.

Due to the complexity of heart and lung transplants, the sample size of this project was limited. Therefore, future plans would be to enrol Kasule Kids for different patient cohorts and different wards. Another area that uses similar medication and conducts more transplants and therefore would benefit from this project





would be the Renal ward at Great Ormond Street Hospital. We have had initial conversations with the team. Currently there are concerns of staffing levels to be able to launch this initiative. We understand the renal wards concerns, as the biggest limitation of this project was staffing and resources. This project was conducted by two pharmacists and an MMT alongside their usual day to day work responsibilities and therefore we were unable to give as much focus to the project as intended. However long term there is an opportunity to improve this as a variety of staff can be involved in the project – whether to support in identifying eligible patients (e.g. Health Care Assistants) or potentially to carry out the training and education session with patients and families. In the future, it would be worthwhile getting play specialists involved which was a supportive element of the Kidzmeds project in Newcastle.

As the next steps, we would also like to improve our resources by investing in different mock pill sizes, medicines administration cups and gels to help assist pill taking and training of especially younger patients. Improving the access to tools will allow for this programme to flourish and support the patients and carers effectively.

### Conclusions:

There are many benefits to training patients on how to take pills from an early onset including improved adherence, cost savings, better continuity of care and is more environmentally sustainable.

Simply asking patients if they would like to attempt taking pills can lead to patient engagement. Easing parent and carer anxiety is the key to encouraging children to take tablets and capsules and finding a vehicle of delivery that is acceptable to the patient. Creating a safe and comfortable environment with room for an open discussion has been the main driver in the success of this project.

Empowering the patient through direct conversation has provided us the success to sustainability. Going forward, we will continue to collect data on patients we switch to pills and would like to broaden this project to other wards if more resources and staffing is provided.

### References and Resources

1. NHS England. 'Delivering a 'Net Zero' National Health Service', 2022.
2. Lim E, Parker E, Vasey N. Why learning how to swallow pills is good for patients, parents, and the planet. *BMJ*. 2024;384:e076257.
3. Rashed AN, Terry D, Fox A, Christiansen N, Tomlin S. Feasibility of developing children's Pill School within a UK hospital. *Archives of Disease in Childhood*. 2021;106(7):705-8.
4. Tse Y, Vasey N, Dua D, Oliver S, Emmet V, Pickering A, et al. The KidzMed project: teaching children to swallow tablet medication. *Archives of Disease in Childhood*. 2020;105(11):1105-7.
5. Patel A, Jacobsen L, Jhaveri R, Bradford KK. Effectiveness of pediatric pill swallowing interventions: a systematic review. *Pediatrics*. 2015;135(5):883-9.
6. NPPG Position statement 2020-01 Choosing an Oral Liquid Medicine for Children.
7. Yeung VW, Wong ICK. When Do Children Convert from Liquid Antiretroviral to Solid Formulations? *Pharmacy World and Science*. 2005;27(5):399-402.
8. Garvie PA, Lensing S, Rai SN. Efficacy of a pill-swallowing training intervention to improve antiretroviral medication adherence in pediatric patients with HIV/AIDS. *Pediatrics*. 2007;119(4):e893-9.





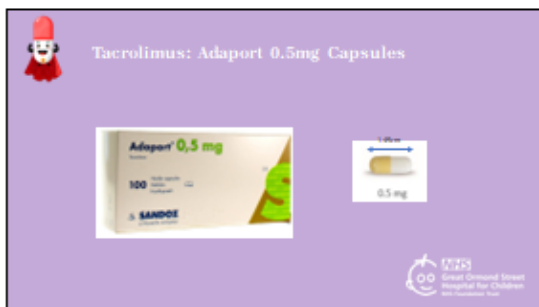
# Appendix 1: Capsule Kids Information Booklet



1



4



2



5



3



6

 Tacrolimus: Prograf 200mcg Granules




0.25 mg



7

 Paracetamol 500mg Effervescent Tablets




1.0 g



10

 Tacrolimus: Prograf 1mg Granules




0.25 mg



8

 Co-Trimoxazole 80mg/400mg Tablets




1.2 g



11

 Paracetamol 500mg Tablets




0.5 g



9




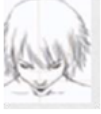

 Co-Trimoxazole 40mg/200mg per 5ml Oral Suspension




12



## Appendix 2 Pill Swallowing techniques

<p>1. Head rotated left</p> <ul style="list-style-type: none"> <li>- Put the sweet in your mouth, as far back on your tongue as possible</li> <li>- Take a mouthful of your preferred drink</li> <li>- As you swallow, turn your head slightly to the left until all the water in your mouth is gone, along with the sweet</li> </ul> 	<p>5. Centre: head face forward</p> <ul style="list-style-type: none"> <li>- Put the sweet in your mouth, as far back on your tongue as possible</li> <li>- Take a mouthful of of your preferred drink</li> <li>- Keep your head in a comfortable centre position facing forward and swallow</li> </ul> 	<p>2. Head rotated right</p> <ul style="list-style-type: none"> <li>- Put the sweet in your mouth, as far back on your tongue as possible</li> <li>- Take a mouthful of your preferred drink</li> <li>- As you swallow, turn your head slightly to the right until all the water in your mouth is gone, along with the sweet</li> </ul> 
<p>3. Chin tilted down</p> <ul style="list-style-type: none"> <li>- Put the sweet in your mouth, as far back on your tongue as possible</li> <li>- Take a mouthful of your preferred drink</li> <li>- Tilt your head towards your chest and lean forward slightly</li> <li>- Swallow the water and sweet. Ngunk! (The funny noise your throat makes when you swallow)</li> </ul> 		<p>4. Head backward</p> <ul style="list-style-type: none"> <li>- Place tablet in your mouth, as far back on your tongue as possible</li> <li>- Take a mouthful of your preferred drink</li> <li>- Tilt your head back and swallow</li> </ul> 

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