Appendix

S1 -Table: Study wards from two hospitals

Hospital	Ward	Patients N	Age in years, median (Interquartile range)	Description
A	1	413	7.0 (1.2-11.0)	Neuroscience
	2	814	7.0 (2.0-11.0)	Surgical
	3	703	9.0 (4.0-13.0)	Orthopaedics
	4	448	3.0 (0.0-9.0)	Cardiology, cardiac surgery, ENT and ophthalmic surgery
	5	134	14.5 (13.0-16.0)	Specialist adolescence
	6	511	11.0 (6.0-14.0)	Medical day stay, parent care, endocrine testing
	7	413	4.0 (1.0-10.0)	Burns and complex wound management
	8	1456	5.0 (2.0-10.0)	Day surgery
	9	638	1.0 (0.0-3.0)	Children with a wide range of conditions
B	10	352	1.5 (0.0-5.0)	Cardiac/renal/infant surgical
	11	1070	5.0 (2.0-10.0)	Short stay surgical
	12	383	6.0 (2.0-11.0)	Neuro/orthopaedic
	13	277	12.0 (10.0-14.0)	Adolescent
	14	759	1.8 (0.0-5.0)	General medical/isolation

S2a -Table: Prescribing error potential harm severity rating scale

Severity level	Severity Rating	Definition
Minor	1	An error occurred with no or minimal potential to cause harm* to the patient and no need for a change in monitoring^ or intervention^^ Staff identifying this error would likely contact: Clinical team
	2	An error occurred which has the potential to cause temporary harm to a patient and may require monitoring^ Staff identifying this error would likely contact: Nurse Unit Manager
Potentially serious	3	An error occurred which has the potential to cause temporary harm to a patient and would require intervention^^ Staff identifying this error would likely contact: Resident Medical Officer
	4	An error occurred which has the potential to cause permanent harm to a patient and would require intervention^^ Staff identifying this error would likely contact: Consultant/Specialist
	5	An error occurred which has the potential to result in the patient's death or would require intervention that is necessary to sustain life Staff identifying this error would likely contact: Medical Emergency Team

* Harm refers to any impairment of structure or function of the body or mind such as disease or suffering and/or any deleterious effect arising there from

^ Monitoring refers to any change in care pattern from the usual standard level of care including assessing urine output, general level of consciousness, or vital signs (heart and breathing rate)

^^ 'Intervention' refers to any active treatment including blood tests, administering a drug, or general medical/surgical treatment

S2b Table: Prescribing clinical error type category

Error category	**Sub-category**	**Definition**	**Examples**
Wrong patient		A medication is prescribed for the wrong patient.	
Wrong drug	Drug-disease interaction	The drug or IV fluid is contraindicated for a co-existing condition.	• NSAID prescribed to an asthmatic patient. • Gentamicin is prescribed to a patient with a history of auditory toxicity caused by an aminoglycoside.
	Incompatible diluent	An IV drug is prescribed with an incompatible diluent (if prescribed).	• Amphotericin B is prescribed with sodium chloride 0.9% as diluent.
	Other	A wrong drug error that cannot be categorised as drug-disease interaction and incompatible diluent. **Exclusion:** Generic or formulary substitution.	• Hyoscine hydrobromide is prescribed for CF patient when hyoscine butylbromide is indicated. • Fluticasone/salmeterol inhaler is prescribed for a patient without a respiratory condition, such as asthma. • Look-alike, sound-alike errors.
Wrong formulation		The wrong dosage form of a medication is prescribed.	• An extended-release tablet is prescribed when an immediate release form is required. • Oral formulation prescribed for IV administration.
Wrong strength		1. The prescribed drug strength is incorrect. 2. The concentration of an IV infusion is prescribed incorrectly.*	• Amoxicillin/clavulanic acid 1:4 ratio prescribed with dose and frequency for 1:7 ratio

		3. The prescribed dose does not exist or would not be able to be obtained from the current dose form. **Exclusion:** Wrong strength which can directly result in either overdose or underdose should be categorised under "Wrong Dose". *Incorrect concentration of infusions was classified as any concentration above or below the limits of reference guidelines	• Wrong volume of diluent for IV drug i.e. concentration too low or too high • Dose unit such as suppository prescribed with strength that does not exist.
Wrong dose	Overdose	1. The prescribed medication dose or IV fluid volume is >10% higher than that recommended for the condition, taking into account the patient's age and weight. 2. The dosing fails to take into account renal and liver function. 3. A dose is not altered in response to abnormal drug serum levels or laboratory tests. **Exclusion:** Doses where local protocols allow for rounding to the nearest measurable dose e.g. quarter tablet for spironolactone.	• Maintenance oral paracetamol dose prescribed at 30 mg/kg every six hours for a 2-month-old infant. • Clonidine prescribed at 200 microg bd for a 10-year-old with ADHD (reference states a max dose of 300 mcg/day in 2-3 doses).
	Under dose	1. The prescribed medication dose or IV fluid volume is >10% lower than that recommended for the condition, taking into account the patient's age and weight. 2. The dosing fails to take into account renal and liver function. 3. A dose is not altered in response to abnormal drug serum levels or laboratory tests.	• Initial dose of gentamicin for a 6-month-old infant with normal renal function is below recommended dose of 7.5 mg/kg once daily. • Hydrocortisone IV bolus 25 mg tds prescribed for a 18 year old patient for acute adrenal insufficiency (reference advises dose of 50–100 mg every 6–8 hours).

		Exclusion: Doses where local protocols allow for rounding to the nearest measurable dose e.g. quarter tablet for spironolactone.	
	Wrong unit	The prescribed medication dose contains the wrong unit which results in either over or under dose. The unit of measure used does not correspond with the dosage form or recommendations for safe prescribing.	• Thyroxine 100 “mg” mane is charted instead of “mcg” which would result in overdose. • Pancreatic enzymes prescribed as capsules or scoops instead of ‘units’.
	Dose unverified	The prescribed medication dose cannot be verified from reference sources.	• Clinical trial drugs without standard dosage guidelines. • Doses where references do not contain dosing recommendation for condition being treated. • Drug prescribed in mL where multiple strengths of liquid formulation are available and dose cannot be determined from order.
Wrong route		A medication is prescribed via an incorrect route of administration.	• IV medication is prescribed orally except for off-label use. • Left eye was written instead of right eye. • PO route is charted for nil by mouth patient on PEG. • IV bolus prescribed for medication that requires intermittent infusion.
Wrong frequency		The prescribed frequency of administration of a drug is outside the recommended range. The frequency is acceptable but the total number of doses exceeds the maximum	• Ceftriaxone TDS • Paracetamol 15 mg/kg 4-hourly prn missing maximum daily dose information (60 mg/kg/day)

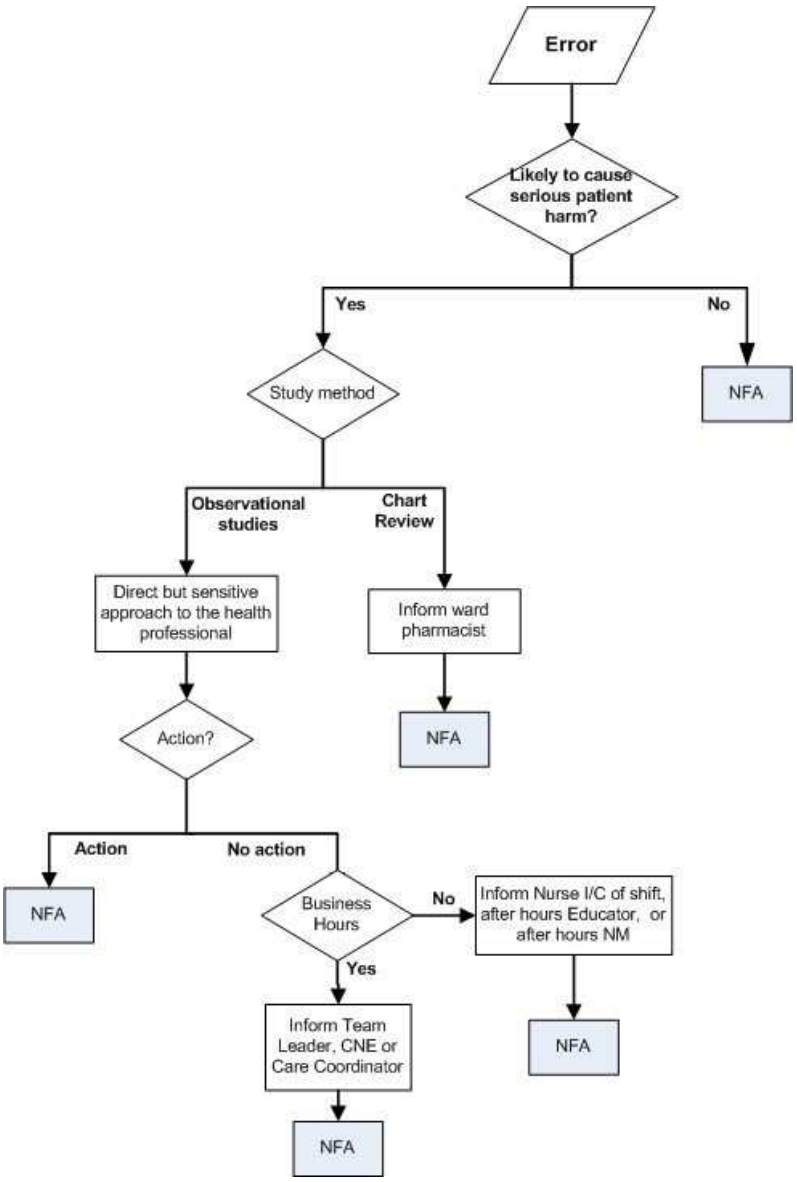
		daily recommended dose.	• Daily dose divided into multiple doses for drug usually given once daily • PRN order with correct frequency and max dose combined with regular order to push over limit e.g. regular ondansetron mane and TDS prn (usually maximum 3 times/day)
Wrong rate	Too fast	An IV rate or the basal rate of infusion falls above the recommended range. **Exclusion:** IV medications requiring TDM for dose adjustments e.g. heparin and vancomycin continuous infusion, review is to be guided by TDM level rather than dose and rate.	
	Too slow	An IV rate or the basal rate of infusion falls below the recommended range. **Exclusion:** IV medications requiring TDM for dose adjustments e.g. heparin and vancomycin continuous infusion, review is to be guided by TDM level rather than dose and rate.	
Wrong timing		A medication is prescribed at the wrong time of day.	• Methylphenidate prescribed in the evening instead of morning. • NSAID prescribed to take before food. • Pre-medication prescribed to prevent infusion reaction scheduled after infusion.

No longer indicated		1. A drug is continued following a clinically significant adverse drug reaction. 2. A drug that is no longer indicated is re-ordered. 3. A drug which should have been discontinued has not been ceased.	• Clonazepam continues to be prescribed following episode of respiratory depression. • Ranitidine liquid is re-ordered following recovery from symptomatic GORD. • Continuation of antibiotic use following recovery from an infection.
Duplicated drug therapy		1. Same drug prescribed twice as two active orders at the same time. 2. The same drug is prescribed twice, as a single agent and as a combination product. 3. Two drugs are prescribed for the same indication when only one is necessary (including two drugs from the same class with the same clinical effect).	• Paracetamol prescribed for both prn and regular doses. • Humalog and Humalog Mix25 which both contain ultra-shorting-acting insulin are charted. • Nurse/patient-controlled analgesia prescribed at same time as oral opiates without instruction on when to administer each order.
Drug-drug interaction		Two or more prescribed drugs have a clinically significant interaction.	• Gentamicin and frusemide are prescribed together, increasing the risk of nephrotoxicity and ototoxicity. • Ondansetron, droperidol and ciprofloxacin are prescribed together which are known to cause QT interval prolongation.
Allergy and adverse drug reaction		A drug is prescribed for a patient with a documented clinically significant adverse reaction to that drug or that class of drugs. Includes drug classes with known cross-reactivity e.g. penicillins and cephalosporins.	• Amoxicillin prescribed for a patient who is allergic to penicillin. • Morphine is prescribed for a patient with documented history of itch from morphine.
Inadequate monitoring		The prescriber fails to order appropriate and	• Insulin is prescribed without requesting

		timely clinical or laboratory tests to assess the patient's response to prescribed therapy. *If adequate laboratory tests are ordered, but the results are not acted upon accordingly, this may be classed as wrong dose or frequency.	blood glucose monitoring. • IV potassium is prescribed at infusion rate >0.4 mmol/kg/hour without ECG monitoring and frequent K levels check. • Vancomycin is ordered without TDM and renal function monitoring.

S3: Serious error protocol for medication administration error observation

Where a researcher notices an error which potentially may lead to serious patient harm, they must first decide whether the error is likely to cause serious harm to the patient or not. If they are concerned about potential consequences of an error but unsure about its potential to cause harm, they can contact the Team Leader or Nurse in charge on the ward to check. They should then follow the decision tree below:



NFA=No further action

Examples of errors that may cause serious harm:

- Giving medication to a patient who has an allergy to that medication
- Giving the wrong drug or using the wrong IV additive
- Serious overdose eg giving methotrexate daily instead of weekly

Example of errors that would not be considered to cause serious harm:

- Procedural errors e.g. not taking a pulse before giving digoxin, not signing for a medication (exception: chemotherapy).
- Missed or late doses of medication (exception: chemotherapy).
- S4 and S8 procedural errors e.g. signing the DD book after medication is given.

S4a Table: Number and percentage of prescribing errors by error type category

Error type	All prescribing errors			Potentially serious errors		
	Errors identified at audit N (col %)	Errors detected by staff N (rate per 1000 errors; 95% CI)	Errors reported by staff N (rate per 1000 errors; 95% CI)	Errors identified at audit N (col %)	Errors detected by staff N (rate per 1000 errors; 95% CI)	Error reported by staff N (rate per 1000 errors; 95% CI)
Wrong dose	5076 (44.9)	494 (97.3; 89.5 - 105.8)	28 (5.5; 3.8 - 8)	771 (34.7)	174 (225.7; 197.6 - 256.5)	19 (24.6; 15.8 - 38.2)
Wrong frequency	2482 (22)	170 (68.5; 59.2 - 79.1)	4 (1.6; 0.6 - 4.1)	184 (8.3)	26 (141.3; 98.3 - 199)	3 (16.3; 5.6 - 46.8)
Duplicated drug therapy	1672 (14.8)	481 (287.7; 266.5 - 309.8)	2 (1.2; 0.3 - 4.4)	499 (22.4)	192 (384.8; 343.1 - 428.2)	1 (2; 0.1 - 11.3)
Wrong route	1207 (10.7)	138 (114.3; 97.6 - 133.5)		478 (21.5)	90 (188.3; 155.8 - 225.8)	
Wrong drug	190 (1.7)	64 (336.8; 273.5 - 406.7)	2 (10.5; 2.9 - 37.6)	56 (2.5)	32 (571.4; 441.4 - 692.3)	2 (35.7; 9.8 - 121.2)
Drug-drug interaction	172 (1.5)	30 (174.4; 125 - 238.1)		95 (4.3)	13 (136.8; 81.7 - 220.2)	
Wrong formulation	123 (1.1)	39 (317.1; 241.4 - 403.8)		24 (1.1)	11 (458.3; 278.9 - 649.3)	
Wrong strength	105 (0.9)	20 (190.5; 126.8 - 276)		17 (0.8)	10 (588.2; 360.1 - 783.9)	
Allergy	96 (0.8)	31 (322.9; 237.8 - 421.7)		31 (1.4)	15 (483.9; 319.7 - 651.6)	
Inadequate monitoring	78 (0.7)	5 (64.1; 27.7 - 141.4)		50 (2.2)	4 (80; 31.5 - 188.4)	
Wrong timing	68 (0.6)	29 (426.5; 316 - 544.8)		8 (0.4)	6 (750; 409.3 - 928.5)	
Wrong rate	14 (0.1)	2 (142.9; 40.1 - 399.4)		3 (0.1)	1 (333.3; 17.1 - 792.3)	
Wrong patient	13 (0.1)	11 (846.2; 577.7 - 956.7)		8 (0.4)	6 (750; 409.3 - 928.5)	
No longer indicated	6 (0.1)	0 (0; 0-614.8)		0(0)		

S4b Table: Number and percentage of prescribing errors by error type category involving high-risk drugs

Error type	All prescribing errors involving high-risk drugs			Potentially serious errors involving high-risk drugs		
	Errors identified at audit N (col %)	Errors detected by staff N (rate per 1000 errors; 95% CI)	Error reported by staff N (rate per 1000 errors; 95% CI)	Errors identified at audit N (col %)	Errors detected by staff N (rate per 1000 errors; 95% CI)	Error reported by staff N (rate per 1000 errors; 95% CI)
Duplicated drug therapy	768 (33.1)	100 (130.2; 108.2 - 155.9)		270 (40.7)	75 (277.8; 227.8 - 334)	
Wrong dose	755 (32.5)	53 (70.2; 54.1 - 90.7)	**6 (7.9; 3.6-17.2)**	158 (23.8)	29 (183.5; 130.9 - 251.2)	**5 (31.6; 13.6-71.9)**
Wrong frequency	379 (16.3)	23 (60.7; 40.8 - 89.4)	**1 (2.6; 0.1-14.8)**	94 (14.2)	7 (74.5; 36.5 - 145.8)	**1 (10.6; 0.6-57.8)**
Wrong route	162 (7)	8 (49.4; 25.2 - 94.4)		66 (10)	6 (90.9; 42.3 - 184.5)	
Wrong strength	71 (3.1)	6 (84.5; 39.3 - 172.4)		11 (1.7)	6 (545.5; 280.1 - 787.3)	
Wrong formulation	53 (2.3)	9 (169.8; 92 - 292.3)		0(0)		
Drug-drug interaction	36 (1.6)	1 (27.8; 1.4 - 141.7)		23 (3.5)		
Inadequate monitoring	35 (1.5)	3 (85.7; 29.6 - 223.8)		27 (4.1)	2 (74.1; 20.6 - 233.7)	
Allergy	31 (1.3)	7 (225.8; 114 - 398.1)		2 (0.3)		
Wrong drug	18 (0.8)	6 (333.3; 162.8 - 562.5)		8 (1.2)	3 (375; 136.8 - 694.3)	
Wrong rate	7 (0.3)	0 (0; 0 - 0)		1 (0.2)		
Wrong timing	4 (0.2)	3 (750; 300.6 - 987.2)		1 (0.2)	1 (1000; 51.3 - 1000)	
Wrong patient	2 (0.1)	2 (1000; 342.4 - 1000)		2 (0.3)	2 (1000; 342.4 - 1000)	