

**Supplementary Supplementary Table 1. Classification for drug related problems**

Code	Domains	Code	Problem/ Cause/ Intervention		
			Original version (V9.0)	Modified version for intervention	Modified version for consultation
Problems (also potential)					
P1	Treatment effectiveness	P1.1	No effect of drug treatment		
	There is a (potential) problem with the (lack of) effect of the pharmacotherapy	P1.2	Effect of drug treatment not optimal		
		P1.3	Untreated symptoms or indication		
P2	Treatment safety	P2.1	Adverse drug event (possibly) occurring		
	Patient suffers, or could suffer, from an adverse drug event				
P3 #	Other	P3.1	Problem with cost-effectiveness of the treatment		Treatment safety and efficacy
		P3.2	Unnecessary drug-treatment		
		P3.3*	Unclear problem/complaint. Further clarification necessary	Needs Supplementary drug therapeutic monitoring (TDM)	
		P3.4*	/	Antibiotics De-escalation	
P4 #	Other	/	/	/	Other
Causes (including possible cases for potential problems)					
C1 #	Drug selection	C1.1	Inappropriate drug according to guidelines/formulary		Drug/Drug regimen selection
	The cause of the DRP can be related to the selection of the drug	C1.2	Inappropriate drug (within guidelines but otherwise contra-indicated)		
		C1.3	No indication for drug		
		C1.4	Inappropriate combination of drugs, or drugs and herbal medications, or drugs and dietary supplements		
		C1.5	Inappropriate duplication of therapeutic group or active ingredient		
		C1.6	No or incomplete drug treatment in spite of existing indication		

Code	Domains	Code	Problem/ Cause/ Intervention		
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		C1.7	Too many drugs prescribed for indication		
		C1.8 *	/ Necessary genetic testing before drug initiation		
C2	Drug form The cause of the DRP is related to the selection of the drug form	C2.1	Inappropriate drug form (for this patient)		Drug form
C3	Dose selection The cause of the DRP can be related to the selection of the dosage schedule	C3.1	Drug dose too low		Dose selection
		C3.2	Drug dose too high		
		C3.3	Dosage regimen not frequent enough		
		C3.4	Dosage regimen too frequent		
		C3.5	Dose timing instructions wrong, unclear or missing		
C4	Treatment duration The cause of the DRP is related to the duration of treatment	C4.1	Duration of treatment too short		Treatment duration
		C4.2	Duration of treatment too long		
C5	Dispensing The cause of the DRP can be related to the logistics of the prescribing and dispensing process	C5.1	Prescribed drug not available		Dispensing
		C5.2	Necessary information not provided		
		C5.3	Wrong drug, strength or dosage advised (OTC)		
		C5.4	Wrong drug or strength dispensed		
C6	Drug use process The cause of the DRP is related to the way the patient gets the drug administered by a health professional or carer, in spite of proper	C6.1	Inappropriate timing of administration or dosing intervals		Drug use process
		C6.2	Drug under-administered		
		C6.3	Drug over-administered		
		C6.4	Drug not administered at all		
		C6.5	Wrong drug administered		

Code	Domains	Code	Problem/ Cause/ Intervention		
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	instructions (on the label)	C6.6	Drug administered via wrong route		
C7 <sup>#</sup>	Patient related  The cause of the DRP can be related to the patient and his behavior (intentional or non-intentional)	C7.1	Patient uses/takes less drug than prescribed or does not take the drug at all	Drug-related adverse effects or drug-induced disease	
		C7.2	Patient uses/takes more drug than prescribed		
		C7.3	Patient abuses drug (unregulated overuse)		
		C7.4	Patient uses unnecessary drug		
		C7.5	Patient takes food that interacts		
		C7.6	Patient stores drug inappropriately		
		C7.7	Inappropriate timing or dosing intervals		
		C7.8	Patient administers/uses the drug in a wrong way		
		C7.9	Patient unable to use drug/form as directed		
		C7.10	Patient unable to understand instructions properly		
C8 <sup>#</sup>	Patient transfer related  The cause of the DRP can be related to the transfer of patients between primary, secondary and tertiary care, or transfer within one care institution.	C8.1	No medication reconciliation at patient transfer	Others, such as drug information	
		C8.2	No updated medication list available		
		C8.3	Discharge/transfer information about medication incomplete or missing		
		C8.4	Insufficient clinical information about the patient		
		C8.5	Patient has not received necessary medication at discharge from hospital or clinic		
C9	Other	C9.1	No or inappropriate outcome monitoring (incl. TDM)	/	
		C9.2	Other cause; specify		
		C9.3	No obvious cause		
Intervention					
I0	No intervention	I0.1	No intervention	/	
I1	At prescriber level	I1.1	Prescriber informed only		

Code	Domains	Code	Problem/ Cause/ Intervention		
			Original version (V9.0)	Modified version for intervention	Modified version for consultation
		I1.2	Prescriber asked for information		
		I1.3	Intervention proposed to prescriber		
		I1.4	Intervention discussed with prescriber		
I2	At patient level	I2.1	Patient (drug) counselling		
		I2.2	Written information provided (only)		
		I2.3	Patient referred to prescriber		
		I2.4	Spoken to family member/caregiver		
I3	At drug level	I3.1	Drug changed to ...		
		I3.2	Dosage changed to ...		
		I3.3	Formulation changed to ...		
		I3.4	Instructions for use changed to ...		
		I3.5	Drug paused or stopped		
		I3.6	Drug started		
		I3.7 *	/	Needs adjustment on parenteral nutrition	
		I3.8 *	/	Necessary frequency adjustment needed based on antibiotics' PK/PD characteristics	
I4	Other intervention or activity	I4.1	Other intervention (specify)		
		I4.2	Side effect reported to authorities		

\* Being modified in intervention problems classification

# Being modified in consultation problems classification

**Supplementary Table 2. Top3 Medicines' Drug Related Problems and Causes of Pharmacy Intervention**

<b>Problem</b>	<b>Cause</b>	<b>N</b>
<b><i>Antibiotic</i></b>		<b>286</b>
P1.1 No effect of drug treatment	C1.1 Inappropriate drug according to guidelines/formulary	10
	C3.2 Drug dose too high	1
	C9.1 No or inappropriate outcome monitoring (incl. TDM)	1
P1.2 Effect of drug treatment not optimal	C1.1 Inappropriate drug according to guidelines/formulary	16
	C1.3 No indication for drug	1
	C1.6 No or incomplete drug treatment in spite of existing indication	7
	C1.7 Too many drugs prescribed for indication	1
	C1.8 Necessary genetic testing before drug initiation	3
	C3.1 Drug dose too low	33
	C3.2 Drug dose too high	1
	C3.3 Dosage regimen not frequent enough	30
	C3.4 Dosage regimen too frequent	1
	C6.1 Inappropriate timing of administration or dosing intervals	1
	C9.1 No or inappropriate outcome monitoring (incl. TDM)	4
P1.3 Untreated symptoms or indication	C1.6 No or incomplete drug treatment in spite of existing indication	8
	C9.1 No or inappropriate outcome monitoring (incl. TDM)	1
P2.1 Adverse drug event (possibly) occurring	C1.1 Inappropriate drug according to guidelines/formulary	3
	C1.2 Inappropriate drug (within guidelines but otherwise contraindicated)	12
	C1.4 Inappropriate combination of drugs, or drugs and herbal medications, or drugs and dietary supplements	1
	C1.5 Inappropriate duplication of therapeutic group or active ingredient	2
	C1.6 No or incomplete drug treatment in spite of existing indication	1
	C1.7 Too many drugs prescribed for indication	1
	C1.8 Necessary genetic testing before drug initiation	2
	C3.2 Drug dose too high	37
	C4.2 Duration of treatment too long	4
	C9.1 No or inappropriate outcome monitoring (incl. TDM)	11
P3.2 Unnecessary drug-treatment	C1.1 Inappropriate drug according to guidelines/formulary	2
	C1.2 Inappropriate drug (within guidelines but otherwise contraindicated)	1
	C1.3 No indication for drug	8
	C1.5 Inappropriate duplication of therapeutic group or active ingredient	6
	C1.7 Too many drugs prescribed for indication	1
	C3.2 Drug dose too high	2
	C4.2 Duration of treatment too long	27
	C9.1 No or inappropriate outcome monitoring (incl. TDM)	1
P3.3 Needs Supplementary drug therapeutic monitoring	C1.2 Inappropriate drug (within guidelines but otherwise contraindicated)	1
	C1.8 Necessary genetic testing before drug initiation	4
	C3.2 Drug dose too high	1

<b>Problem</b>	<b>Cause</b>	<b>N</b>
(TDM)	C4.2 Duration of treatment too long	1
	C9.1 No or inappropriate outcome monitoring (incl. TDM)	32
P3.4 Antibiotics De-escalation	C1.1 Inappropriate drug according to guidelines/formulary	5
	C4.2 Duration of treatment too long	1
<b><i>Parenteral nutrition</i></b>		<b>28</b>
P1.2 Effect of drug treatment not optimal	C1.6 No or incomplete drug treatment in spite of existing indication	4
	C3.2 Drug dose too high	1
P1.3 Untreated symptoms or indication	C1.6 No or incomplete drug treatment in spite of existing indication	3
P2.1 Adverse drug event (possibly) occurring	C1.1 Inappropriate drug according to guidelines/formulary	1
	C1.2 Inappropriate drug (within guidelines but otherwise contraindicated)	4
	C1.5 Inappropriate duplication of therapeutic group or active ingredient	1
	C1.7 Too many drugs prescribed for indication	1
	C3.1 Drug dose too low	2
	C3.2 Drug dose too high	2
P3.1 Problem with cost-effectiveness of the treatment	C1.3 No indication for drug	1
	C2.1 Inappropriate drug form (for this patient)	1
P3.2 Unnecessary drug-treatment	C1.3 No indication for drug	5
	C4.2 Duration of treatment too long	2
<b><i>Proton pump inhibitor</i></b>		<b>13</b>
P2.1 Adverse drug event (possibly) occurring	C1.6 No or incomplete drug treatment in spite of existing indication	1
	C3.2 Drug dose too high	3
P3.2 Unnecessary drug-treatment	C4.2 Duration of treatment too long	9

**Supplementary Table 3. Top3 Medicines' Drug Related Problems and Causes of Pharmacy Consultation**

Problem	Cause	N
<b><i>Antibiotic</i></b>		<b>153</b>
P1.1 No effect of drug treatment	C1 Drug selection	1
	C3 Dose selection	2
P1.2 Effect of drug treatment not optimal	C1 Drug selection	6
	C3 Dose selection	10
P1.3 Untreated symptoms or indication	C1 Drug selection	7
	C3 Dose selection	12
P1.4 Other	C3 Dose selection	1
P2.1 Adverse drug event (possibly) occurring	C1 Drug selection	6
	C3 Dose selection	78
	C6 Drug use process	3
	C7 Drug-related side effects/Drug-induced diseases	9
	C8 Other	3
P3 Treatment safety and cost-effectiveness	C1 Drug selection	1
	C3 Dose selection	10
	C4 Treatment duration	1
P4 Other	C3 Dose selection	1
	C4 Treatment duration	1
	C6 Drug use process	1
<b><i>Antifungal drugs</i></b>		<b>21</b>
P1.2 Effect of drug treatment not optimal	C3 Dose selection	1
P1.3 Untreated symptoms or indication	C1 Drug selection	3
	C3 Dose selection	4
	C8 Other	1
P1.4 Other	C4 Treatment duration	1
P2.1 Adverse drug event (possibly) occurring	C1 Drug selection	2
	C3 Dose selection	4
	C7 Drug-related side effects/Drug-induced diseases	3
P4 Other	C3 Dose selection	1
	C8 Other	1
<b><i>Antiepileptic drugs</i></b>		<b>9</b>
P1.2 Effect of drug treatment not optimal	C3 Dose selection	3
P1.3 Untreated symptoms or indication	C3 Dose selection	1
P2.1 Adverse drug event (possibly) occurring	C3 Dose selection	2
P4 Other	C3 Dose selection	1
	C8 Other	2