Development of TRIM: A Clinical Decision Support System to Improve Medication Prescribing for Older Adults

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- TRIM, the **T**ool to **R**educe **I**nappropriate **M**edications, is a clinical decision support system designed to aid healthcare clinicians in identifying medications to deprescribe.

- This document contains the algorithms that were created for use in TRIM. You will find the patient-specific characteristics with the respective recommendations. The following categories:

    - **Medication Regimen Feasibility**
    - **Potential Overtreatment (e.g Diabetes, Hypertension)**
    - **Potentially Inappropriate Medications**
    - **Inappropriate Renal Dosing**

MEDICATION REGIMEN FEASIBILITY ALGORITHMS								
IF							**FEEDBACK**	**RECOMMENDATION**
LOW adherence	**AND**	**No current social support**	**AND**	**No future social support**			• Your patient scored LOW on a measure of medication adherence. This is a strong indicator that [he/she] may be missing pill doses. Persons with similar scores in one study were demonstrated not to refill their medications correctly. • Your patient has NO help with [his/her] medications and NO ONE available to help with medications.	• Your patient's regimen needs to be as simple as you can possibly make it. If we identified medications that could be removed, these will be outlined below. Otherwise, you can look at the general tips for simplifying medications. • A pharmacist is also available to do an additional medication review. Indicate your preference for pharmacist intervention at the end of this hand-out.
LOW adherence	**AND**	**No current social support**	**AND**	**Yes future social support**			• Your patient scored LOW on a measure of medication adherence. This is a strong indicator that [he/she] may be missing pill doses. Persons with similar scores in one study were demonstrated not to refill their medications correctly. • Your patient has NO help with [his/her] medications, but does have [spouce/partner; son /daughter; other family member; other] who could help with [filling prescriptions; picking up medications from pharmacy; filling the pillbox; reminders to take medications; medication administration; other].	• Your patient's regimen needs to be as simple as you can possibly make it. If we identified medications that could be removed, these will be outlined below. Otherwise, you can look at the general tips for simplifying medications. • A pharmacist is also available to do an additional medication review and to contact the social support to make a plan for increased oversight. Indicate your preference for pharmacist intervention at the end of this hand-out.
LOW adherence	**AND**	**Yes current social support**					• Your patient scored LOW on a measure of medication adherence. This is a strong indicator that [he/she] may be missing pill doses. Persons with similar scores in one study were demonstrated not to refill their medications correctly.	• Your patient's regimen needs to be as simple as you can possibly make it. If we identified medications that could be removed, these will be outlined below. Otherwise, you can look at the general tips for simplifying medications. • A pharmacist is also available to do an additional medication review. Your patient told us there was someone helping at home with medications. A pharmacist can contact this person to review the regimen and make sure he/she knows to how to help. Indicate your preference for pharmacist intervention at the end of this hand-out.
LOW Executive Function	**AND**	**No current social support**	**AND**	**No future social support**			• Your patient scored LOW on a test of executive function. This is a strong indicator that [he/she] has impairment in cognitive function that can lead to medication errors. • Your patient has NO help with [his/her] medications and NO ONE available to help with medications.	• Your patient's regimen needs to be as simple as you can possibly make it. If we identified medications that could be removed, these will be outlined below. Otherwise, you can look at the general tips for simplifying medications. • A pharmacist is also available to do an additional medication review. Indicate your preference for pharmacist intervention at the end of this hand-out.

MEDICATION REGIMEN FEASIBILITY ALGORITHMS

IF							FEEDBACK	RECOMMENDATION
LOW Executive Function	**AND**	**No current social support**	**AND**	**Yes future social support**			• Your patient scored LOW on a test of executive function. This is a strong indicator that [he/she] has impairment in cognitive function that can lead to medication errors. • Your patient has NO help with [his/her] medications, but does have [spouce/partner; son /daughter; other family member; other] who could help with [filling prescriptions; picking up medications from pharmacy; filling the pillbox; reminders to take medications; medication administration; other].	• Your patient's regimen needs to be as simple as you can possibly make it. If we identified medications that could be removed, these will be outlined below. Otherwise, you can look at the general tips for simplifying medications. • A pharmacist is also available to do an additional medication review and to contact the social support to make a plan for increased oversight. Indicate your preference for pharmacist intervention at the end of this hand-out.
LOW adherence	**AND**	**LOW Executive Function**	**AND**	**No current social support**	**AND**	**No future social support**	• Your patient scored LOW on a measure of medication adherence. This is a strong indicator that [he/she] may be missing pill doses. Persons with similar scores in one study were demonstrated not to refill their medications correctly. • Your patient scored LOW on a test of executive function. This is a strong indicator that [he/she] has impairment in cognitive function that can lead to medication errors. • Your patient has NO help with [his/her] medications and NO ONE available to help with medications.	• Your patient's regimen needs to be as simple as you can possibly make it. If we identified medications that could be removed, these will be outlined below. Otherwise, you can look at the general tips for simplifying medications. • A pharmacist is also available to do an additional medication review. Indicate your preference for pharmacist intervention at the end of this hand-out.
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Definitions:

Low adherence *= Morisky Medication Adherence Scale <6 (Morisky DE, et al. Predictive validity of a medication adherence measure for hypertension control. J Clin Hypertens 2008;10:348-354.)*

Low Executive Function *= Oral Trail Making Test >2 (Ricker J, Axelrod B. Analysis of an oral paradigm for the trail making test. Assessment 1994;1:47-51.)*

Social Support Questions (Patient Report): *'Does anyone help you with you medications?' (Answer=Yes/No) If No: 'Is there anyone who could help you with your medications if you need it?' (Answer=Yes/No) If yes: 'Who helps/could help you?' (Answer=Spouse/partner; son/daughter; Other family member; other) 'What does/could this person help you do?' (Helps me refill prescriptions; picks my prescriptions up from the pharmacy; fills my pillbox for me; reminds me to take my medications; gives me my medications when its time to take them; other)*

POTENTIAL OVERTREATMENT OF DIABETES AND HYPERTENSION ALGORITHMS

	IF											RECOMMENDATION
Hypertension (HTN) Algorithms	HTN	AND	HTN Medication	AND	Falls	AND	SBP<140					Consider liberalizing blood pressure control to a target of <150/90. Studies have shown a relationship between intensity of blood pressure treatment and fall risk. Decreasing antihypertensive load may lower this risk.
	HTN	AND	HTN Medication	AND	Dizziness	AND	SBP<140					Consider liberalizing blood pressure control to a target of <150/90. Studies have shown a relationship between antihypertensive use, dizziness, and fall risk. Decreasing antihypertensive load may lower this risk.
	HTN	AND	HTN Medication	AND	Diabetes	AND	SBP<130	OR	DBP<85			Consider liberalizing treatment of hypertension to a target of <140/90. Studies have shown no benefit from lower blood pressures among patients with DM and HTN and potential for increased risk.
	HTN	AND	HTN Medication	AND	≥80 years old	AND	SBP<140	NO	DM			Consider liberalizing blood pressure control to a target of <150/80. This was the goal used in the HYVET trial. Also, think about checking orthostatics, since this increases fall risk.
	HTN	AND	HTN Medication	AND	SBP<140	NO	DM					Consider checking orthostatics. If orthostasis present, would liberalize blood pressure control to a target of <150/90 to decrease fall risk.
Diabetes Mellitus (DM) Algorithms	DM	AND	DM Medication	AND	A1C<7.5%	AND	life expectancy <50% at 5 years					Consider liberalizing treatment of diabetes to a target A1C of <8%. Your patient might not live long enough to benefit from tighter control.
	DM	AND	DM Medication	AND	A1C<7.5%	AND	functional disability	AND	≥2 comorbid conditions	NO	life expectancy <50% at 5 years	Consider liberalizing treatment of diabetes to a target A1C of <8%. Your patient may have too many competing risks because of comorbidities and disability to benefit from tighter control.
	DM	AND	DM Medication	AND	A1C<7.5%	AND	functional disability	NO	≥2 comorbid conditions	NO	life expectancy <50% at 5 years	Consider liberalizing treatment of diabetes to a target A1C of <8%. Your patient's functional disability is a risk factor for adverse events from tight control.
	DM	AND	DM Medication	AND	A1C<7.5%	NO	functional disability	YES	≥2 comorbid conditions	NO	life expectancy <50% at 5 years	Consider liberalizing treatment of diabetes to a target A1C of <8%. Your patient may have too many competing risks because of comorbidity to benefit from tighter control.

Definitions:

DM (Diabetes) *= ICD 9 codes from electronic health record (EHR); A1C goals (Diabetes Care 2014;37(Supplement 1):S14-S80./Fried TR. BMC Geriatrics 2016;16:1-8.)*

HTN (Hypertension) *= ICD 9 codes from EHR; Blood pressure goals (JNC 8. JAMA 2014;311:507-520./Fried TR. BMC Geriatrics 2016;16:1-8./Beckett NS. N Engl J Med 2008;385.)*

Medications *= From EHR & patient report*

Systolic Blood Pressure (SBP) Diastolic Blood Pressure (DBP) *= Average blood pressure over the previous three months from electronic health record*

A1C *= Last recorded A1C from electronic health record*

Falls = *From patient report when asked: 'Have you had any falls in the past 12 months?'*

Dizziness = *From patient report when asked: 'In the past 2 months, have you had episodes of feeling dizzy, unsteady, or like you were spinning or moving, lightheaded or faint that was not a result of being sick?' (Tinetti ME. Ann Intern Med 2000;132:337-344.)*

Functional Disability *= ≥1 ADL with 'needs assistance' or 'unable to do activity'; From patient report, Activities of Daily Living (Katz S. The Gerontologist 1970;10:20-30.)*

Life expectancy *= ≥16 points; From electronic health record and patient report (Appendix of Schonberg MA. J Gen Intern Med 2009;24:1115-1122.)*

POTENTIALLY INAPPROPRIATE MEDICATION ALGORITHMS

						RECOMMENDATION: Discontinuation of the mediation, if possible, or, if not, either substitution of another medication or dose reduction. **The same recommendation is provided for all medications with individualized feedback which is listed below.**
Medication Class	**IF**					**FEEDBACK**
Anticholinergics	Diphenhydramine Chlorpheniramine Hydroxyzine Promethazine Dimenhydrinate Doxylamine					Increases the risk of cognitive decline, delirium, sedation, orthostatic hypotension, falls, dry mouth, and constipation due to anticholinergic properties. If using for sleep, consider referral to Mental Health for sleep hygiene education.
Anticoagulation	Aspirin	AND	Peptic ulcer disease	NOT	Pantoprazole Lansoprazole Esomeprazole Rabeprazole Omeprazole Famotidine Ranitidine	Peptic ulcer disease but no H2 blocker or PPI increases the risk of bleeding
			Warfarin			Warfarin but no H2 blocker or PPI increases the risk of bleeding
Antidiabetic	Chlorpropramide Glyburide					Increases the risk of prolonged hypoglycemia
Antiemetic	Prochlorperazine Metoclopramide	AND	Parkinson's Disease			Increases risk of exacerbating Parkinson's symptoms
Antispasmodics	Oxybutynin Tolterodine Trospium	AND	Dementia			Increases the risk of worsening confusion and agitation
			Constipation			Increases risk of worsening constipation
			BPH/history of urinary retention			Increases risk of worsening urinary retention
Benzodiazepines	Chlordiazepoxide Diazepam Alprazolam Lorazepam Tempazepam Clonazepam Oxazepam					Increases the risk of cognitive impairment, delirium, fractures, and falls. If using for sleep, consider referral to Mental Health for sleep hygiene education.
Beta Blocker	Metoprolol Atenolol Carvedilol Labetalol Propranolol	AND	Verapamil			Increases risk of symptomatic heart block

POTENTIALLY INAPPROPRIATE MEDICATION ALGORITHMS						
Constipation	Codeine Oxycodone Hydrocodone Fentanyl Morphine Methadone Hydromorphone Diltiazem Verapamil	AND	Amitriptyline Imipramine Desipramine Nortriptyline			Increases the risk of severe constipation
	Diltiazem Verapamil	AND	Constipation			Increases the risk of worsening constipation
Digoxin	Digoxin>125mcg/day					Increases the risk of digoxin toxicity
NSAIDS	Diclofenac Etodolac Ibuprofen Meloxicam Nabumetone Naproxen Piroxicam Indomethacin Sulindac	AND	GFR<50			Increases the risk of worsening renal function
			GI bleed			Increases the risk of bleeding, which is reduced but not eliminated by a PPI or misoprostol
			Warfarin			Increases the risk of bleeding, which is reduced but not eliminated by a PPI or misoprostol
			Clopidogrel			Increases the risk of bleeding, which is reduced but not eliminated by a PPI or misoprostol
			Peptic ulcer disease			Increases the risk of bleeding, which is reduced but not eliminated by a PPI or misoprostol
			Hypertension			Increases the risk of worsening the hypertension
			Heart failure			Increases the risk of worsening the heart failure
			Age>75			Increases the risk of bleeding, which is reduced but not eliminated by a PPI or misoprostol
Non-Benzodiazepine Hypnotic	Eszopiclone Zolpidem Zaleplon					Increases the risk of fall and subsequent fracture risk. Avoid chronic use greater than 90 days. Consider referral to Mental Health for sleep hygiene education.
Skeletal Muscle Relaxants	Cyclobenzaprine Methocarbamol					Increases the risk of sedation and fracture due to anticholinergic properties.

POTENTIALLY INAPPROPRIATE MEDICATION ALGORITHMS						
Tricyclic antidepressants	Amitriptyline	AND	Dementia			Increases the risk of worsening cognitive impairment
			Constipation			Increases risk of worsening constipation
			BPH/history of urinary retention			Increases the risk of worsening urinary retention
						Increases the risk of cognitive decline, delirium, sedation, & orthostatic hypotension due to anticholinergic properties
	Imipramine	AND	Dementia			Increases the risk of worsening cognitive impairment
			Constipation			Increases risk of worsening constipation
			BPH/history of urinary retention			Increases the risk of worsening urinary retention
						Increases the risk of cognitive decline, delirium, sedation, & orthostatic hypotension due to anticholinergic properties
	Desipramine	AND	Dementia			Increases the risk of worsening cognitive impairment
			Constipation			Increases risk of worsening constipation
			BPH/history of urinary retention			Increases the risk of worsening urinary retention
	Nortriptyline	AND	Dementia			Increases the risk of worsening cognitive impairment
			Constipation			Increases risk of worsening constipation
			BPH/history of urinary retention			Increases the risk of worsening urinary retention
Additional Rules	Citalopram					Increased risk of QT prolongation risk. The maximum recommended daily dose is 20mg in patients greater than 60 years of age
	Gabapentin					Increased risk of drowsiness/sedation, dizziness, and falls with daily dose greater than 600mg.

Definitions:

American Geriatrics Society 2012 Beers Criteria Update Expert Panel. American Geriatrics Society updated Beers criteria for potentially inappropriate medication use in older adults. J Am Geriatr Soc 2012;60:616-631.

FDA Drug Safety Communication: Abnormal heart rhythms associated with high doses of Celexa® (citalopram hydrobromide).
http://www.fda.gov/Drugs/DrugSafety/ucm269086.htm . (Accessed March 28, 2016)

Gallagher P, Ryan S, Byrne S, Kennedy J, O'Mahony D. STOPP (Screening Tool of Older Person's Prescriptions) and START (Screening Tools to Alert doctors to Right Treatment). Consensus validation. Int J Clin Pharmacol Ther 2008;46:72-83.

McLean MJ. Gabapentin. Epilepsia. 1995; 36(Suppl. 2):S73-S86.

INAPPROPRIATE RENAL DOSING ALGORITHMS					
IF					**RECOMMEDATION**
Alendronate	AND	CrCl <35			Recommendation is to discontinue medication if CrCl <35ml/min
Allopurinol	AND	CrCl 10-19	AND	total daily dose >200mg	Recommendation is to to exceed 200mg daily if CrCl 10-20 ml/min
		CrCl <10		total daily dose >100mg	Recommendation is to to exceed 100mg daily if CrCl <10 ml/min
Atenolol	AND	CrCl 15-34	AND	total daily dose >50mg	Recommendation is not to exceed 50mg daily if CrCl 15-35 ml/min
		CrCl <15		total daily dose >25mg	Recommendation is not to exceed 25mg daily if CrCl <15ml/min
Chlorpropamide	AND	CrCl <50			Recommendation is to discontinue if CrCl is <50 ml/min
Gabapentin	AND	CrCl 30-59	AND	total daily dose > 1200mg	Recommendation is not to exceed 600mg twice daily if CrCl 30-60 ml/min
		CrCl 15-29		total daily dose > 600mg	Recommendation is not to exceed 300mg twice daily if CrCl 15-29 ml/min
		CrCl <15		total daily dose > 300mg	Recommendation is not to exceed 300mg daily if CrCl <15ml/min
Galantamine	AND	CrCl <9			Recommendation is to discontinue if CrCl is <9ml/min
Glyburide	AND	CrCl <30			Recommendation is to discontinue if CrCl is <30 ml/min
Hydrochlorothiazide	AND	CrCl <30			Recommendation is to discontinue if CrCl is <30 ml/min
Memantine	AND	CrCl <30	AND	total daily dose >10mg daily	Recommendation is not to exceed 10mg daily if CrCl <30 ml/min
Metformin	AND	GFR 30-44	AND	total daily dose >1999mg	Recommendation is to use half-maximal dose and closely monitor renal function every three months if GFR 30-44
		GFR <30			Recommendation is to discontinue medication if GFR <30
Ranitidine	AND	CrCl <50	AND	total daily dose >150mg	Recommendation is not to exceed 150mg daily if CrCl <50ml/min
Rosuvastatin	AND	CrCl <30	AND	total daily dose >10mg	Recommendation is not to exceed 10mg daily if CrCl <30 ml/min
Spironolactone	AND	CrCl <30			Recommendation is to discontinue if CrCl <30 ml/min.
Tramadol	AND	CrCl <30	AND	total daily dose >200mg	Recommendation is not to exceed 200mg if CrCl <30ml/min
Triamterene	AND	CrCl <30			Recommendation is to discontinue if CrCl is <30 ml/min