TRANSPLANT PHARMACY PEARLS

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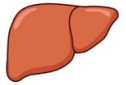
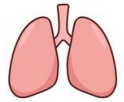
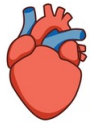




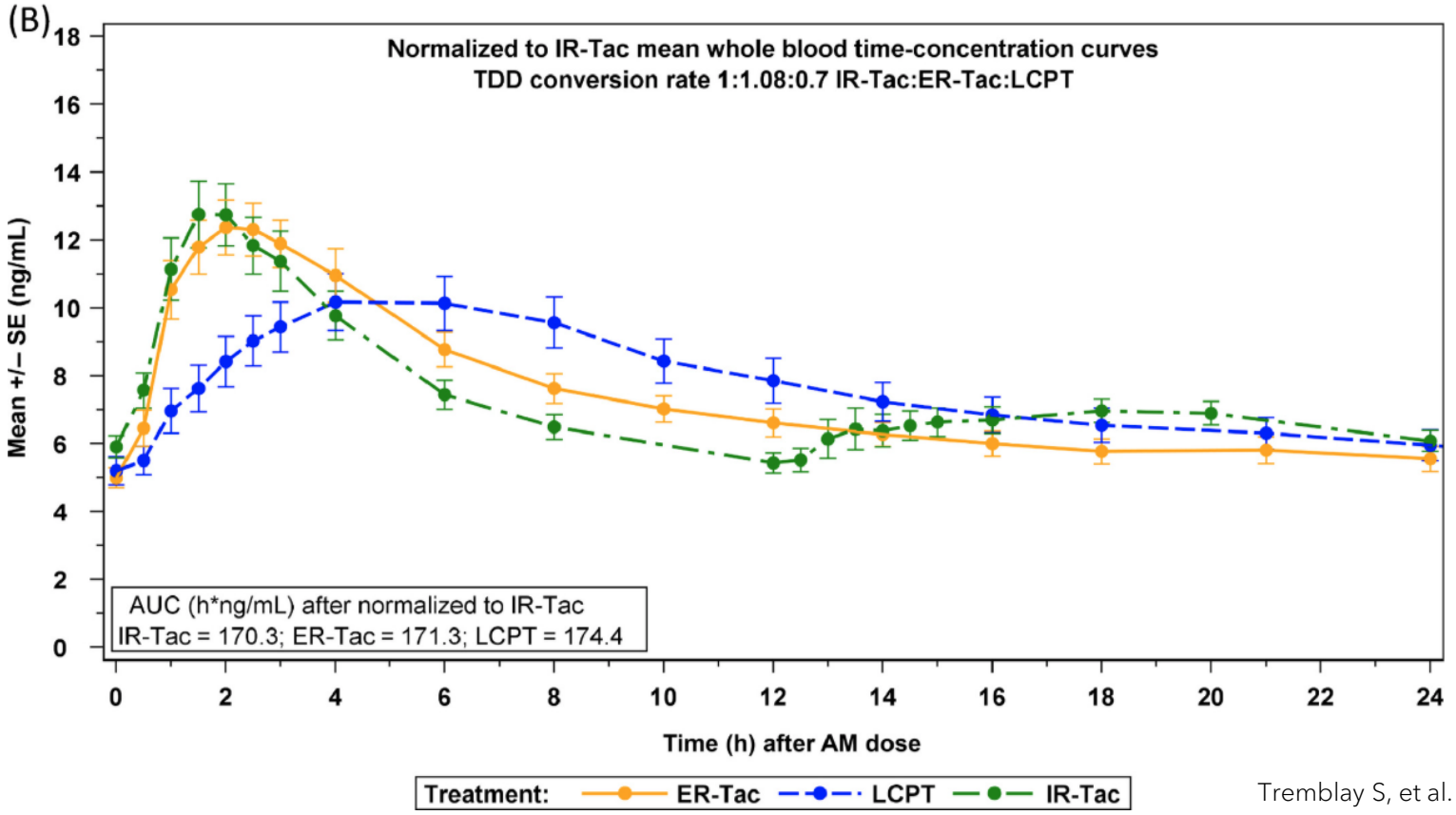


TAKE IT PERSONALLY

Tips for personalizing medication dosing via therapeutic drug monitoring (TDM)

CNIS & MTOR INHIBITORS

- Always confirm the timing of levels relative to last dose taken (assess if level is a true trough)
  - If level is not a true trough, can sometimes still make an educated assessment



Tremblay S, et al. Am J Transplant. 2017;17(2):432-442.

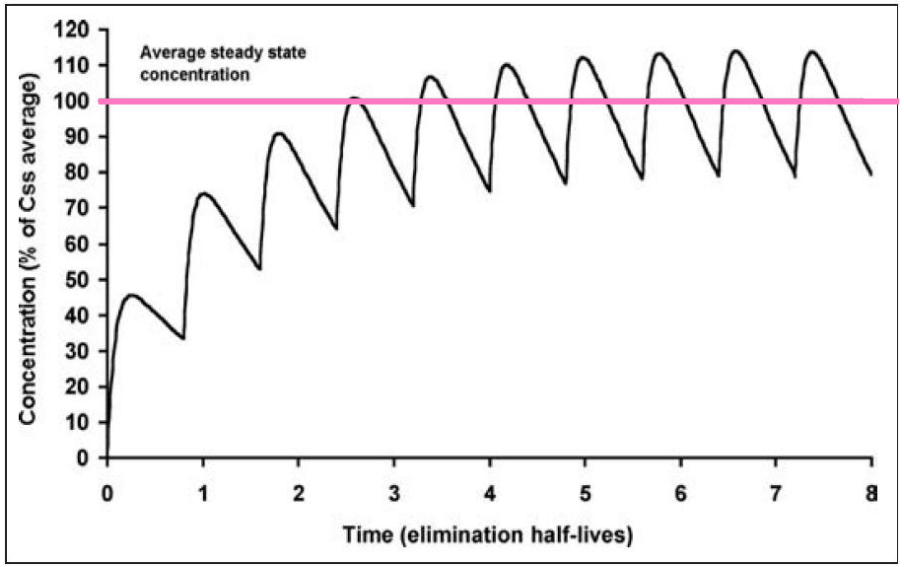
CNIS & MTOR INHIBITORS

Investigative questions to ask if levels are erratic:
Dose timing in relation to food
Missed doses, late doses, doses that were thrown up
Changes in bowel habits
Changes in medications, including OTCs and supplements
Consumption of interacting foods/substances - grapefruit, marijuana/CBD

CNI & MTOR MONITORING PEARLS

- Troughs must be drawn immediately prior to the next dose
  - Usually 12 or 24 hours post-dose
  - Atypical dosing frequency may require longer troughs – e.g. every 48 hour tacrolimus dosing
- Consider time since last medication dose change
  - Level reaches "steady state" after 4-5 half-lives of the same medication dose

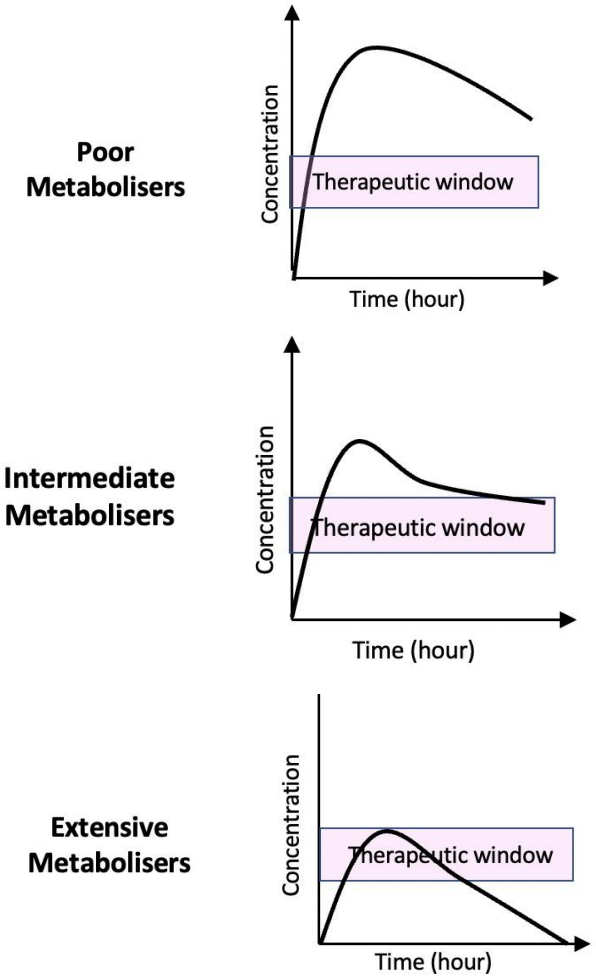
Medication	Average (estimated) Half Life
Tacrolimus (Prograf)	12-24 hours
LCP-Tacrolimus (Envarsus XR)	24-36 hours
Cyclosporine	~12 hours
Sirolimus	~60 hours
Everolimus	~30 hours



Thomson A. The Pharmaceutical Journal. 2004. DOI:10.1211/PJ.2021.1.66346

CNI & MTOR MONITORING PEARLS

- When starting interacting medications, consider how long it will take for inhibition/induction to have full effect
  - Vice versa when stopping interacting medications
  - Inducers generally take longer for the interaction to come on/off
- Consider CYP3A5 phenotype
  - Intermediate/extensive metabolizers will have altered pharmacokinetic profiles
- Consider checking CII (2 hour) level for cyclosporine



MYCOPHENOLATE

- No routine therapeutic drug monitoring
- Pharmacokinetics are complex and nonlinear
- Consider monitoring in the certain settings and/or populations
  - Noncompliance
  - Recurrent rejection
  - Toxicity
  - Extremes of body weight
  - Atypical GI absorption

MYCOPHENOLATE

- Timing is critical and differs based on mycophenolate formulation

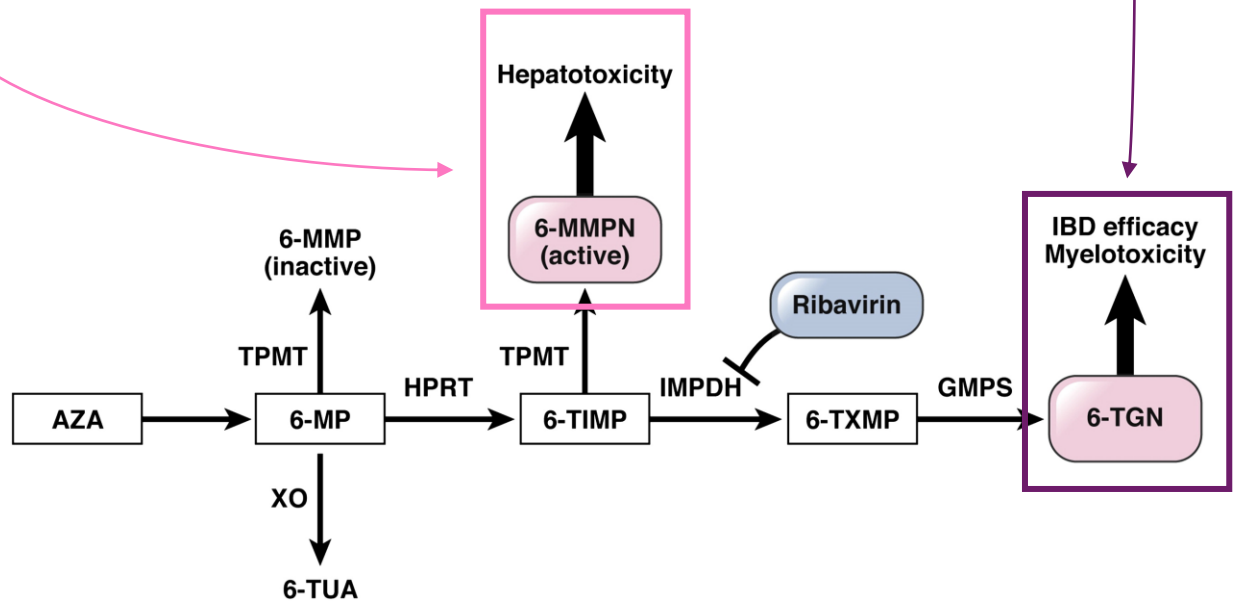
	Mycophenolate mofetil (Cellcept®)	Mycophenolic acid sodium (Myfortic®)
Level #1	0.5 hours post-dose	1 hour post-dose
Level #2	2 hours post-dose	2.5 hours post-dose
Level #3	12 hours post-dose (trough)	12 hours post-dose (trough)

- AUC calculation:
  - AUC = 7.75 + (6.49 x C_{0h}) + (0.76 x $C_{0.5h}$) + (2.43 x C_{2h})
  - Goal AUC 30-60 mg*h/L within first year (van Gelder 2009)

AZATHIOPRINE

- In patients with inflammatory bowel disease (IBD):
  - 6-TG levels are associated with leukopenia and clinical IBD remission
  - Elevated 6-MMP levels have been associated with hepatotoxicity (limited data)

6-TG / 6-TGN = 6-Thioguanine
6-MMP = 6-Methylmercaptopurine



Casteele NV, et al. Gastroenterology. 2017;153(3):835-857.
Gonzalez-Lama Y, et al. Frontline Gastroenterol. 2016;7(4):301-307.

AZATHIOPRINE

- Consider monitoring thiopurine metabolites in the certain patient scenarios (for-cause)
  - Suspicion for noncompliance
  - Elevated liver enzymes – evaluate hepatotoxicity versus lack of response in liver transplant recipients
  - Evaluate adverse effects – bone marrow suppression
- Timing: recommend drawing as a trough level (e.g. with morning transplant labs)
  - Given very short medication half-life, random collection time is acceptable per Quest Diagnostics

6-TG Level (pmol/8 x 10^8 erythrocytes)	Interpretation in IBD
<230	Non-adherence (particularly if 6-TG undetectable); suboptimal AZA dose (consider dose increase)
230 - 450	Commonly used target in IBD
>450	Increased risk of myelosuppression (consider AZA dose reduction)
6-MMP Level	
>5700	Possible increased hepatotoxicity risk (consider dividing AZA into twice daily dosing or reducing/discontinuing AZA)

ENOXAPARIN

- Monitoring anti-factor Xa activity / Low Molecular Weight Heparin (LMWH) level may be useful in certain patient populations
  - Obesity (BMI≥40 kg/m^2, weight>140 kg)
  - Renal impairment (risk of drug accumulation)
    - Patients in whom CrCl calculation may not be accurate – e.g. cirrhosis, malnutrition
  - Pregnant patients
  - Lung and heart transplant recipients
- Timing: draw level at steady state (after 3-4 stable enoxaparin doses)
  - Level should be drawn as a peak level, 4-6 hours after an enoxaparin dose

Garcia DA, et al. Chest. 2012;141(2 Suppl):e24s-e43s.
Creager MA, et al. J Am Coll Cardiol. 2026;87(13):1626-1710.

ENOXAPARIN

- Therapeutic goals (VTE treatment)
  - Once-daily dosing: 1-2 units/mL
  - Twice-daily dosing: 0.6-1 units/mL
- If level is outside of goal range, consider dose adjustment by 10-20%
  - Generally try to round to the nearest enoxaparin syringe size to reduce risk of medication errors

Enoxaparin Syringe Sizes
30 mg/0.3 mL
40 mg/0.4 mL
60 mg/0.6 mL
80 mg/0.8 mL
100 mg/1 mL
120 mg/0.8 mL
150 mg /1 mL

Garcia DA, et al. Chest. 2012;141(2 Suppl):e24s-e43s.
Creager MA, et al. J Am Coll Cardiol. 2026;87(13):1626-1710.

THEOPHYLLINE

- Treats chronic asthma/COPD & post heart transplant chronotropic incompetence
- Signs of toxicity: nausea, vomiting, arrhythmias, seizures
- Can check peaks or troughs depending on purpose

	Peak	Trough
Purpose	Monitor for toxicity	Monitor for efficacy
Indication	Any	Chronic use (e.g. asthma, COPD)
Timing	4 hours after dose	Trough level (8, 12, or 24 hours after dose, depending on regimen and formulation)
Goal level	<20 mcg/mL	5-15 mcg/mL

WEIGHT A SECOND...

Managing GLP-1s and SGLT2is peri- and post-transplant

BENEFITS OF SGLT2 / GLP1 MEDS

- Possible improvement in graft survival (kidney, heart transplant)
- Weight loss (both pre- and post- transplant)
- Glycemic control
- SGLT2: reduction in proteinuria, potential benefit in FSGS (still being studied)

Lin, et al. *Cardiovasc Diabetol* 2025. 24(1):87.
Orandi, et al. *Lancet Diabetes Endocrinol* 2025. 13(5):374-383.
Diker Cohen, et al. *Diabetes Metab* 2025. 51(3):101624.
Abbas, et al. *J Heart Lung Transplant* 2026. 45(7):1024-1032.

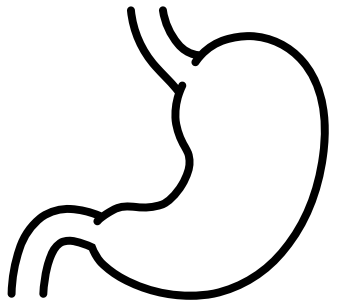
RISKS OF SGLT2 INHIBITORS

- Dehydration, volume depletion
- Peri-operative vasoplegia (maybe?)
- Euglycemic DKA
- Urinary tract infections (fungal and bacterial)

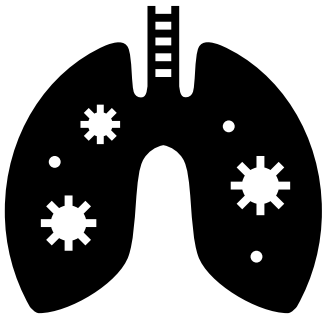
Clin Kidney J. 2023;16(6):1022-1034
Diabetes Care. 2026;49(Suppl):S1-S2300

RISKS OF GLP1S

- Appetite loss, dehydration, nausea
  - AKI
  - Poor wound healing



- Gastroparesis



- Ileus

- Aspiration

Li, et al. *J Clin Anesth* 2025. 104:111862.

OUR PRACTICE (KIDNEY TXP)

- GLP1s
  - Discontinue at time of transplant
  - Hold for a minimum 1 month post-transplant
  - Resume cautiously
- SGLT2is
  - Discontinue at time of transplant
  - Can be initiated/ resumed ~6 months post-transplant
  - Highly dependent on renal function and infection history

OUR PRACTICE (LUNG TXP)

- GLP1s
  - Hold at time of listing for transplant
  - Hold for a minimum of 3-6 months post-transplant
  - Resume cautiously
- SGLT2is
  - Hold at time of listing for transplant
  - Consider infectious history and renal function
  - Can be resumed 3-6 months post-transplant

OUR PRACTICE

- Encourage patients to use reputable providers and avoid sourcing these products from online pharmacies
- Compounded formulations (often prescribed by telehealth providers) are not regulated by the FDA and cannot be evaluated for safety, efficacy, or purity

Website: FDA's Concerns with Unapproved GLP-1 Drugs Used for Weight Loss | FDA

CONCLUSION

- Weigh benefits vs risks in your individual patient
- Consider holding these medications if patient is experiencing negative side effects prior to changing immunosuppression
- Obtain medication from a reputable source