Liver Transplant Pathway v9.1: **Table of Contents**

Stop and **Review**

Inclusion Criteria

- Patient admitted for liver transplant surgery

Exclusion Criteria

- Kidney or intestine transplant

Liver Transplant Care

Appendix

Last Updated: December 2023
Next Expected Review: September 2027

For questions concerning this pathway, contact:
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If you are a patient with questions contact your medical provider, Medical Disclaimer

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Liver Transplant Pathway v9.1: **Admission**

Stop and **Review**

Inclusion Criteria
- Patient admitted for liver transplant surgery

Exclusion Criteria
- Kidney or intestine transplant

Admission

Drawing Labs (high priority)
- Nurse draw or contact lab or VAS team to draw lab ASAP
- If VAS team unavailable, contact shift administrator to request assistance from ICU or ED
- Hand-deliver blood samples to lab, do NOT use tube system
- See here for lab schedule
  - OK to exceed maximum daily draw volume for admit labs (patient can receive blood products in OR if necessary)
  - Call transplant surgery with concerns

Admitting Procedure
- Schedule: patient and family will arrive at Seattle Children's Hospital after being notified by the Transplant Coordinator of the available donor organ
- Transplant Coordinator notifies
  - Shift administrator to create preadmit encounter
  - VAS team to be prepared to draw stat labs and start peripheral IV (regardless of current access)
  - Charge nurse on receiving unit at least 60 minutes before patient arrives
  - Also PICU charge, ED com nurse, ED security, main lab, HLA lab, pharmacy, blood bank
- Patient
  - Goes to River C 6 surgical unit for height, weight, labs, and admission
  - Will be admitted to a single room on River 6 whenever possible

For questions or clarification, contact Transplant Nurse Coordinator On-Call via paging operator (do not contact OR or Transplant Nurse Coordinator to request surgery time or for inpatient orders)

Surgical Team
- APP weekdays; surgical hospitalist or attending surgeon on call after hours, weekends, and holidays
- Orders Liver Transplant Pre-procedure Admission including
  - Intra-op antibiotics, see Surgical Antimicrobial Prophylaxis P&P 10999 (*for SCH only*), first-line: ampicillin/cefepime
  - Blood products, lab, and radiology
  - Case request
- Orders Liver Transplant Thymoglobulin (or Basiliximab) Immunosuppression
- Completes required forms
  - H&P note
  - Consent to Operation Form 45101
  - Informed Consent for Transfusion Form 51365
  - Completes HSCT_Organ Transplant form in EHR
- Surgeon will estimate OR time
- Contact transplant surgery team for questions about orders

Anesthesiologist
- Sees patient and completes pre-procedure anesthesia documentation

Nursing Preprocedure

- Obtain height and weight; enter into EHR immediately
- Sign and release pre-procedure admission orders in EHR
- Draw labs (see Drawing Labs box above)
- After lab draw, send patient to radiology for chest x-ray
- Verify labs are being processed
  - Check EHR for results. If uncertain, contact lab for clarification
  - Confirm lymphocyte crossmatch has been sent and received at BloodWorks Northwest (BWNW) HLA Lab
- Complete nursing documentation on preprocedure tab
- Confirm the following forms are in chart and completed by Surgical Team
  - H&P note or addendum
  - Consent to Operation Form 45101
  - Informed Consent for Transfusion Form 51365
- Ensure patient is NPO and has IVF/TPN infusing
- Check Blood Admin Navigator to confirm blood is available
  - ≤30 kg: 3 units RBC, 3 units plasma
  - >30 kg: 6 units RBC, 6 units plasma
- Bathe patient with chlorhexidine
  - See Pre-Operative P&P 10854 (*for SCH only*)
- OR notifies floor when they are ready (do not contact transplant coordinator or OR to request surgery time)
- Orient family to surgical floor, PICU Waiting Area, and PICU Front Desk. Obtain pager for updates from operating room staff

Phase Change
- To Intra-Op

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Last Updated: December 2023
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Liver Transplant Pathway v9.1: **Intra-Op**

Stop and **Review**

Inclusion Criteria
- Patient admitted for liver transplant surgery

Exclusion Criteria
- Kidney or intestine transplant

Phase Change
- From Admission

Operating Room

Circulating Nurse
- Complete Organ Chain of Custody Form in EHR
- Pre-Transplant ABO Verification by licensed healthcare professional, if recipient's surgery starts before organ arrives

Anesthesiologist
- Confirm interoperative antibiotics ordered, and release orders
- Check for blood availability
- Release Liver Transplant Thymoglobulin (or Basiliximab) Immunosuppression Orderset
- Order hydromorphone, D5LR, vasoactive infusions as needed
- Complete preprocedure anesthesia documentation

Operative Team
- In addition to standard surgical checklist:
  - ABO Verification
  - Blood products ordered
  - Organ status

Close of Case

Circulating Nurse
- Document graft reperfusion time in surgical record in EHR
- Follow process for vessel storage P&P
- Send donor lab sample to lab for HLA crossmatch
- Call consult PICU charge nurse when surgeon is closing

Surgical Signout
- Complete ABO Verification
- Extubation plan

Phase Change
- To Post-Op Critical Care

To Table of Contents

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Liver Transplant Pathway v9.1: **Post-Op Critical Care**

Stop and **Review**

Inclusion Criteria
- Patient admitted for liver transplant surgery

Exclusion Criteria
- Kidney or intestine transplant

Phase Change
- From Intra-op

OR to PICU Handoff

Surgeon and anesthesiologist handoff to PICU
- Use Postoperative Handoff Template (OR/IR to ICU)
- Clarify pain management plan

Postoperative Management

Transplant Team Orders
- Liver Transplant Post-procedure Order Set
- PICU RN to release orders

Medications
- Immunosuppression, refer to patient-specific roadmap, found in media tab in EHR, based on Immunosuppression for Liver Transplant P&P 10536 (*for SCH only*)
- Surgical antibiotic prophylaxis (first-line: ampicillin/cefepime) x 24 hours post-op
- Trimethoprim-sulfamethoxazole
- Ganciclovir based on recipient/donor CMV status P&P 10652 (*for SCH only*)
- Nystatin
- Pantoprazole
- Thrombosis prevention, Liver Transplant Anticoagulation GOC 12548 (*for SCH only*)
- Acetaminophen
- ICU Team manages pain/sedation per Comfort and Sedation in the ICU GOC 10270 (*for SCH only*)

Investigations
- Labs see appendix GOC Post Liver Transplant 10842 (*for SCH only*)
- Ultrasounds post-operative day 1, 2, 4

Hematology
- Plasma transfusion 5 mL/kg IV over 4 hours, every 12 hours for 4-6 total doses
- Dextran infusion x 3 days

Guideline of Care (GOC) and Clinical Policy and Procedure (P&P)
- Post Liver Transplant GOC 10842 (*for SCH only*)
- Liver Transplant Anticoagulation GOC 12548 (*for SCH only*)
- Comfort and Sedation in the ICU GOC 10270 (*for SCH only*)
- Intubated/Mechanically Ventilated GOC 10198 (*for SCH only*)

Care Progression

Patient/Family Education
- Medication teaching to be initiated by transplant pharmacist as soon as possible
- Transplant APP or RN will arrange formal discharge education

Transfer Criteria
- Not requiring ventilatory support
- Not requiring hemodynamic support
- Good organ function
- Intensity of care appropriate for surgical unit
- Bed available on River C 6 surgical unit

Phase Change
- To Post-Op Acute Care

!
No ill care providers or visitors. No flowers or plants.

!
Do not use vasopressin

!
Call transplant team for concern of bleeding or hypotension

!
Draw tacro levels as trough at 0830h Administer AM tacro at 0900h

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Liver Transplant Pathway v9.1: **Post-Op Acute Care**

Stop and **Review**

Inclusion Criteria
- Patient admitted for liver transplant surgery

Exclusion Criteria
- Kidney or intestine transplant

Phase Change
- From Critical Care

Postoperative Management – Surgical Floor

Guideline of Care (GOC) and Clinical Policy and Procedure (P&P)
- Post Liver Transplant GOC 10842 (*for SCH only*)
- Infection Prevention for Organ Transplant Patients P&P 10559 (*for SCH only*)
- Liver Transplant Anticoagulation GOC 12548 (*for SCH only*)
- Liver Biopsy GOC 10632 (*for SCH only*)
- If gastric tube: Gastric Suction P&P 10460 (*for SCH only*)
- Peripheral Intravenous (PIV) Management P&P 12664 (*for SCH only*)
- Central Venous Catheter (CVC) Management P&P 12665 (*for SCH only*)

Labs:
- See appendix Post Liver Transplant GOC 10842 (*for SCH only*)

Medications - See Patient-Specific Roadmap in EHR
- Immunosuppression, refer to patient-specific roadmap, found in media tab in EHR, based on Immunosuppression for Liver Transplant P&P 10536 (*for SCH only*)
- Thrombosis prevention OR aspirin 12548 (*for SCH only*)
- Valganciclovir based on recipient/donor CMV status P&P 10652 (*for SCH only*)
- Trimethoprim-sulfamethoxazole
- Nystatin
- Magnesium if needed
- Acetaminophen and/or oxycodone PRN

Consults
- Child Life
- Social work

Discharge Criteria
- Good graft function
- Therapeutic immunosuppression at target goals
- Afebrile
- Stable nutritional status
- Tolerating fluid goals and enteral medications
- Completed teaching: nursing, pharmacy, dietitian, social work
- Follow-up appointment scheduled

Discharge Instructions
- Follow up appointment(s) and blood draws communicated to patient and family
- If applicable: PE1262 Bile Drainage Tube (Catheter)

!
Draw tacro levels as trough at 0830h Administer AM tacro at 0900h

!
No ill care providers or visitors. No flowers or plants.

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Liver Transplant Pathway v9.1: **Admit Labs**

Hematology:

CBC/diff
PT/INR
PTT
Thrombin Time
Fibrinogen
TEG (must be sent stat)

→ Normal volume:
- **1 lavender = 1 mL**
- **2 lt blue citrate = 1.8 mL in each**

or

Micro volume:
- **1 lavender microtainer = 0.5 mL**
- **2 lt blue citrate = 1.8 mL in each**

Chemistry:

Basic Metabolic Panel
Magnesium
Phosphorus
Hepatic Function Panel
GGT
Liver Transplant Listing
Bilirubin Levels
+ HCG for female ≥ 12 years

→ Normal volume: **1 gold = 1 mL**

+ Female ≥ 12 yr: **1 gold = 1 mL**

CA - ionized

→ Normal volume: **Heparanized syringe = 0.5 mL**

Virology (if ordered):

CMV IgG/IgM, EBV IgG/IgM
Hep B Battery
Hep C Antibody, PCR Quant

→ Normal volume: **1 red top = 6 mL**

or

Micro volume: **1 red top = 4 mL**

HIV Antigen and Antibody

→ Normal volume: **1 lavender = 3 mL**

or

Micro volume: **1 lavender = 3 mL**

Other:

ABO/RhD and Antibody Screen (Type and Screen) for Liver Pack blood order

→ Normal volume: **1 lavender = 3 mL**

or

Micro volume: **2 lavender microtainer = 0.5 mL in each**

ABO Incompatible Liver Titers, Anti-A or Anti-B (if ordered), send to Bloodworks NW

→ Normal volume: **1 lavender = 3 mL**

or

Micro volume: **2 lavender microtainer = 0.5 mL in each**

*HLA Lymphocyte Crossmatch

→ **Patient Weight Sample Requirements (no serum separator)**

9-13 kg:	****ACD = 10 mL**	+	**1 red top = 5 mL**
14-21 kg:	****ACD = 20 mL**	+	**1 red top = 5 mL**
22+ kg:	****ACD = 30 mL**	+	**1 red top = 7 mL**
Post-transplant 9-21kg:			**1 red top = 5 mL**
Post-transplant 22+ kg:			**1 red top = 7 mL**

Urinalysis and culture

COVID-19 test (nasal swab)

*** Call BloodWorks Immunogenetics Lab for HLA questions and for patients less than 9 kg.**
**** Call main laboratory for ACD tubes. Attach Bloodworks Northwest form.**

Summary of Version Changes

- **Version 1.0 (4/29/2014):** Go live.
- **Version 2.0 (11/13/2014):** Reduced plasma dose, clarified line placement requirements upon admit, removed link to blood draw limits.
- **Version 3.0 (1/22/2016):** CSW Value Analysis completed, changes include to recommend core labs over ePOC (use ePOC when speed is more important than accuracy).
- **Version 4.0 (4/4/2016):** Added additional information for Admit Labs.
- **Version 4.1 (11/21/2016):** Reformatted Admit Labs page for readability.
- **Version 4.2 (9/25/2017):** Renamed email address.
- **Version 5.0 (1/10/2019):** Updated anticoagulation recommendations.
- **Version 6.0 (4/6/2021):** Full approval go live with new formatting style and some content changes: updated anesthesia protocol and aligned verbiage to correspond with Epic.
- **Version 7.0 (9/21/2022):** Periodic review
  - Updated policy and guideline names and links
  - Updated workflow including postop ultrasound schedule
  - Removed reference to standard immunosuppression protocol with dosing
- **Version 8.0 (5/12/2023):** Updated perioperative antibiotics and added policy link, revised 9/21/2022 go-live documentation to reflect that it was a periodic review. Added national collaboratives to bibliography.
- **Version 9.0 (6/2/2023):** The order quantity of preoperative RBC units has been revised to match order set; removed note to keep 2 units of crossmatched RBCs for 24 hours postop because the blood bank is on-site; clarified that separate tubes are needed for ABO/RhD and Antibody Screen and ABO Incompatible Liver Titers as they are processed in different labs.
- **Version 9.1 (12/19/2023):** Updates made to reflect changes to pre liver transplant labs. Removed HLA typing from Nursing Preprocedure section in Admission phase. Removed HLA typing and HLA antibody detection from Admit Labs information page.

Approval & Citation

Approved by the CSW Liver Transplant Pathway team for September 21, 2022, go-live

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Retrieval Website: https://www.seattlechildrens.org/pdf/liver-transplant-pathway.pdf

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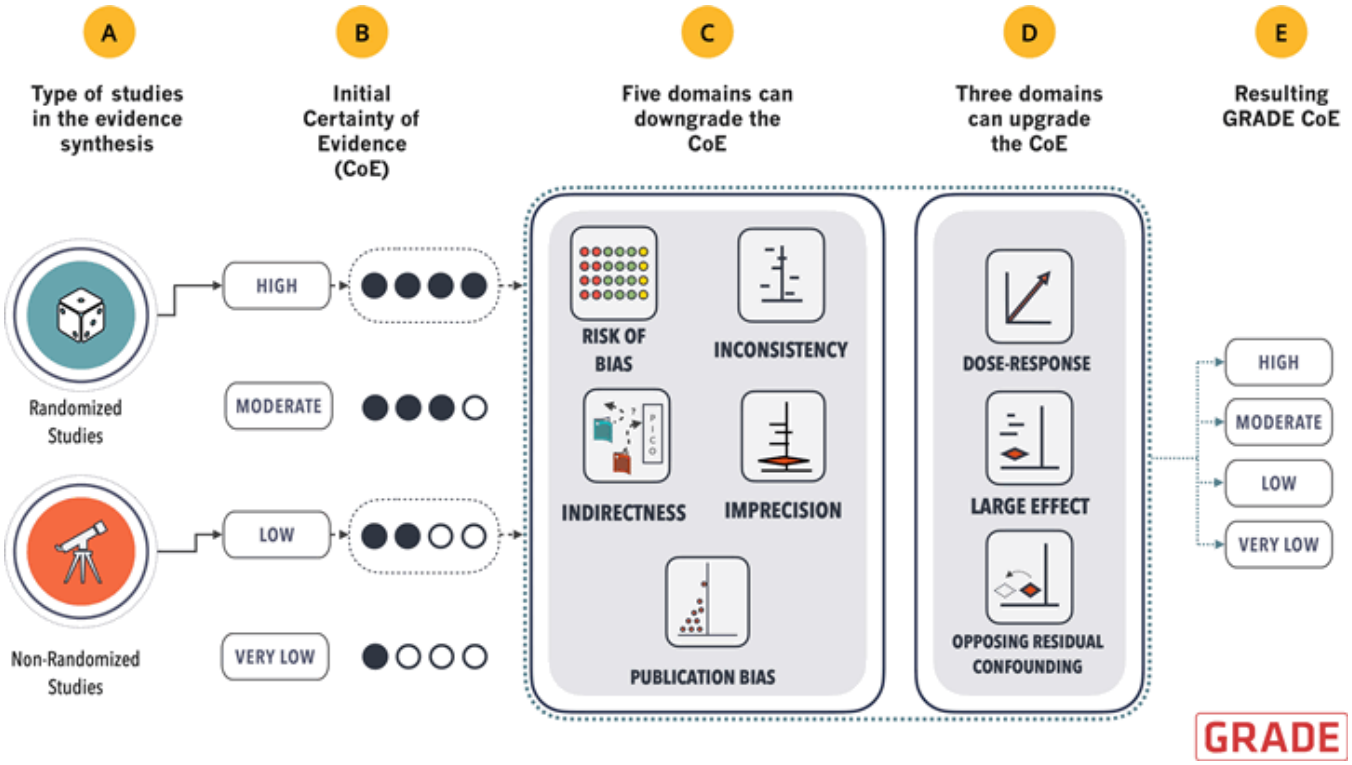
Seattle Children's Hospital, Healey P., Lundberg C., Dick A., Hrachovec J., Hunyady A., Lorenzo K., Valentino P., Migita D., 2022 September. Liver Transplant Pathway. Available from: https://www.seattlechildrens.org/pdf/liver-transplant-pathway.pdf

Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children's. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94, Hultcrantz M et al. J Clin Epidemiol. 2017;87:4-13, Klugar et al. J Clin Epidmiol. 2021 Nov 11;S0895-4356(21)00361-9.):



Source: Carlos Cuello

Certainty of Evidence

✪✪✪✪ High certainty: The authors have a lot of confidence that the true effect is similar to the estimated effect
✪✪✪○ Moderate certainty: The authors believe that the true effect is probably close to the estimated effect
✪✪○○ Low certainty: The true effect might be markedly different from the estimated effect
✪○○○ Very low certainty: The true effect is probably markedly different from the estimated effect
Guideline: Recommendation is from a published guideline that used methodology deemed acceptable by the team
Expert Opinion: Based on available evidence that does not meet GRADE criteria (for example, case-control studies)

Deductions labeled 1=risk bias, 2=indirectness, 3=imprecision, 4=inconsistency, 5=publication bias

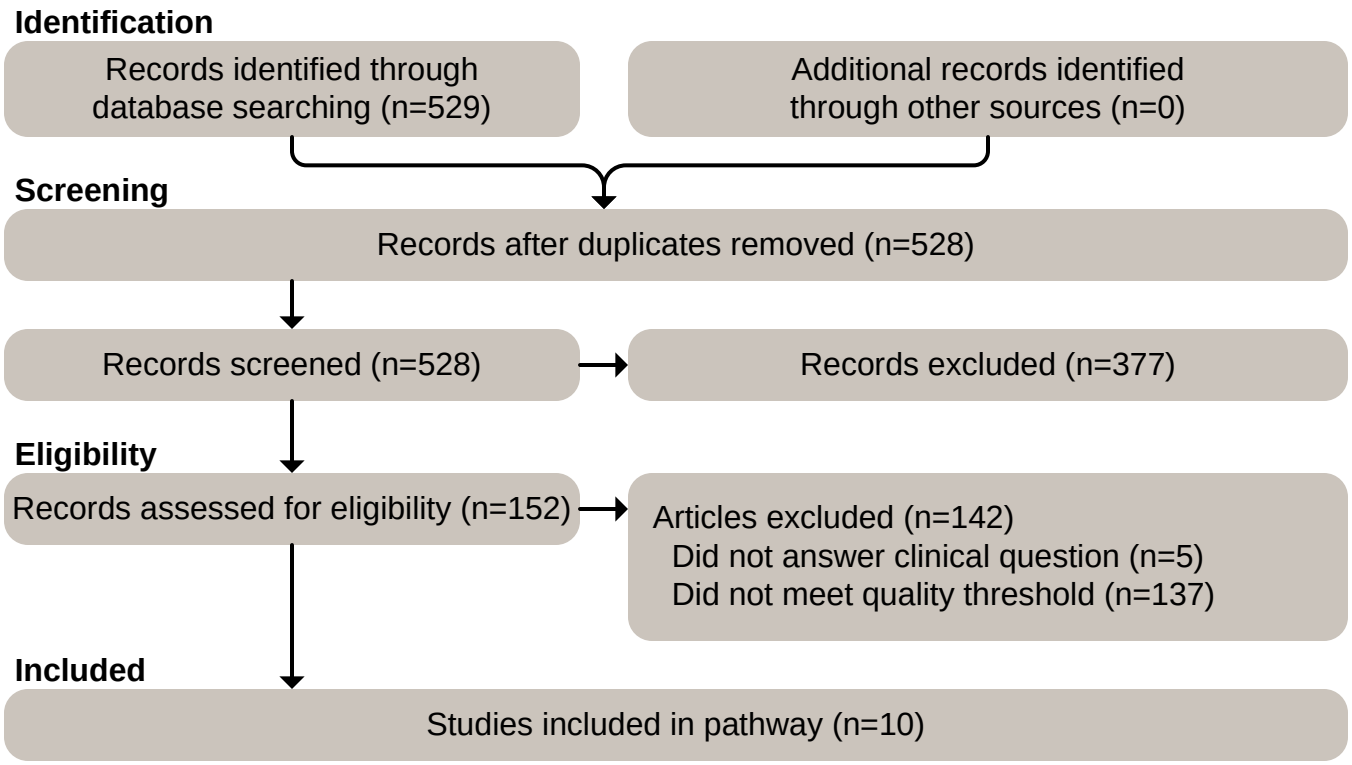
Bibliography

Literature Search Methods

Studies were identified by searching electronic databases using search strategies developed and executed by a medical librarian, Susan Klawansky. Searches were performed in July and September, 2013. The following databases were searched – on the Ovid platform: Medline (2002 to date), Cochrane Database of Systematic Reviews (2005 to date), Cochrane Central Register of Controlled Trials (2002 to date); elsewhere – Embase (2002 to date), Clinical Evidence, National Guideline Clearinghouse, TRIP (2002 to date) and Cincinnati Children's Evidence-Based Care Guidelines. Retrieval was limited to humans 0-18 and English language. In Medline and Embase, appropriate Medical Subject Headings (MeSH) and Emtree headings were used respectively, along with text words, and the search strategy was adapted for other databases using their controlled vocabularies, where available, along with text words. Concepts searched were liver transplantation and any of the following: immunosuppression, immunosuppressive agents, human herpesvirus 4, Epstein-Barr virus infections, cytomegalovirus, cytomegalovirus infections, pneumocystis pneumonia, pneumocystis carinii, lymphoproliferative disorders, steroids. All retrieval was further limited to certain evidence categories, such as relevant publication types, Clinical Queries, index terms for study types and other similar limits.

Literature Search Results

The search retrieved 529 records. Once duplicates had been removed, we had a total of 528 records. We excluded 377 records based on titles and abstracts. We obtained the full text of the remaining 152 records and excluded 142. We included 10 studies. The flow diagram summarizes the study selection process.



Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535

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Society of Pediatric Liver Transplantation, available at https://www.tts.org/split-home

Starzl Network, available at https://starzlnetwork.org/

Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

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