



# Management of intestinal failure a pediatric perspective

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# Disclosures

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# CanMEDS roles covered

✓	<b>Medical Expert</b> (as <i>Medical Experts</i> , physicians integrate all of the CanMEDS Roles, applying medical knowledge, clinical skills, and professional values in their provision of high-quality and safe patient-centered care. <i>Medical Expert</i> is the central physician Role in the CanMEDS Framework and defines the physician's clinical scope of practice.)
	<b>Communicator</b> (as <i>Communicators</i> , physicians form relationships with patients and their families that facilitate the gathering and sharing of essential information for effective health care.)
✓	<b>Collaborator</b> (as <i>Collaborators</i> , physicians work effectively with other health care professionals to provide safe, high-quality, patient-centred care.)
	<b>Leader</b> (as <i>Leaders</i> , physicians engage with others to contribute to a vision of a high-quality health care system and take responsibility for the delivery of excellent patient care through their activities as clinicians, administrators, scholars, or teachers.)
✓	<b>Health Advocate</b> (as <i>Health Advocates</i> , physicians contribute their expertise and influence as they work with communities or patient populations to improve health. They work with those they serve to determine and understand needs, speak on behalf of others when required, and support the mobilization of resources to effect change.)
	<b>Scholar</b> (as <i>Scholars</i> , physicians demonstrate a lifelong commitment to excellence in practice through continuous learning and by teaching others, evaluating evidence, and contributing to scholarship.)
	<b>Professional</b> (as <i>Professionals</i> , physicians are committed to the health and well-being of individual patients and society through ethical practice, high personal standards of behaviour, accountability to the profession and society, physician-led regulation, and maintenance of personal health.)

# Objectives

- Recognize the structure and important contribution of multidisciplinary care for pediatric intestinal failure (IF)
- Understand the management of long term complications of surgical strategies with a focus on anastomotic ulcers
- Discuss the follow up and management of medical complications like kidney and bone disease
- Identify indications for intestinal transplantation in the era of novel lipid therapies for IFALD

# Case 1

- 32 week male
- NEC
  - 25 cm of residual small bowel
  - Transverse colon remnant
- Nutrition
  - 10% of calories enterally
  - PN – 24 hours per day



**?**  
**What does  
his future  
hold in 2017**



# Traditional Morbidity

- Sepsis
- Central Venous catheter complications
- Metabolic complications
- Neurodevelopmental complications
- Impact on quality of life and family function
- Cholestasis and Liver failure
- Early death

**Is this your current  
experience?**

# What Do You View The Single Most Important Development Accounting For Recent Improved Outcome To Be?

- A: Multi-disciplinary Intestinal Rehabilitation
- B: Improved sepsis prevention
- C: Enhanced outcomes of intestinal transplantation
- D: Novel Lipid Management Strategies
- E: Autologous Reconstruction (STEP)
- F: Hormonal Therapy (GLP-2, GH)

# What Do You View The Single Most Important Development Accounting For The Improved Outcome To Be?

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# What Does an IRP Need?

- Volume of patients
- Expertise
- Institutional support
- Offer assessment and comprehensive care
- Clinical pathways/protocol development
- Clinical/research database

# Group for Improvement of Intestinal Function and Treatment (GIFT)

- Team Members
  - Surgery
  - GI, Transplant
  - Neonatology
  - Clinical Nutrition, 2 RDs
  - Nursing, 2 NPs, 0.5 RN
  - Social Work
  - Child psychology
  - OT/PT
  - Child Life



## Children's Hospitals Intestinal Rehabilitation Programs (ChIRP)

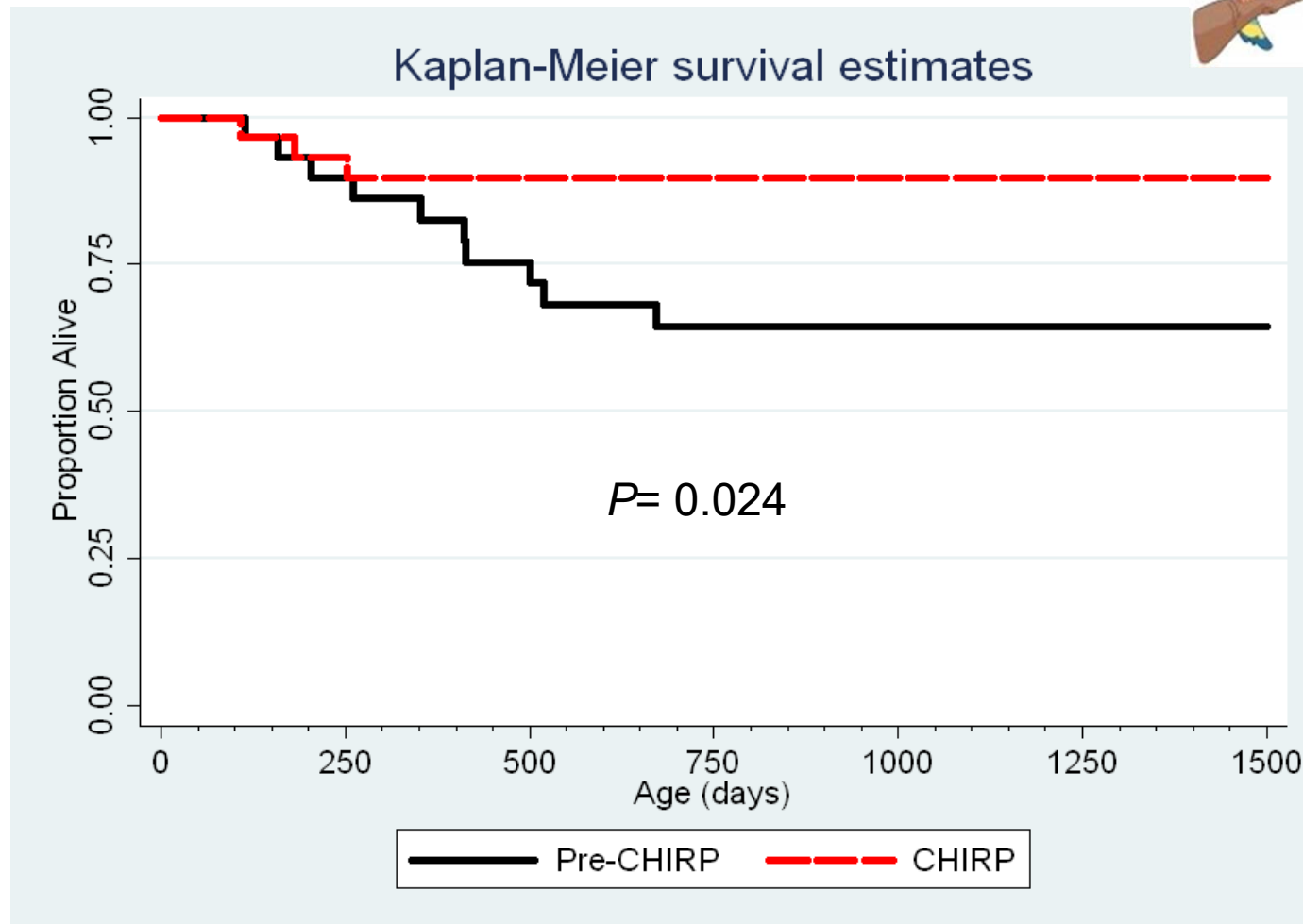
- Sites
  - Calgary
  - Edmonton (Transplant)
  - Vancouver
  - Victoria



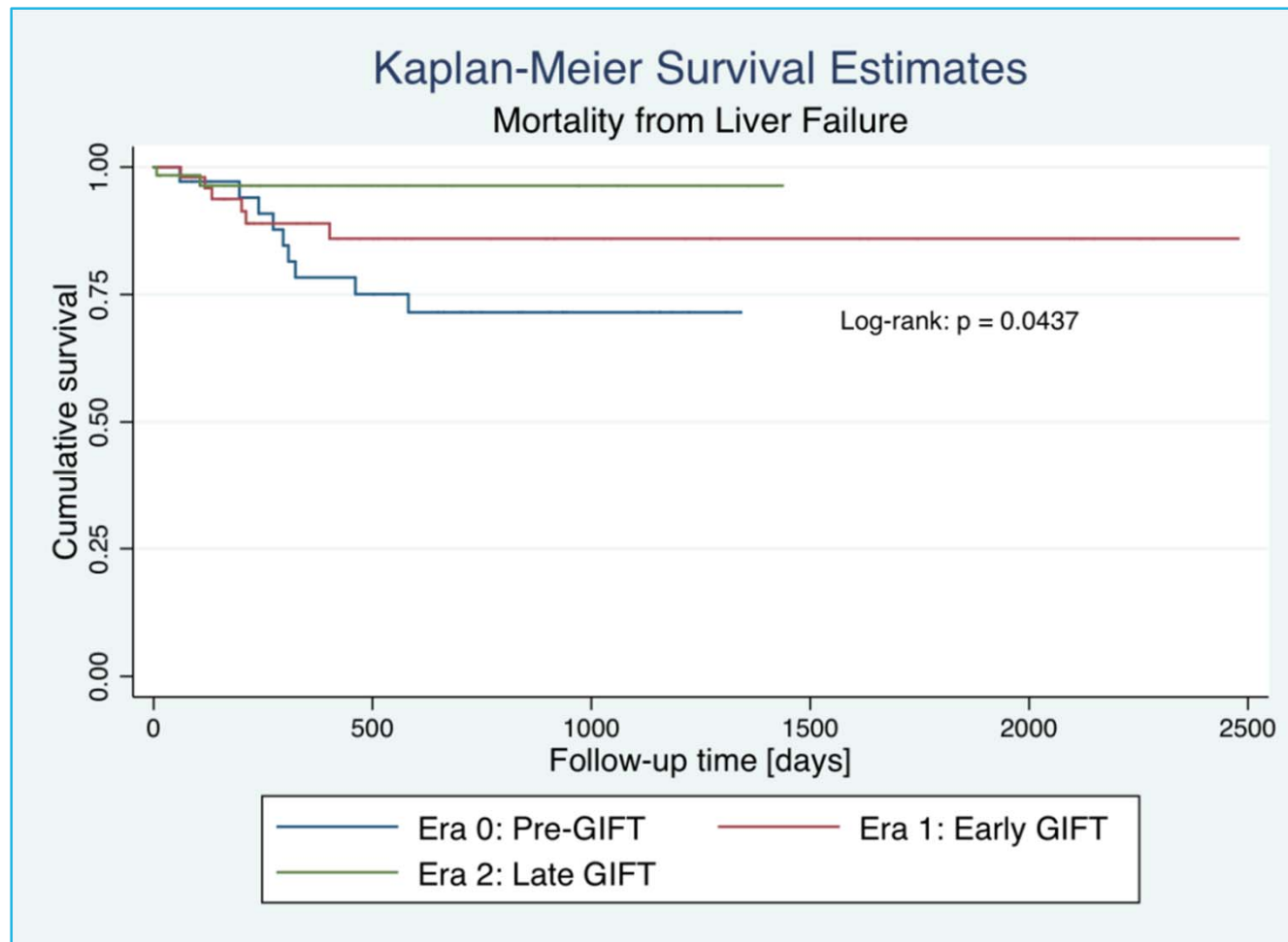
# Goals of IRP

- Optimize growth
- Optimize bowel adaptation and function
- Feeding therapy
- Decrease complications
- Family Support
- Transplant evaluation

# Overall Survival



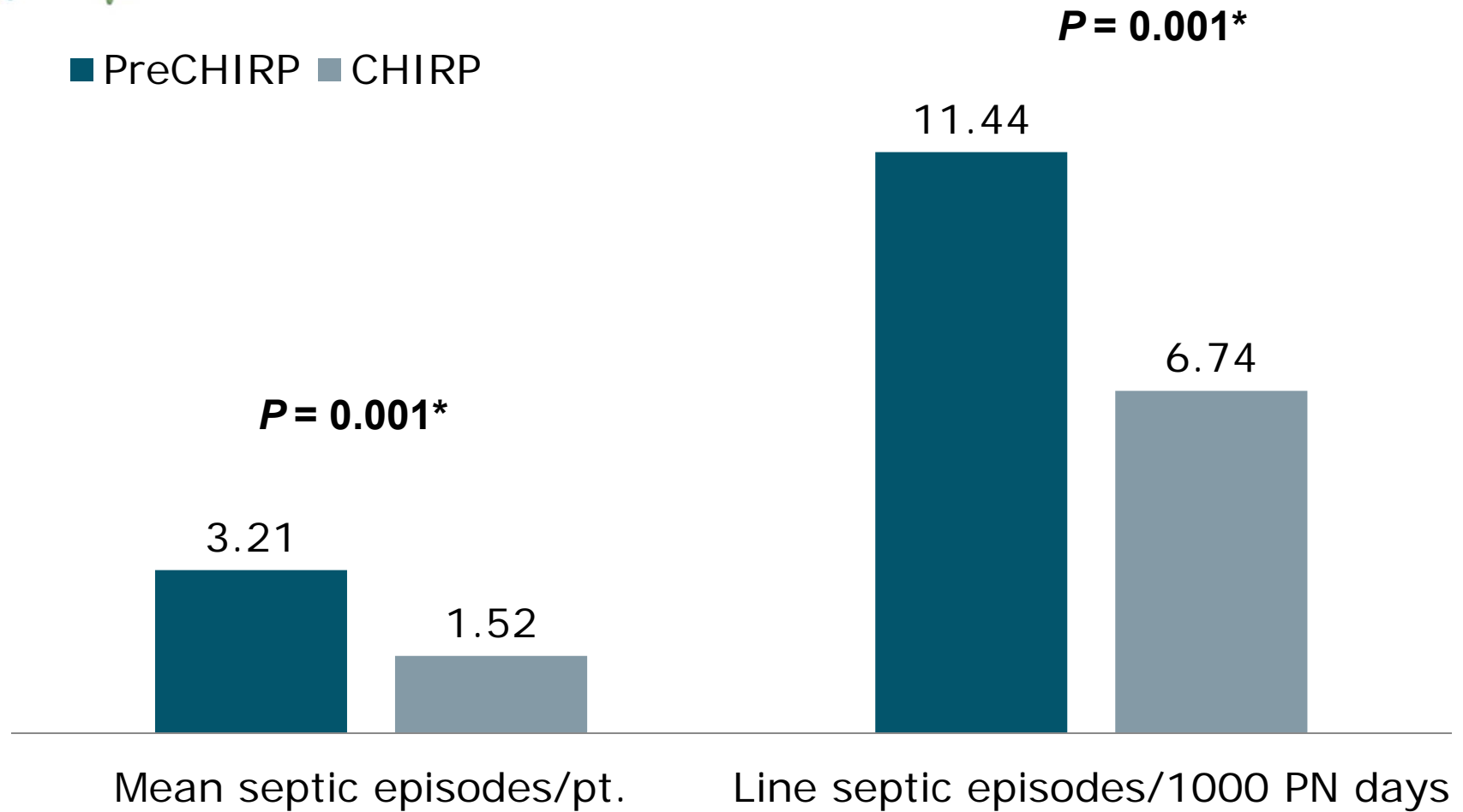
# Mortality from Liver Failure

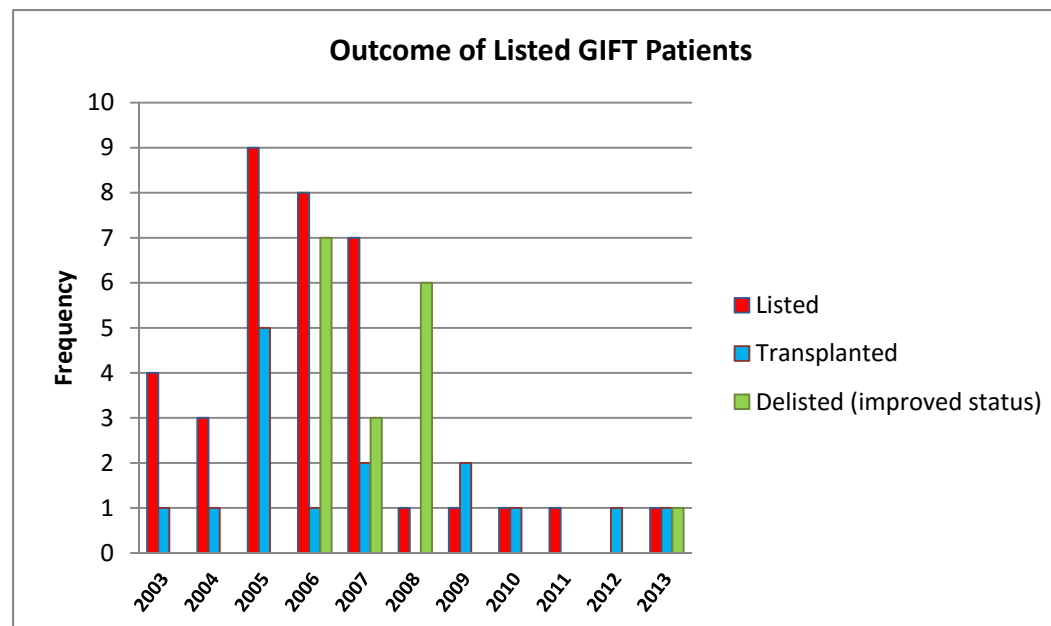
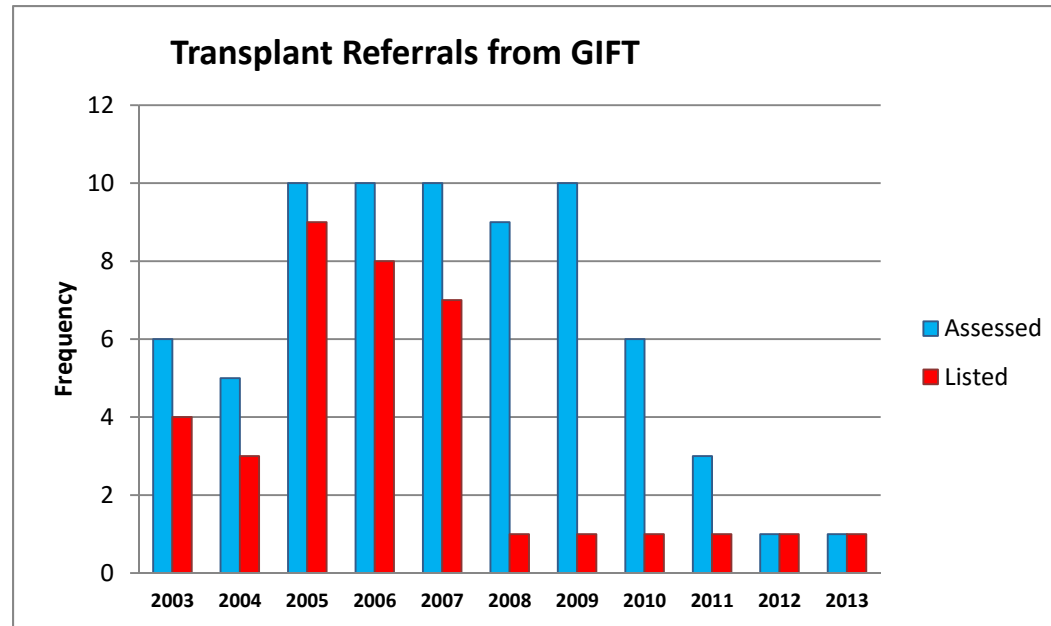




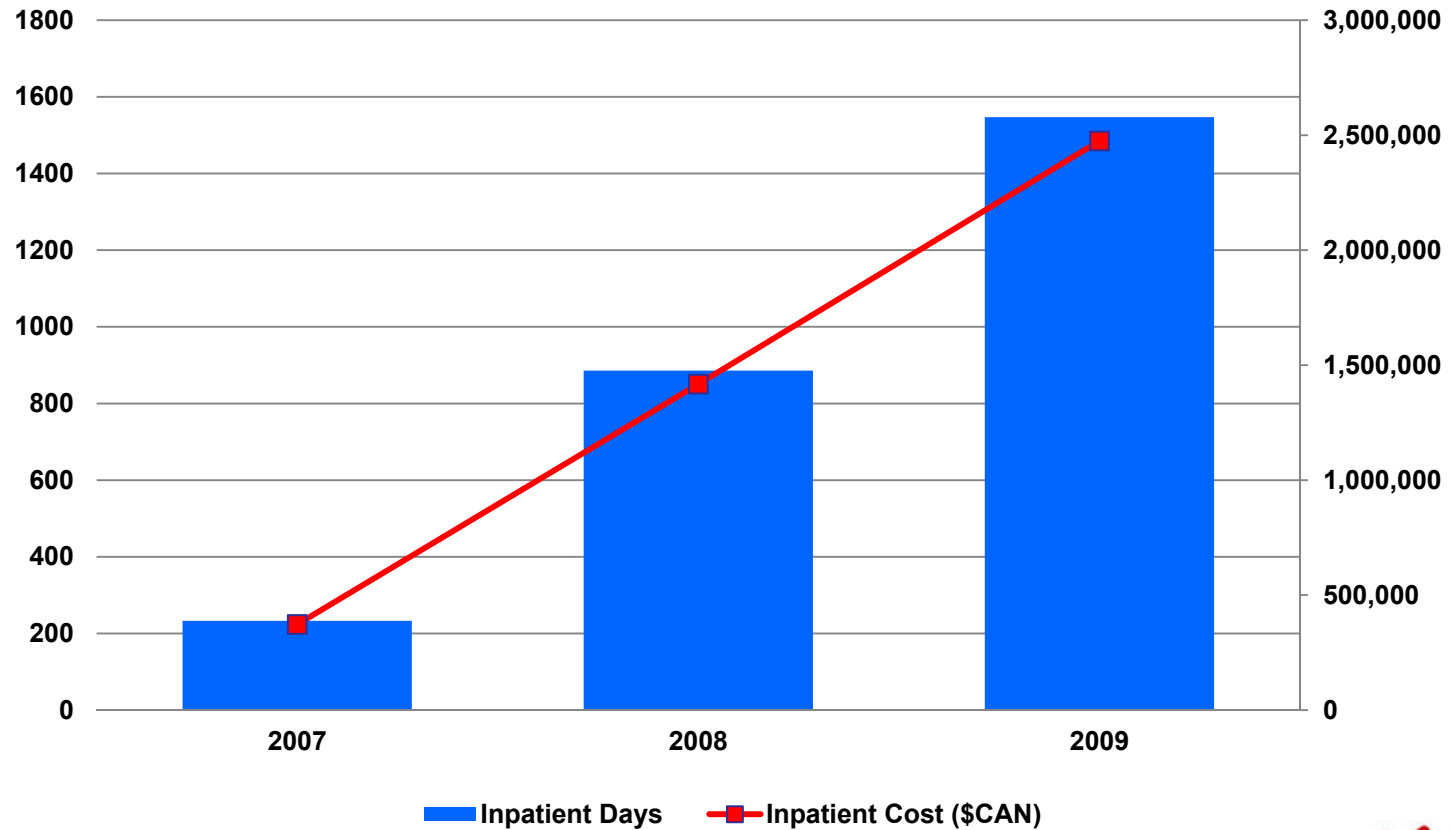
# Catheter Septic Episode

■ PreCHIRP ■ CHIRP





## Inpatient Days and Costs





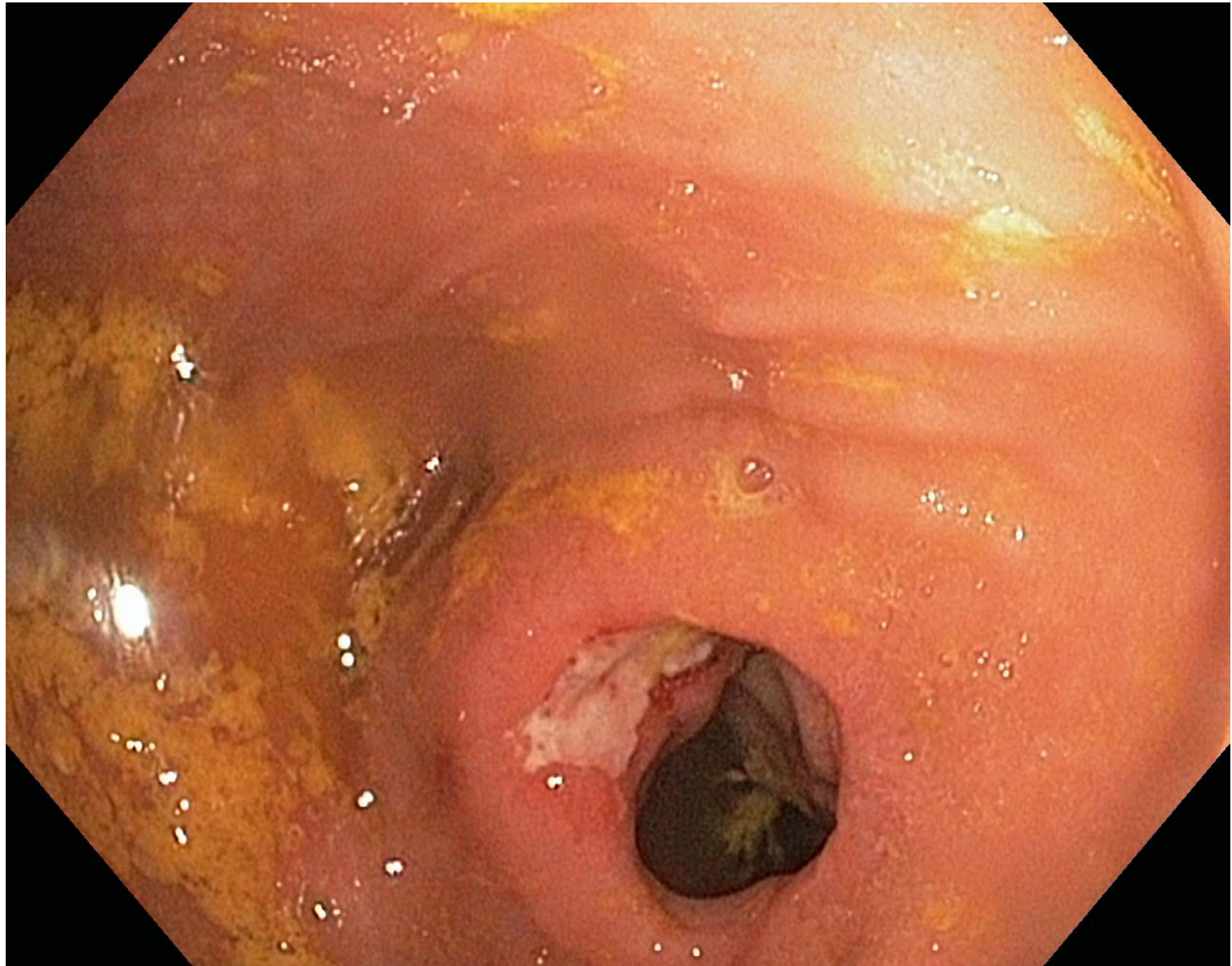
# The IF New Paradigm

- IF need no longer be a disease characterized by need for early transplantation or death
- IF has become a chronic condition
  - Prolonged period for intestinal adaptation free of IFALD
  - Prolonged survival to isolated intestinal transplantation in those who do not have the capacity to adapt
  - New morbidities
  - New costs of care

## Case 2

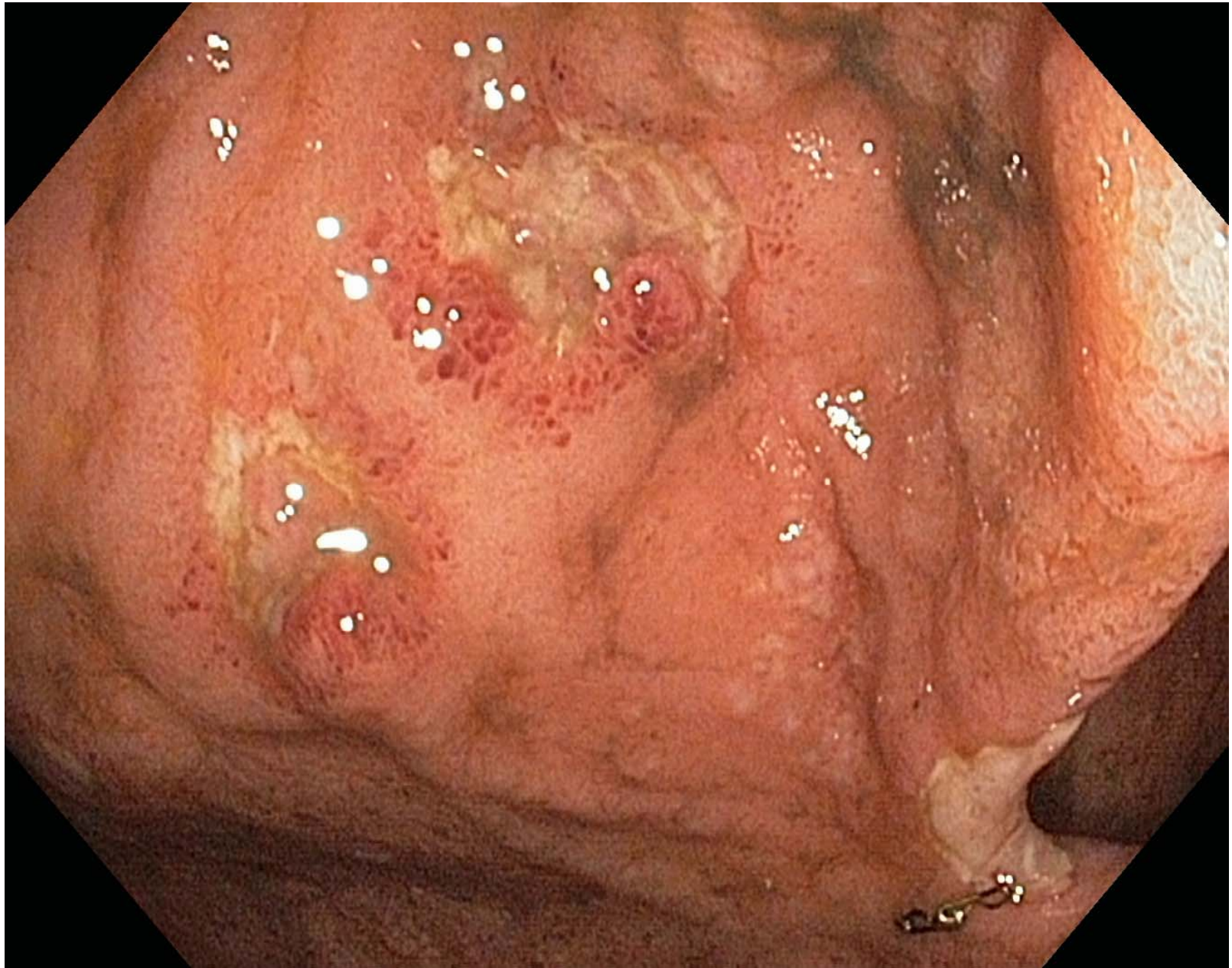
- 5y old male, IF secondary to intestinal atresia
- PMH - TPN dependent until 3y of age
  - G-tube feeding
  - SBBO requiring cyclic antibiotics
- HPI - recurrent abdominal pain, abdominal distention
  - chronic microcytic anemia, refractory to iron therapy

**Next Steps ?**









# Anastomotic Ulcers

- Prevalence ? – 0.3-8%, rare
- **Clinical** – chronic, refractory iron deficiency anemia, occult / overt blood in stool, abdominal pain, hypoalbuminemia, growth retardation
- More common in ileocolonic anastomosis ≈80%
- **Etiology** ? – ischemia, bacterial induced, IBD like, bile acid related
- **Pathology** – chronic non specific inflammation
- **Therapy** - medical – ABx, 5-ASA, sulfasalazine, steroids
  - Surgical – high recurrence rate (50-70%) months to years post surgery

# What Morbidity Do You Screen Your IF Patients for over time, how and when?

## Lets discuss a wish list!

- A: Renal disease: annual urinalysis and GFR
- B: Renal disease: annual ultrasound and eGFR
- C: Bone disease: annual PTH, phosphate, calcitonin
- D: Bone disease: annual DXA
- E: Formal annual neurodevelopmental testing

# Prevalence of renal abnormality in pediatric intestinal failure<sup>☆</sup>

Journal of Pediatric  
Surgery

Christina Kosar<sup>a</sup>, Nicole De Silva<sup>a</sup>, Yaron Avitzur<sup>a,b</sup>, Karen Steinberg<sup>a</sup>, Glenda Courtney-Martin<sup>a</sup>, Kathryn Chambers<sup>a</sup>, Kevin Fitzgerald<sup>a</sup>, Elizabeth Harvey<sup>a,c</sup>, Paul W. Wales<sup>a,d,\*</sup>

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- Echogenicity nonspecific indicator renal parenchymal disease
  - glomerular, tubular, interstitial inflammation, nephrocalcinosis
- Nephrocalcinosis
  - imbalance between stone-forming and inhibiting factors
  - acidosis, diuretics, Vit D, hyperoxaluria, PN factors like aluminum, fat malabsorption, dehydration



# Metabolic bone disease in pediatric intestinal failure patients: Prevalence and risk factors ☆☆☆

Journal of Pediatric Surgery

Faraz A. Khan <sup>a</sup>, Jeremy G. Fisher <sup>a</sup>, Sigrid Bairdain <sup>a</sup>, Eric A. Sparks <sup>a</sup>, David Zurakowski <sup>a,c</sup>, Biren P. Modi <sup>a</sup>, Christopher Duggan <sup>b</sup>, Tom Jaksic <sup>a,\*</sup>

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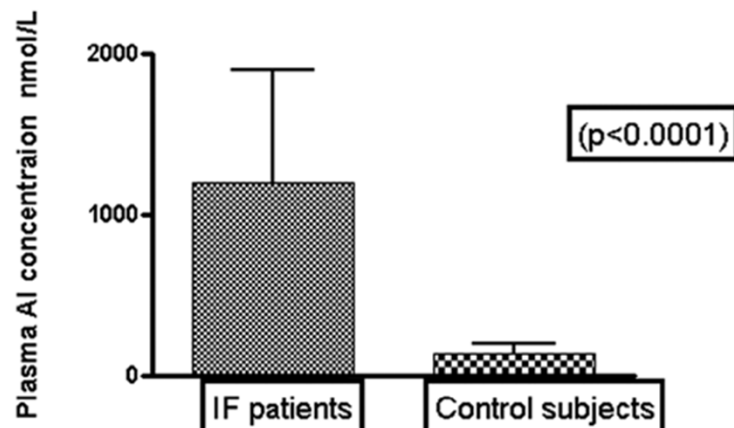
<sup>c</sup> Department of Anesthesiology, Perioperative and Pain Medicine, Boston Children's Hospital and Harvard Medical School, USA

- Osteomalacia: deficient calcification of osteoid (vitamin D)
- Osteoporosis: decreased bone mass: ↑resorption / ↓formation
- Fractures (29%)
- Mechanism: negative Ca balance, AI-induced low PTH or 1,25-OHVitD, inflammation
- Measurement: DEXA, but poor reference data < 5yrs

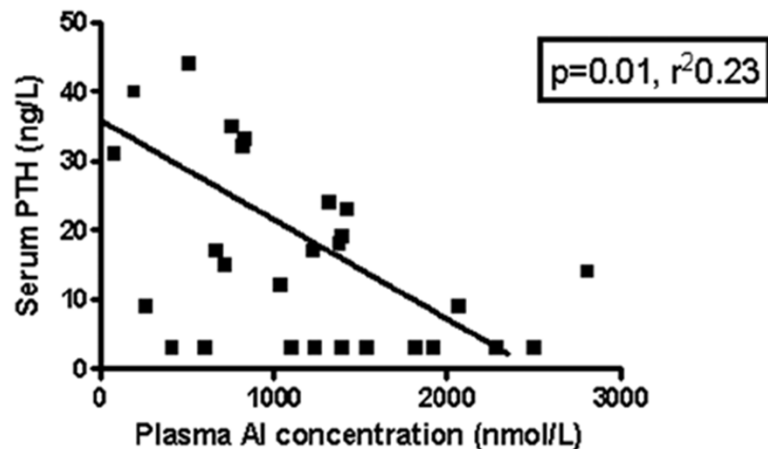
# Plasma Aluminum Concentrations in Pediatric Patients Receiving Long-Term Parenteral Nutrition

Glenda Courtney-Martin, PhD, RD<sup>1,2</sup>; Christina Kosar, MN, RN<sup>1,2</sup>;  
Alison Campbell, RD<sup>1</sup>; Yaron Avitzur, MD<sup>1,2,3</sup>; Paul W. Wales, MD, MSc<sup>1,2,4</sup>;  
Karen Steinberg, MN, RN<sup>1,2</sup>; Debra Harrison, BScN<sup>1,2</sup>;  
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**SAGE**



- A risk due to bypass of gut
- No regulations in Canada
- Deposits in Bone, liver, brain, kidney, parathyroid, spleen
- FDA max exposure 5 ug/kg/d
- HSC cohort Al exposure 15 ug/kg/d



- **Social and Developmental issues**
  - Developmental delay 2° to long term hospitalization
  - Underlying neuro-developmental deficits (preterm)
  - Oral feeding aversion/intolerance
  - Attachment/Bonding
  - Attaining milestones
  - Play



## Case 3

- 4y old male, IF secondary to gastroschisis
- PMH – IFALD with C. Bilirubin of 90 mmol/l at 4m, resolved after a switch to Omegaven
  - 6 line infections
  - SBBO
  - Enteral nutrition up to 30% of total calories
- HPI – Upper GI bleeding due to GE varices X3
  - ALT 82, AST 53, GGT 50, Total bilirubin 3 mmol/l
  - Albumin 28, INR 1.7, PLT 45,000
  - Liver biopsy – dense non-inflammatory portal fibrosis, no cholestasis

**Listing for Intestine Transplantation?**

# Indications for Listing for ITx - Children

Indications for Intestine Transplantation		
#	Factor	Criteria
1	Intestinal Failure	<ul style="list-style-type: none"> <li>Progressive intestinal failure associated liver disease with plasma bilirubin &gt;100mmol/l and signs of portal hypertension, or synthetic liver dysfunction with coagulopathy.</li> </ul>
2	Quality of Life	<ul style="list-style-type: none"> <li>Intestinal failure with high morbidity and poor quality of life.</li> </ul>
3	Sepsis	<ul style="list-style-type: none"> <li>Recurrent life threatening episodes of sepsis resulting in multi-organ failure, metastatic infectious foci or acquisition of flora with limited antibiotic sensitivities</li> </ul>
4	Vascular Access	<ul style="list-style-type: none"> <li>Loss of more than 50% of the standard central venous access sites</li> </ul>
5	Congenital mucosal disorders	<ul style="list-style-type: none"> <li>Microvillus inclusion disease</li> <li>Tufting enteropathy</li> </ul>
6	Ultra short bowel syndrome	<ul style="list-style-type: none"> <li>&lt; 20 cm</li> </ul>

# Ideal Intestine Transplant Listing Criteria

- Identify patients with intestinal failure at high risk of death and projected survival below the 5 year survival rate post intestine transplantation
- Based on simple clinical tools
- Specific and clear
- Reflect current patient outcome and practices
- Replicated by multiple centers
- High statistical reliability

# **Pediatric Intestinal Transplant Listing Criteria – A Call for a Change in the New Era of Intestinal Failure Outcomes**

K. M. Burghardt<sup>1,2</sup>, P. W. Wales<sup>1,3</sup>,  
N. de Silva<sup>1</sup>, D. Stephens<sup>4</sup>, J. Yap<sup>5</sup>,  
D. Grant<sup>3</sup> and Y. Avitzur<sup>1,2,\*</sup>

\*

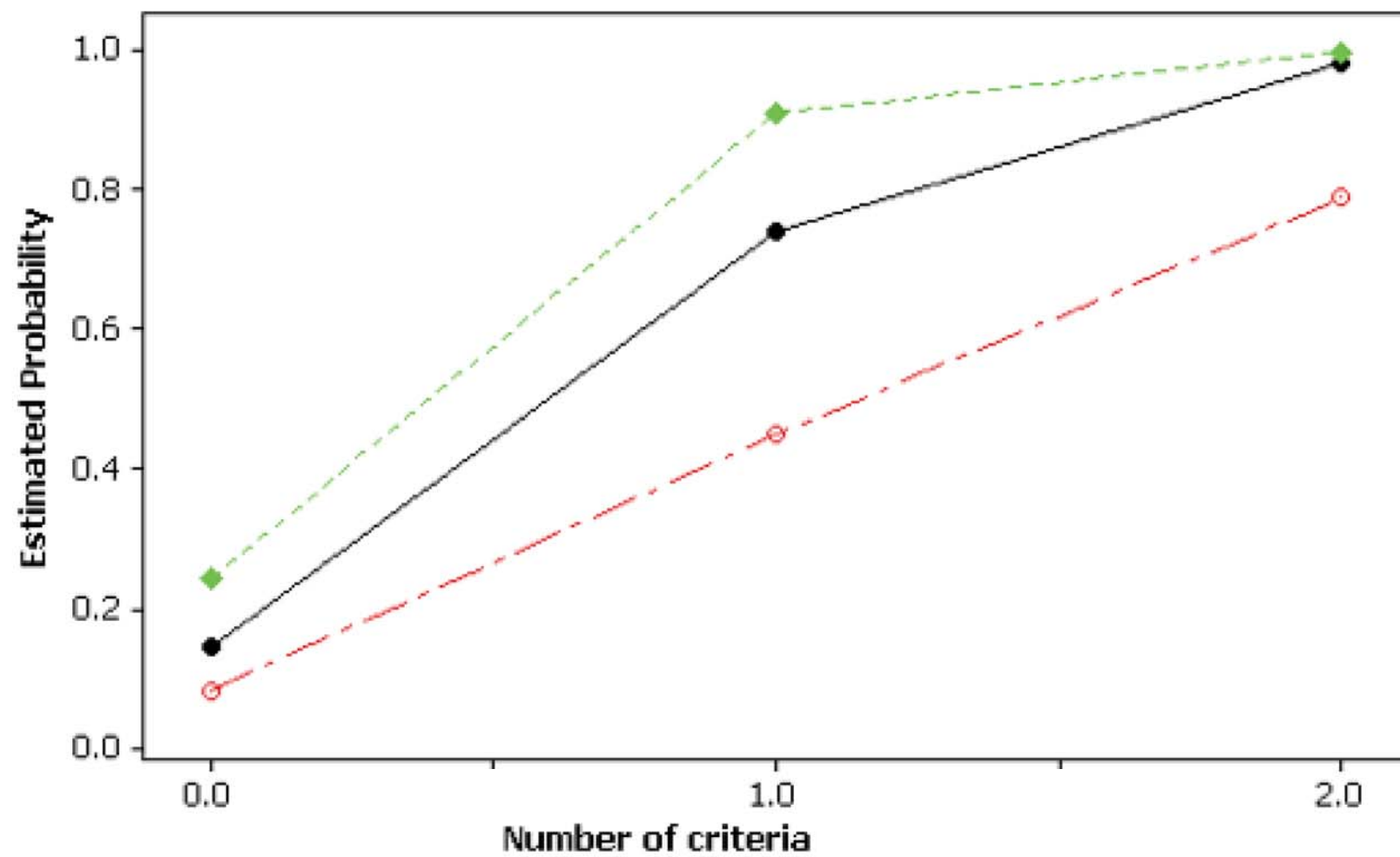
# Proposed criteria

Proposed Intestinal transplant criteria	Odds ratio	95% CI	p-value
>2 admissions to ICU	23.6	2.7 – 209.8	0.0001
Loss of >3 CVC sites	33.3	18.8 – 54.0	0.0003
Persistent elevation of conjugated bilirubin ( $\geq 75 \mu\text{mol/L}$ ) following 6 wks of lipid strategies	24.0	3.2 – 302.7	0.0003

Proposed Intestinal transplant criteria	PPV	NPV	Sensitivity	Specificity
>2 admissions to ICU	86	80	26	98
Loss of >3 CVC sites	100	78	17	100
Persistent elevation of conjugated bilirubin ( $\geq 75 \mu\text{mol/L}$ ) following 6 wks of lipid strategies	75	89	67	92



Predicted Probability of Poor Outcome vs Number of Criteria



# Proposed listing indications for Pediatric Intestinal Transplantation

- $\geq 2$  admissions to ICU<sup>⌘</sup>
- Loss of  $\geq 3$  central venous catheter sites<sup>★</sup>
- Persistent elevation of conjugated bilirubin ( $\geq 75 \mu\text{mol/L}$ ) following 6 weeks of lipid strategies
- Frequent episodes of dehydration
- Poor quality of life

## Legend:

<sup>⌘</sup> More than 2 admissions to pediatric intensive care unit that were not related to post-surgical recovery or initial NICU stay.

<sup>★</sup> Documented radiological evidence on ultrasound or CT of vascular system of occlusive clot formation at a site used for central vein catheterization (right and left internal jugular vein, right and left subclavian vein, right and left femoral veins).

# Controversies in Pediatric Intestinal Transplant Criteria

- Listing for congenital diarrheas syndromes
- Listing for declining vascular access
- Listing for non cholestatic IFALD in the era of intravenous fish oil
- Listing for poor quality of life