

# Enhancement of MELD

W. Ray Kim, MD  
Mayo Clinic College of Medicine  
Rochester, MN

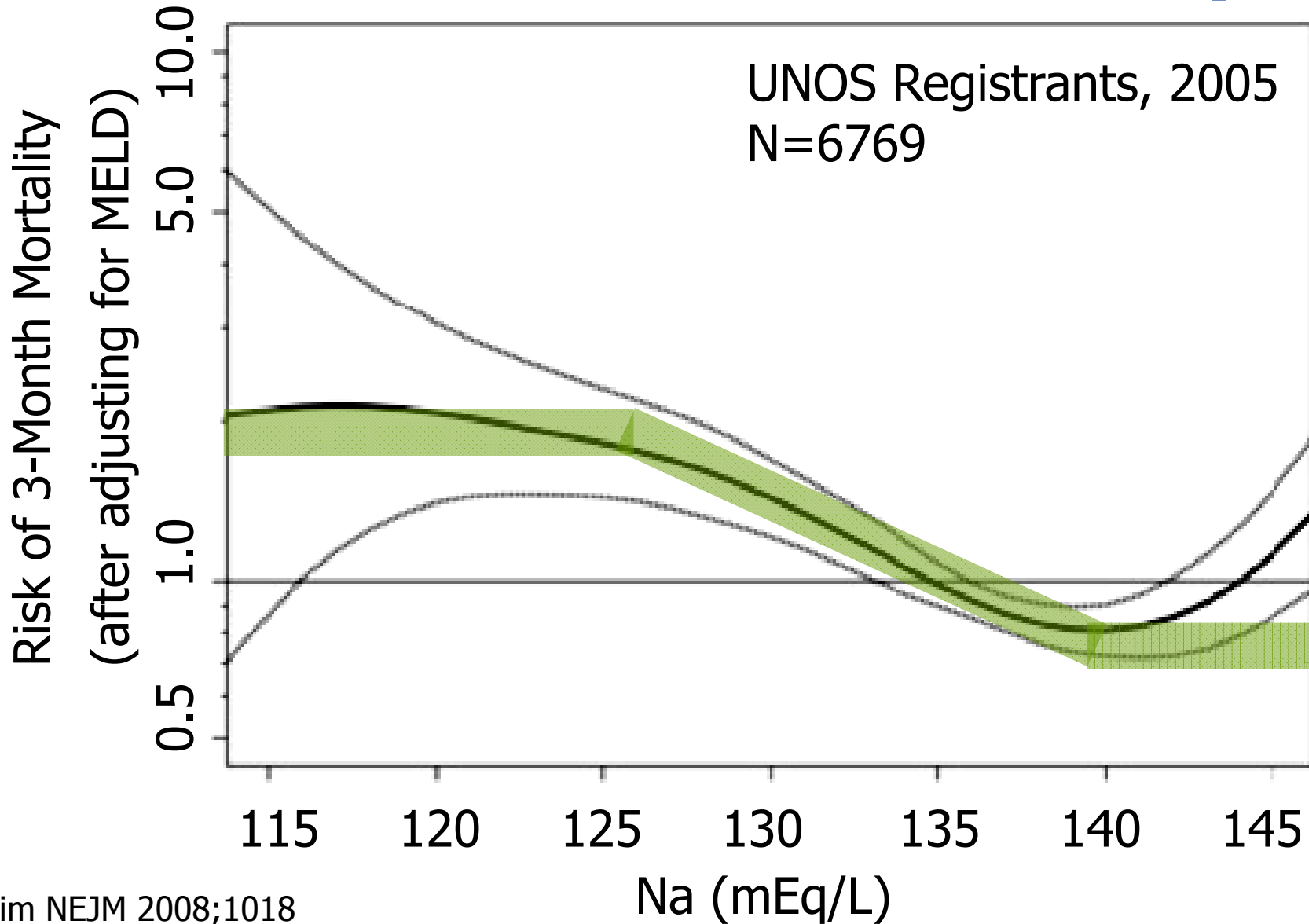


Plummer Building, Rochester, MN

# Agenda

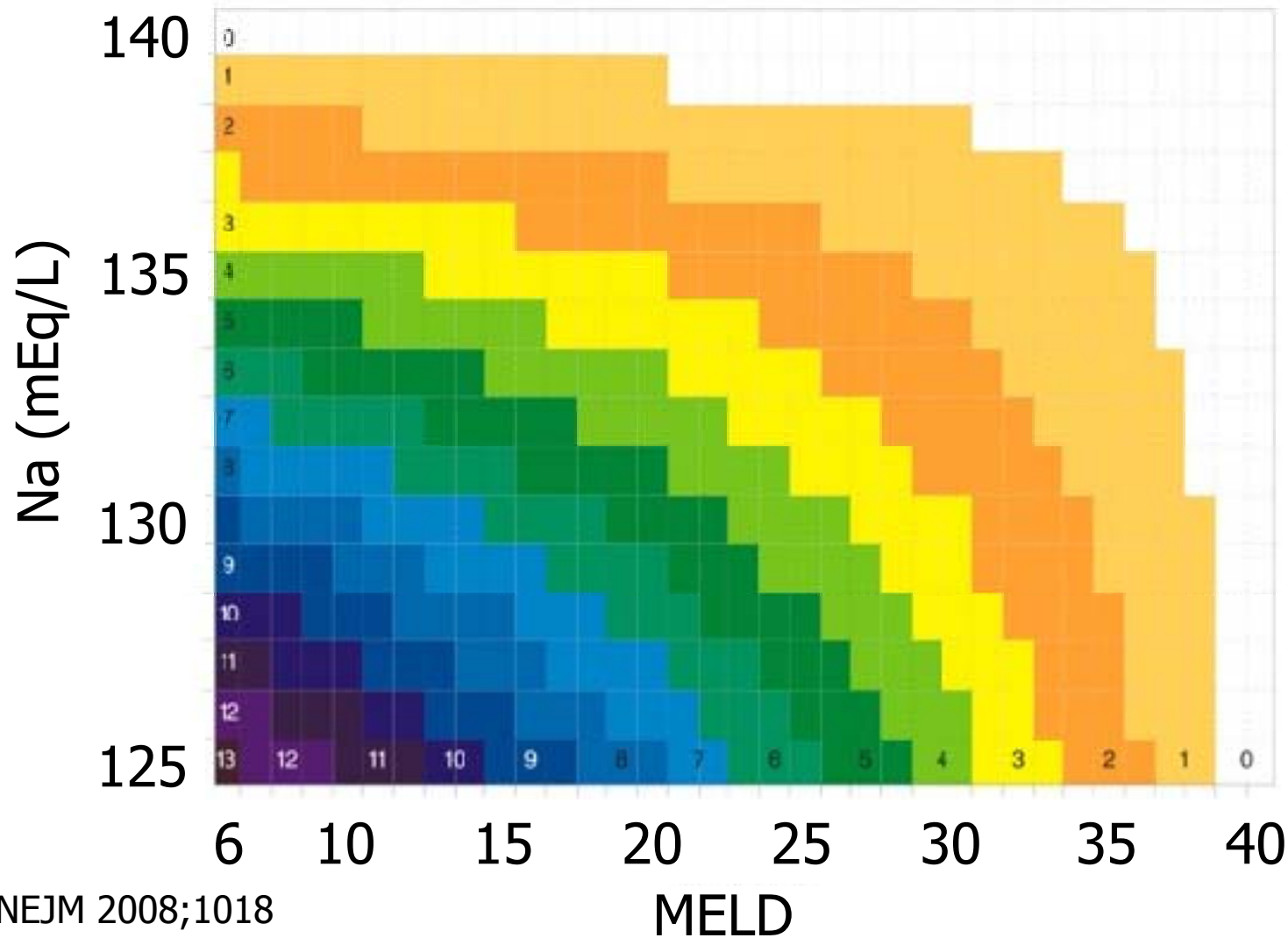
- How to make MELD better
  - As an indicator of pretransplant mortality
    - Add more variable(s): MELDNa
    - Optimize model: Refit MELD
  - As an indicator of posttransplant outcome
- Limitations

# Serum Sodium and Mortality

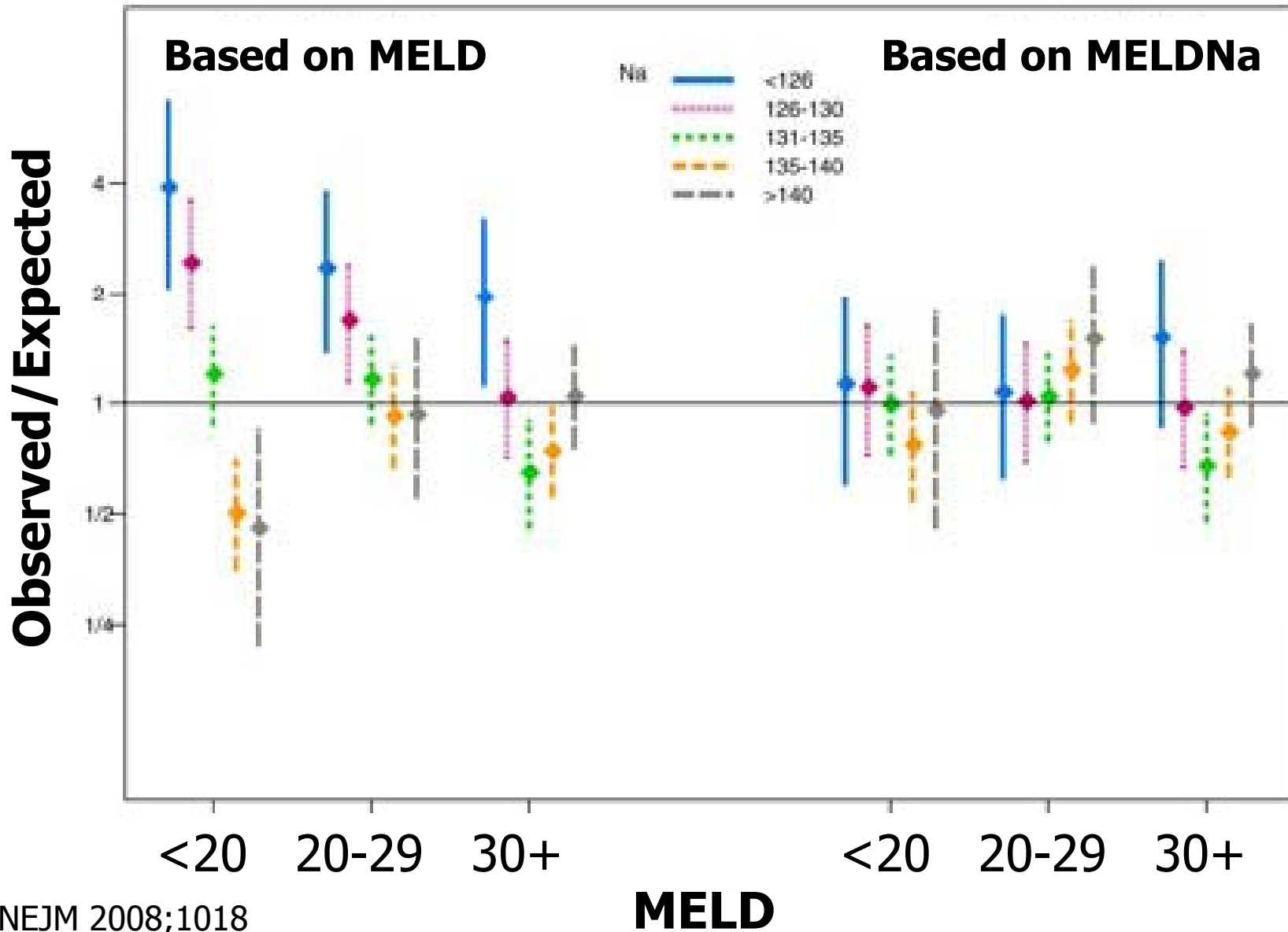


# MELDNa: Incorporating Na to MELD

$$\text{MELDNa} = \text{MELD} - \text{Na} - 0.025 * \text{MELD} * (140 - \text{Na}) + 140$$



# Validation: MELDNa vs MELD



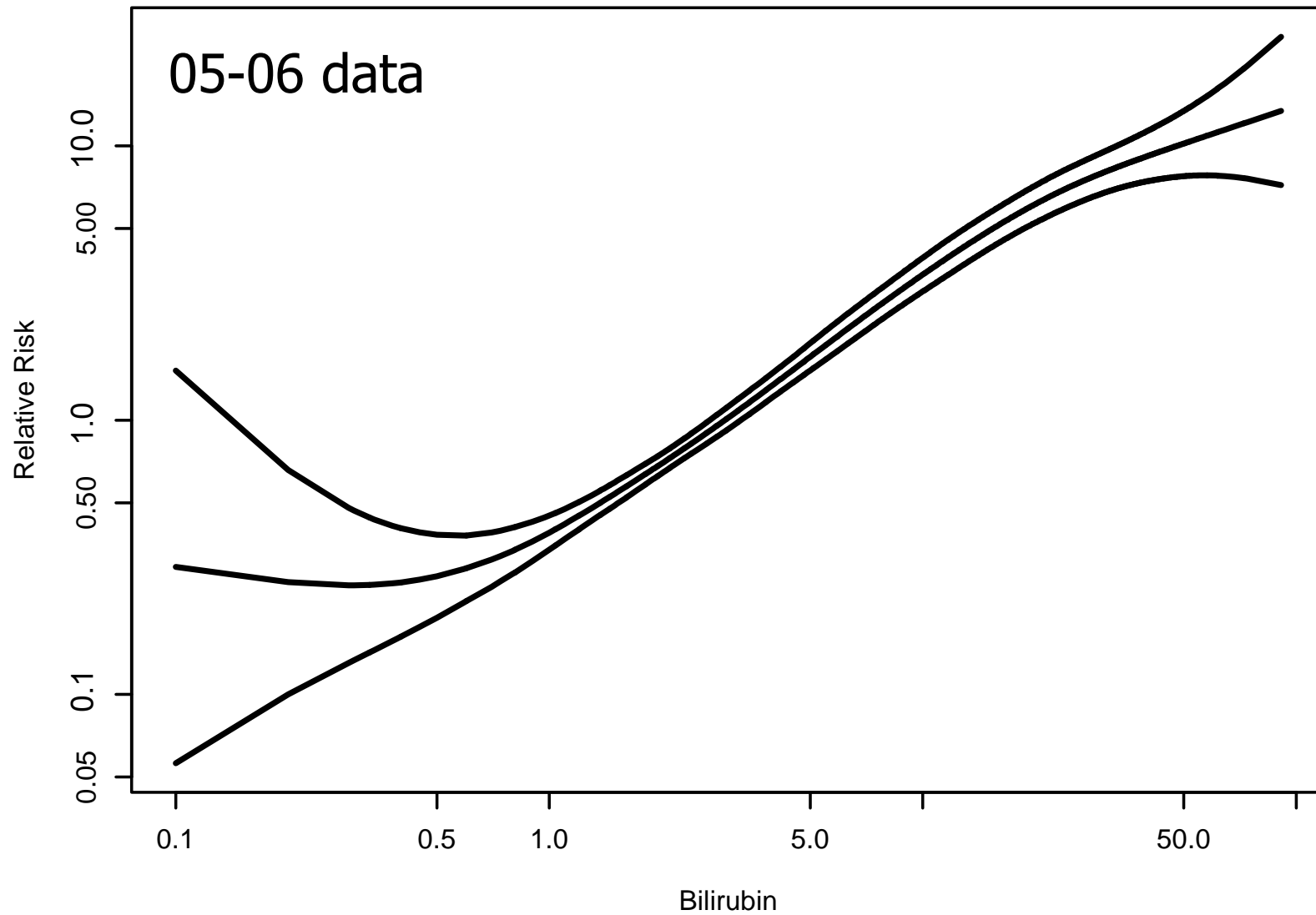
# Refitting Coefficients

## Methods

- Waitlist data obtained from OPTN from 2005-2008:
  - Model derivation set (05-06): n=14,214
  - Model validation set (07-08): n=13,945
- All adult, primary LTx candidates with end stage liver disease included (HCC and status 1 excluded)
- The proportional hazards regression analysis predicting mortality within 90 days of listing
  - Define lower and upper bounds
  - Optimize coefficients
  - Bilirubin, Creatinine, INR, and Na

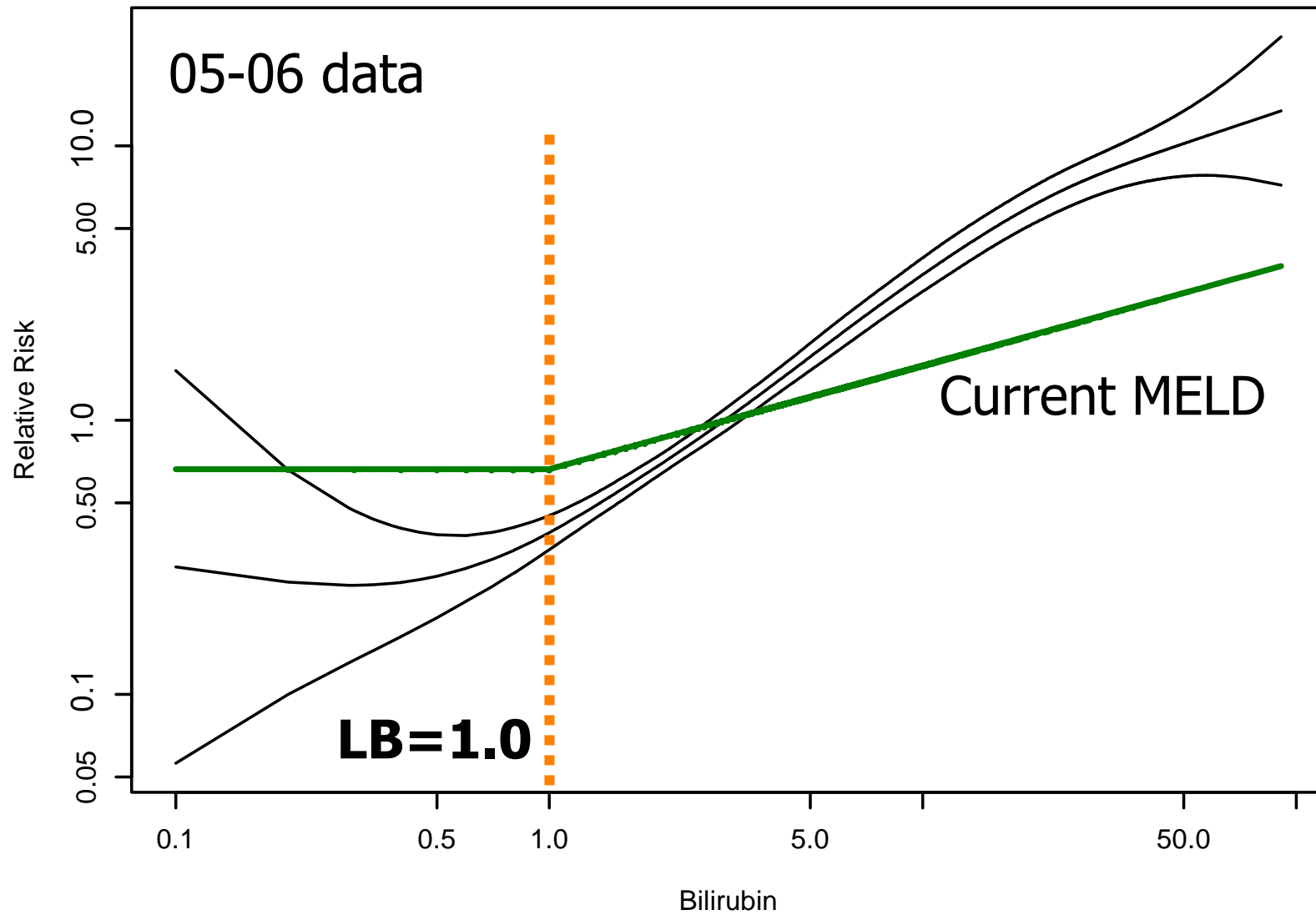
# Bilirubin

Adjusted for creatinine and INR



# Bilirubin

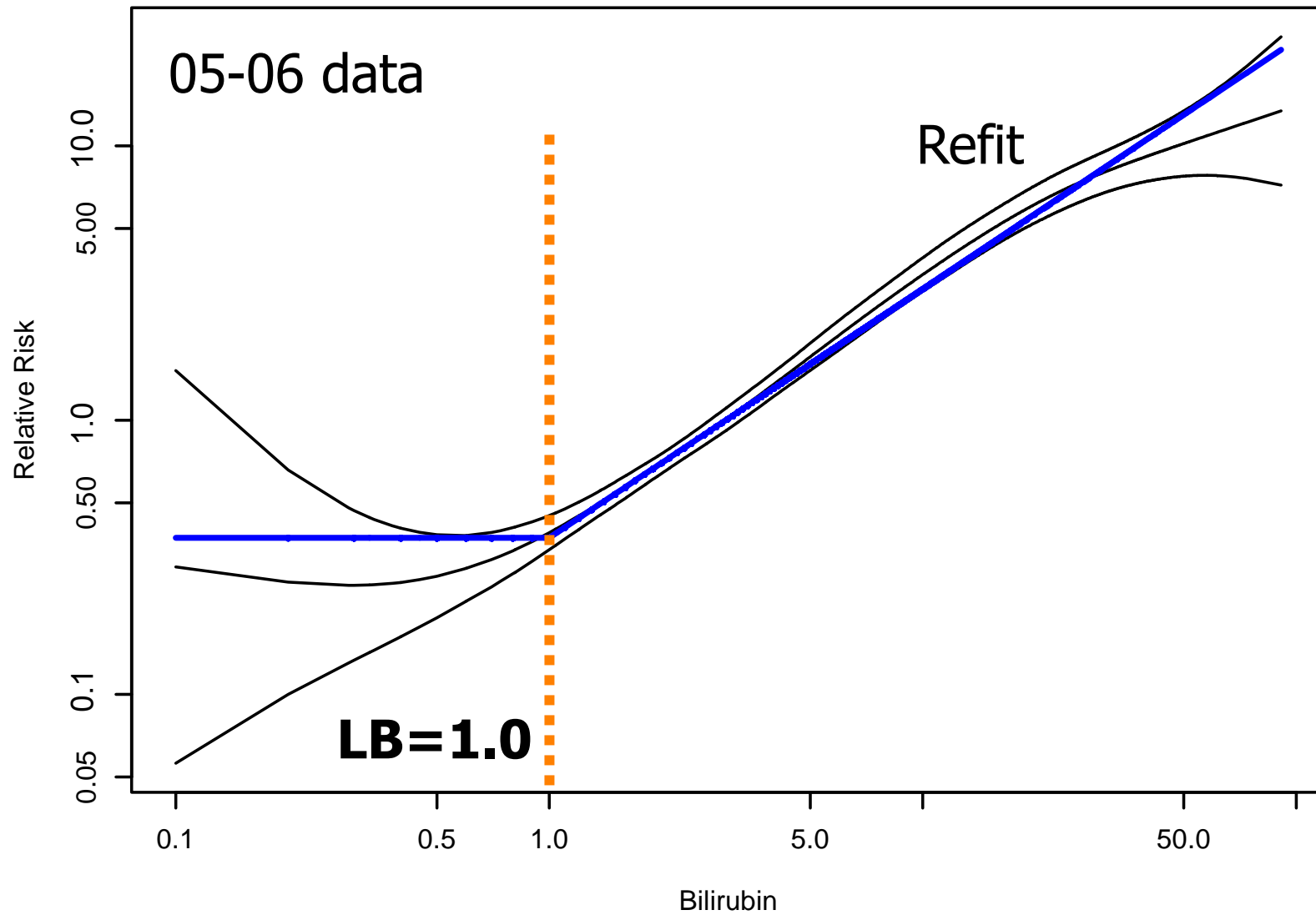
Adjusted for creatinine and INR





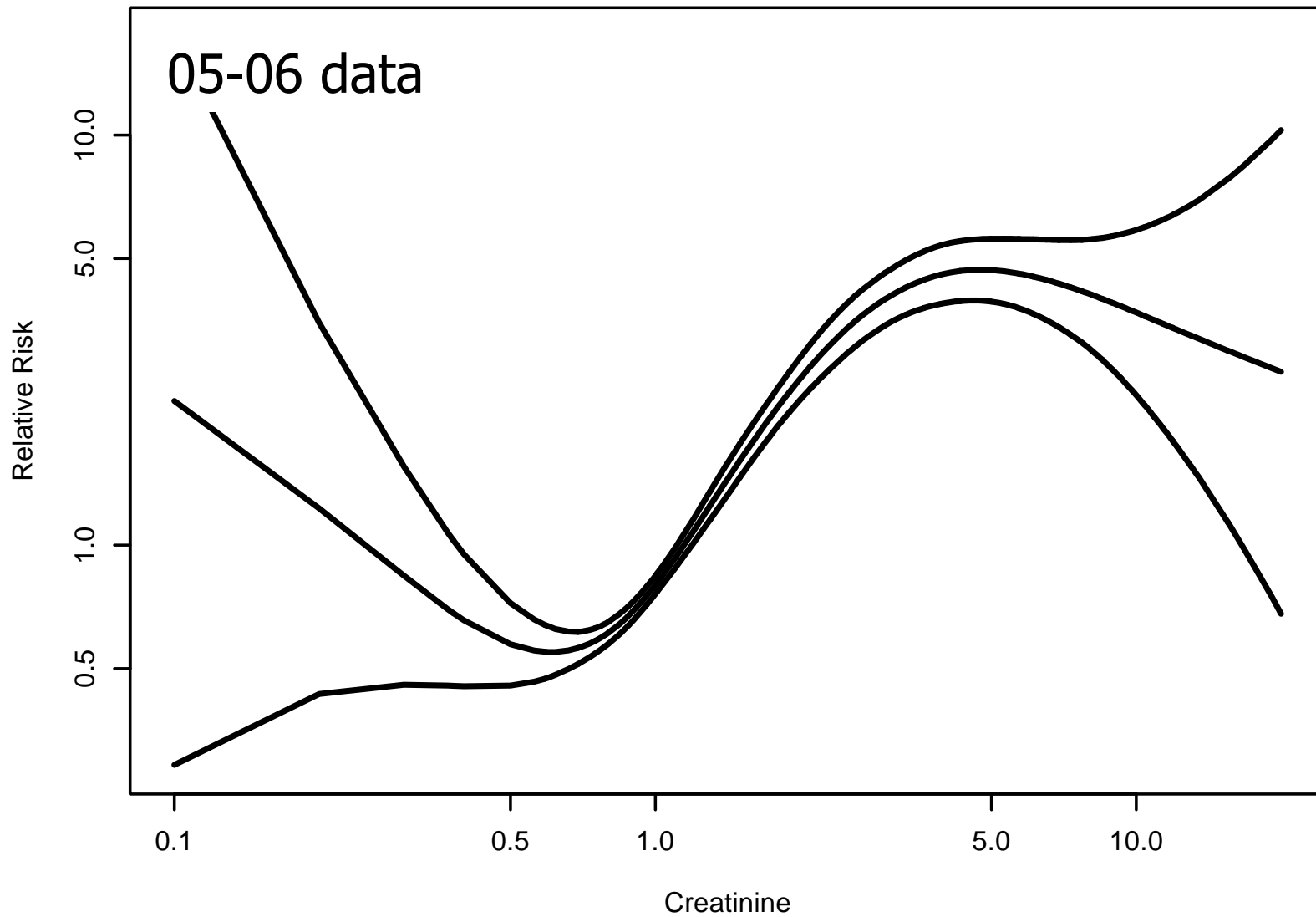
# Bilirubin

Adjusted for creatinine and INR



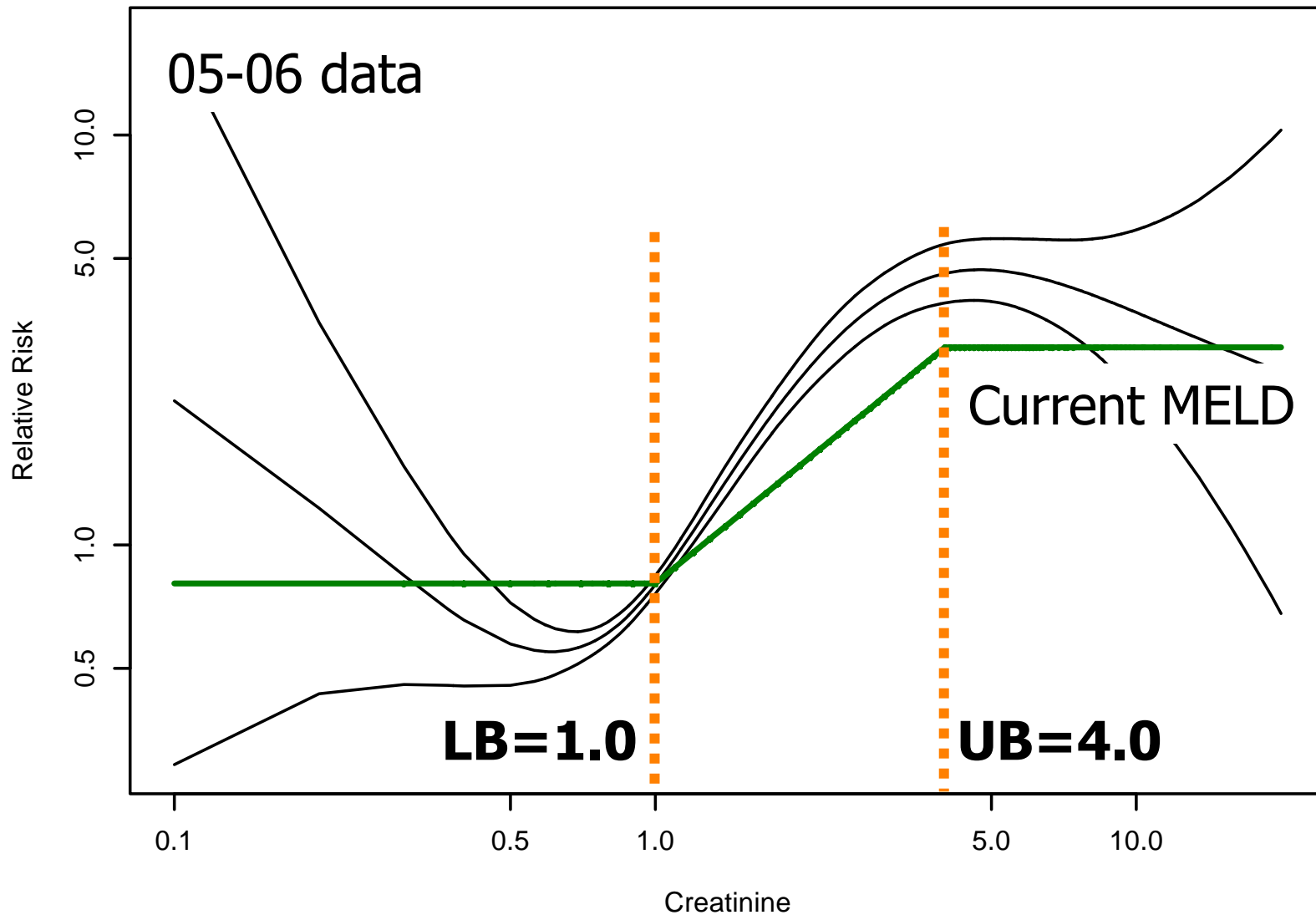
# Creatinine

Adjusted for bilirubin and INR



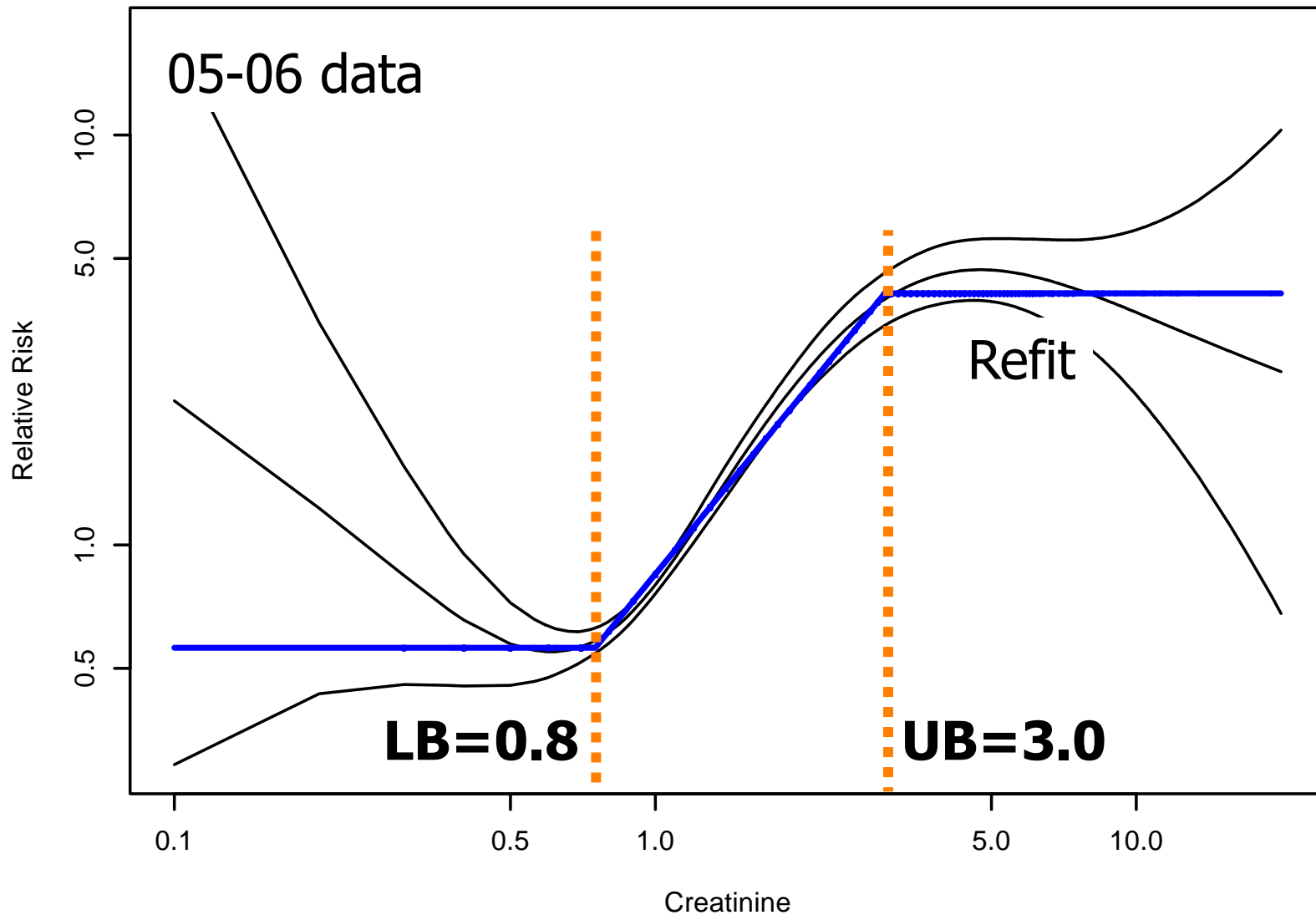
# Creatinine

Adjusted for bilirubin and INR



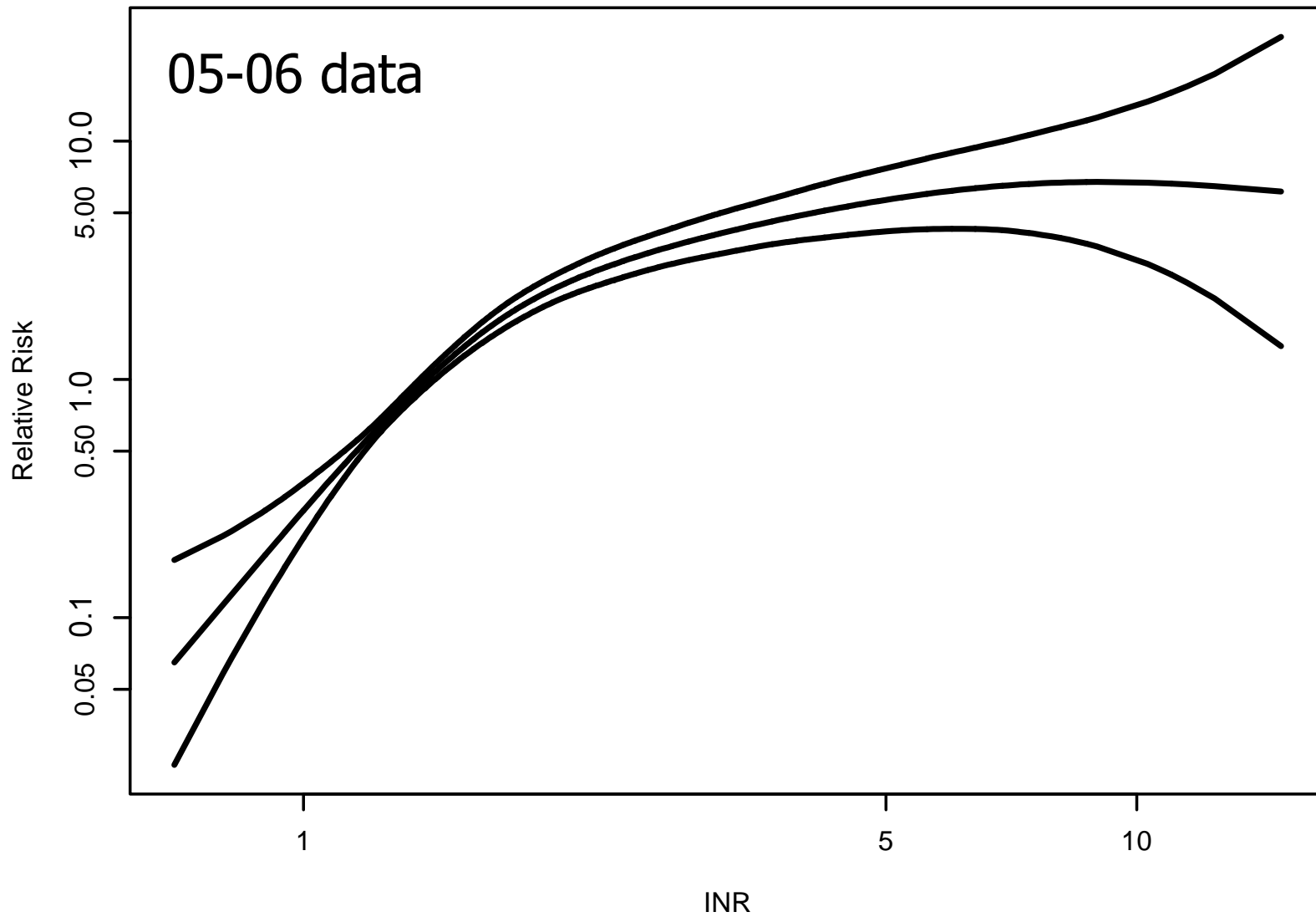
# Creatinine

Adjusted for bilirubin and INR



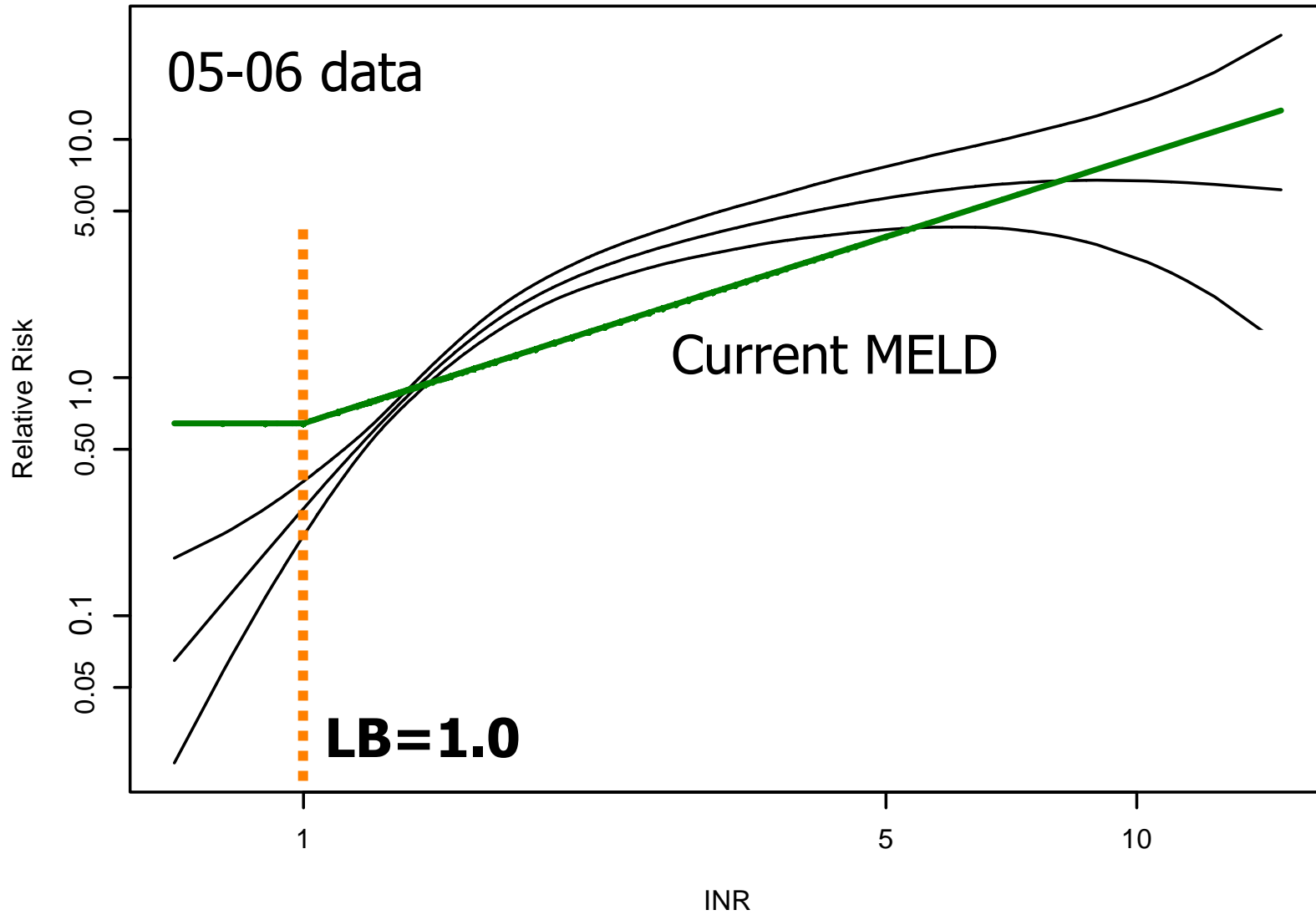
# INR

Adjusted for bilirubin and creatinine



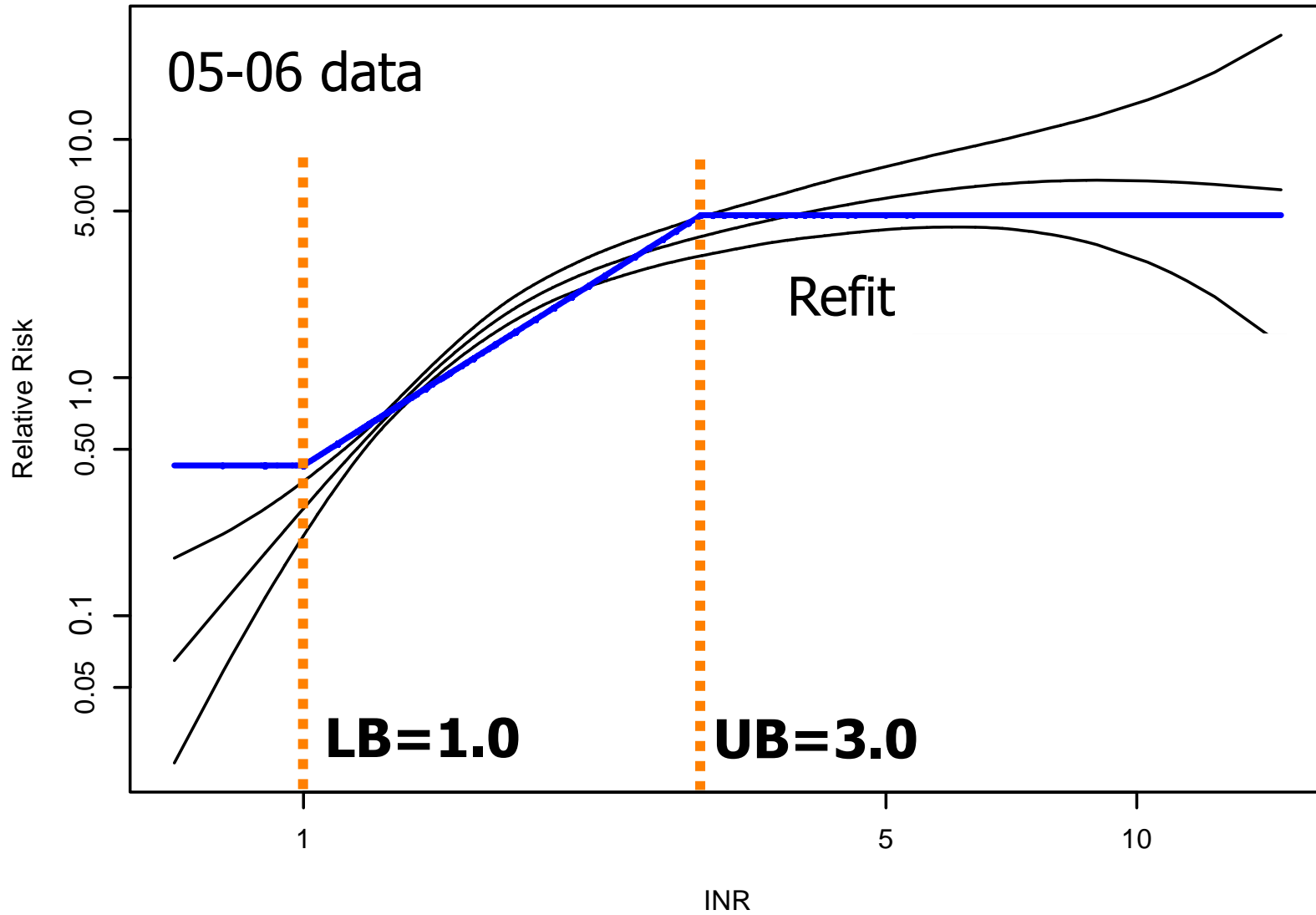
# INR

Adjusted for bilirubin and creatinine



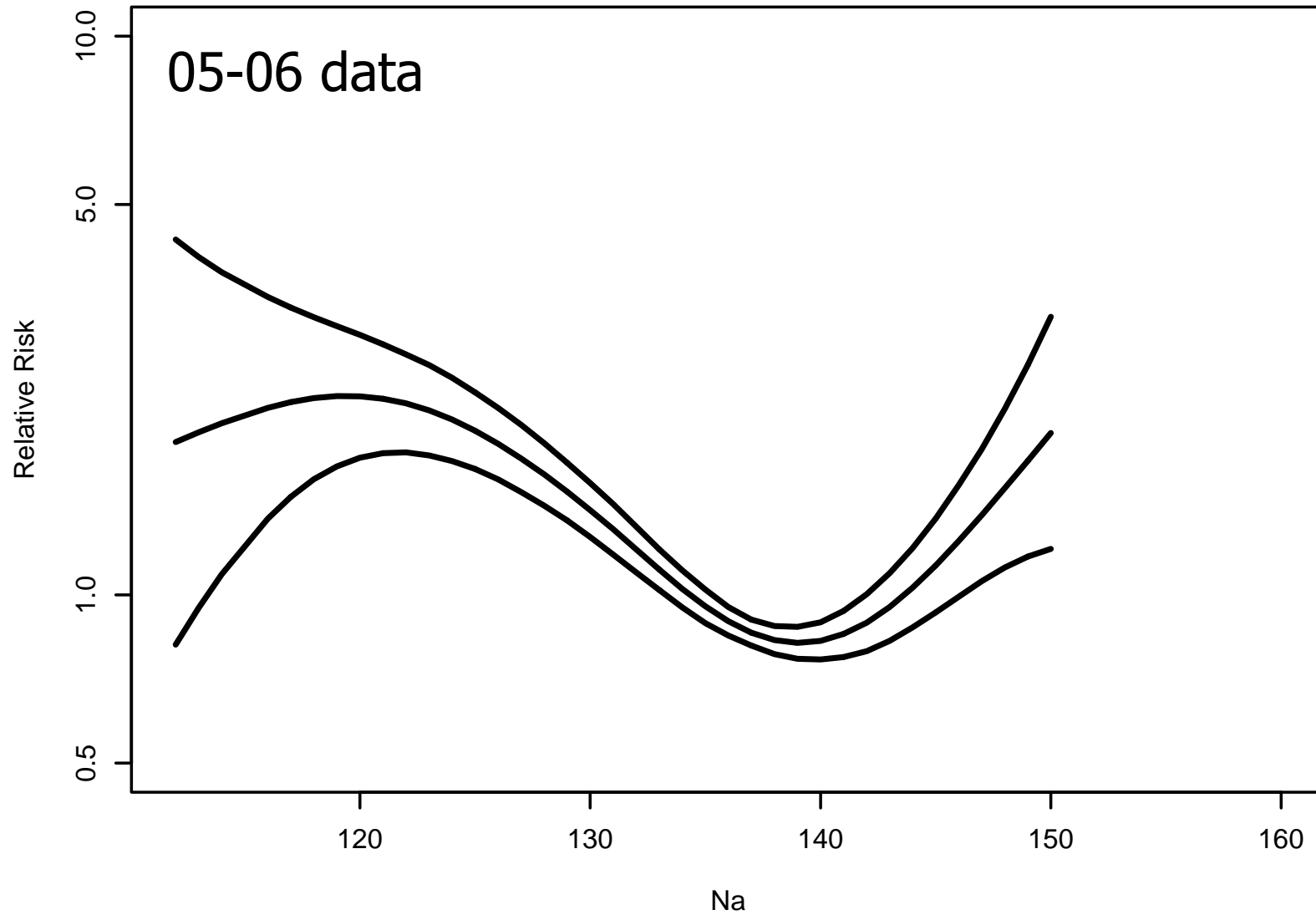
# INR

Adjusted for bilirubin and creatinine



# Sodium

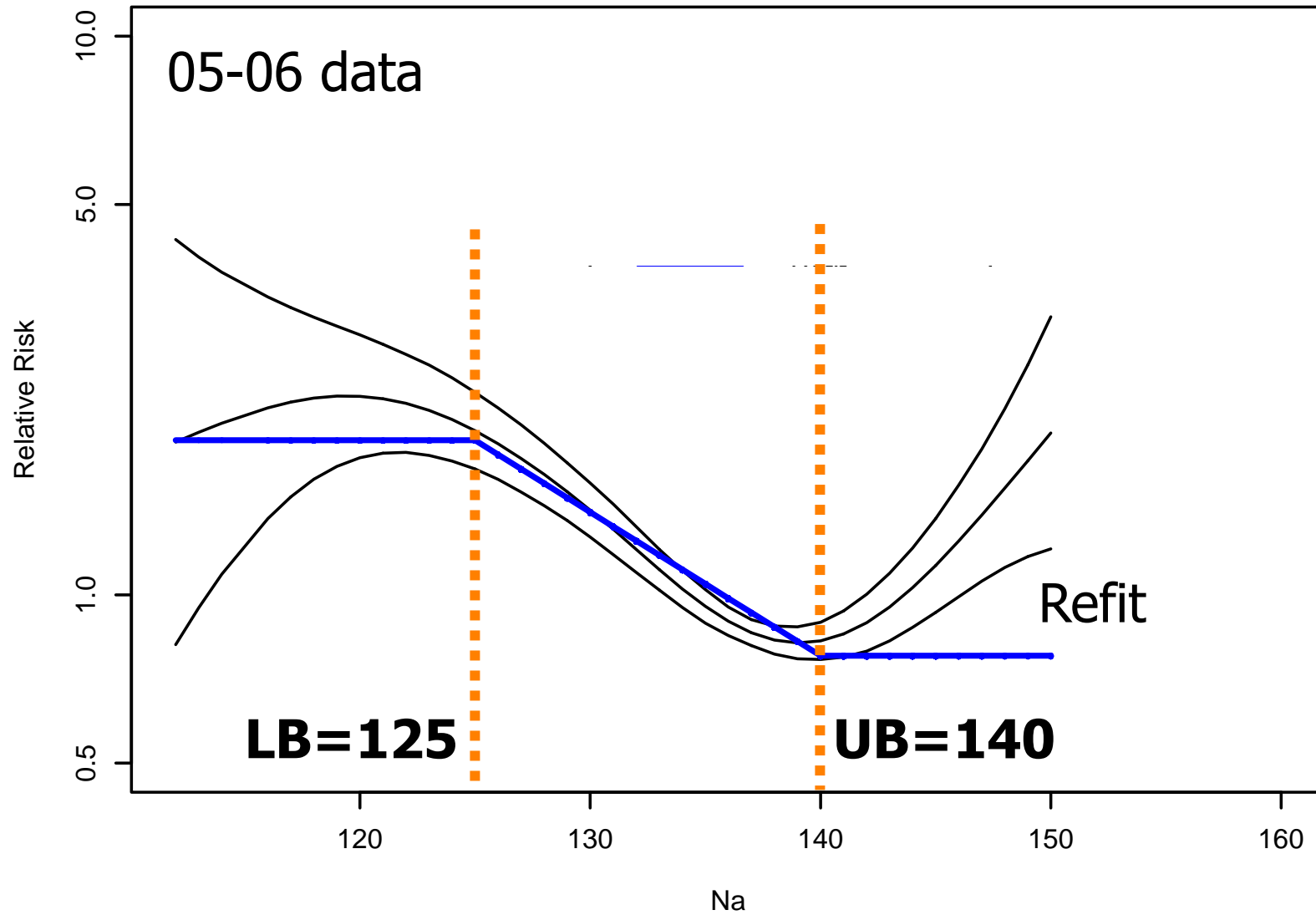
Adjusted for bilirubin, creatinine and INR





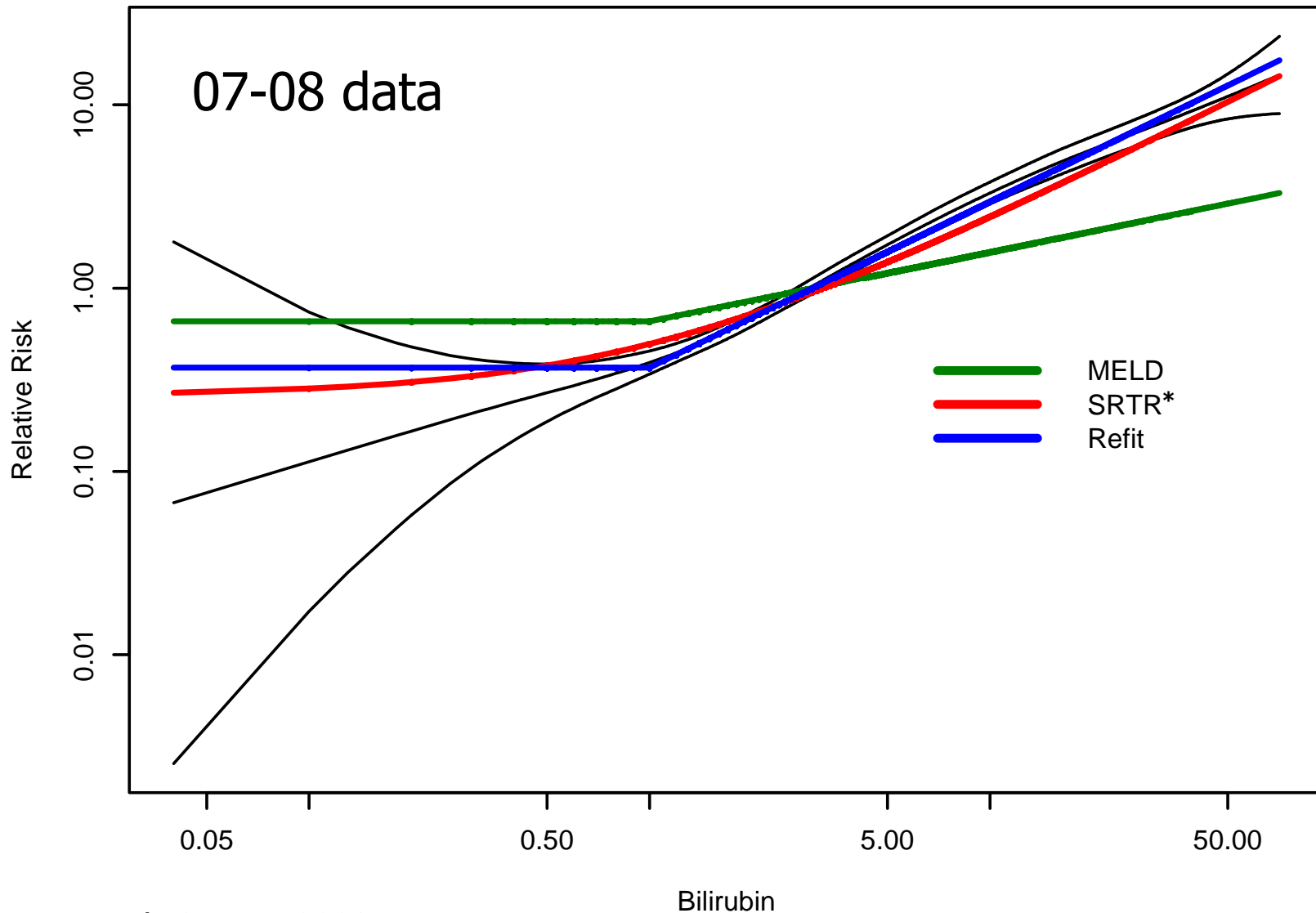
# Sodium

Adjusted for bilirubin, creatinine and INR



# Validation: Bilirubin

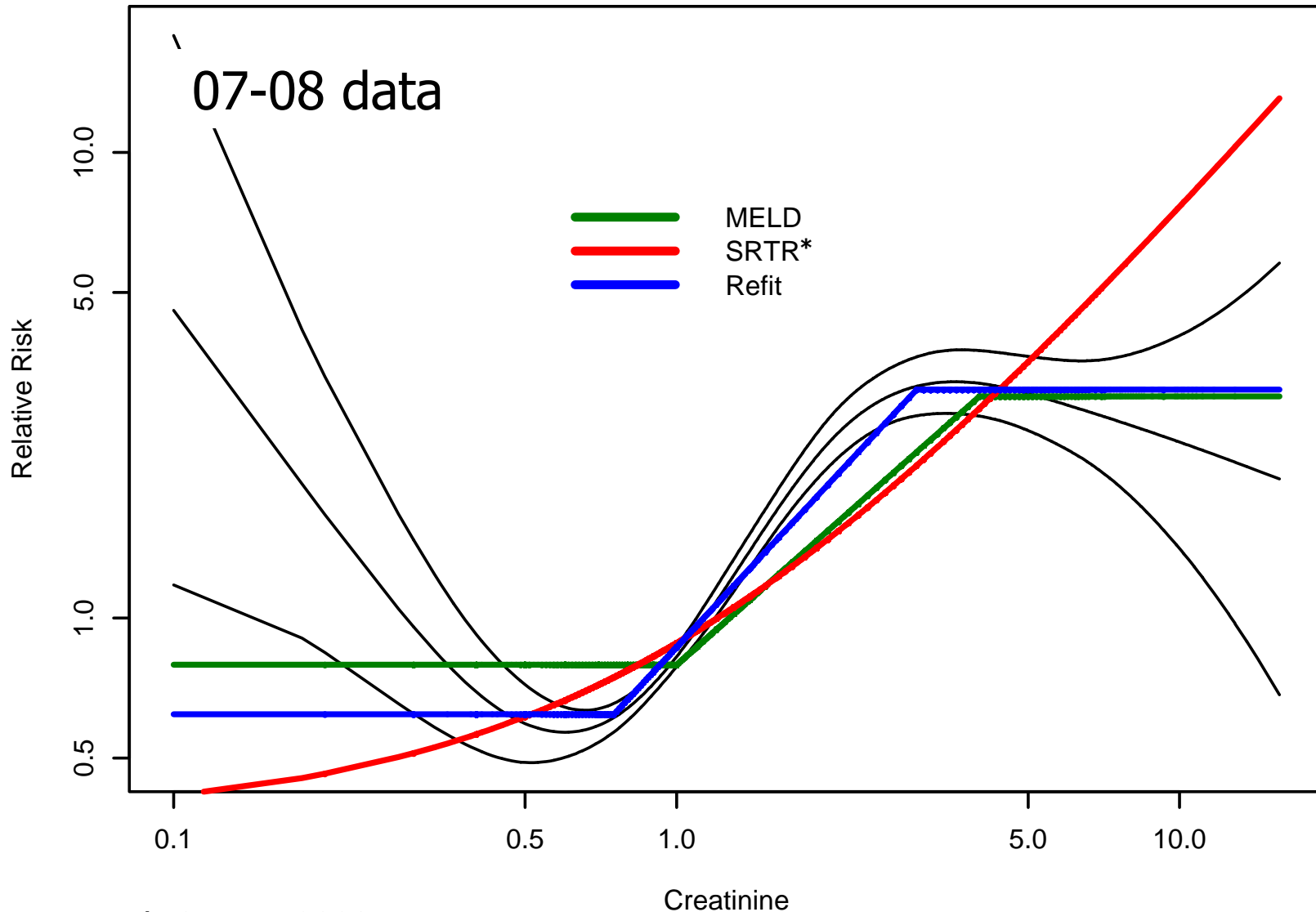
Adjusted for creatinine and INR



\*Sharma et al. Gastro. 2008;1575

# Validation: Creatinine

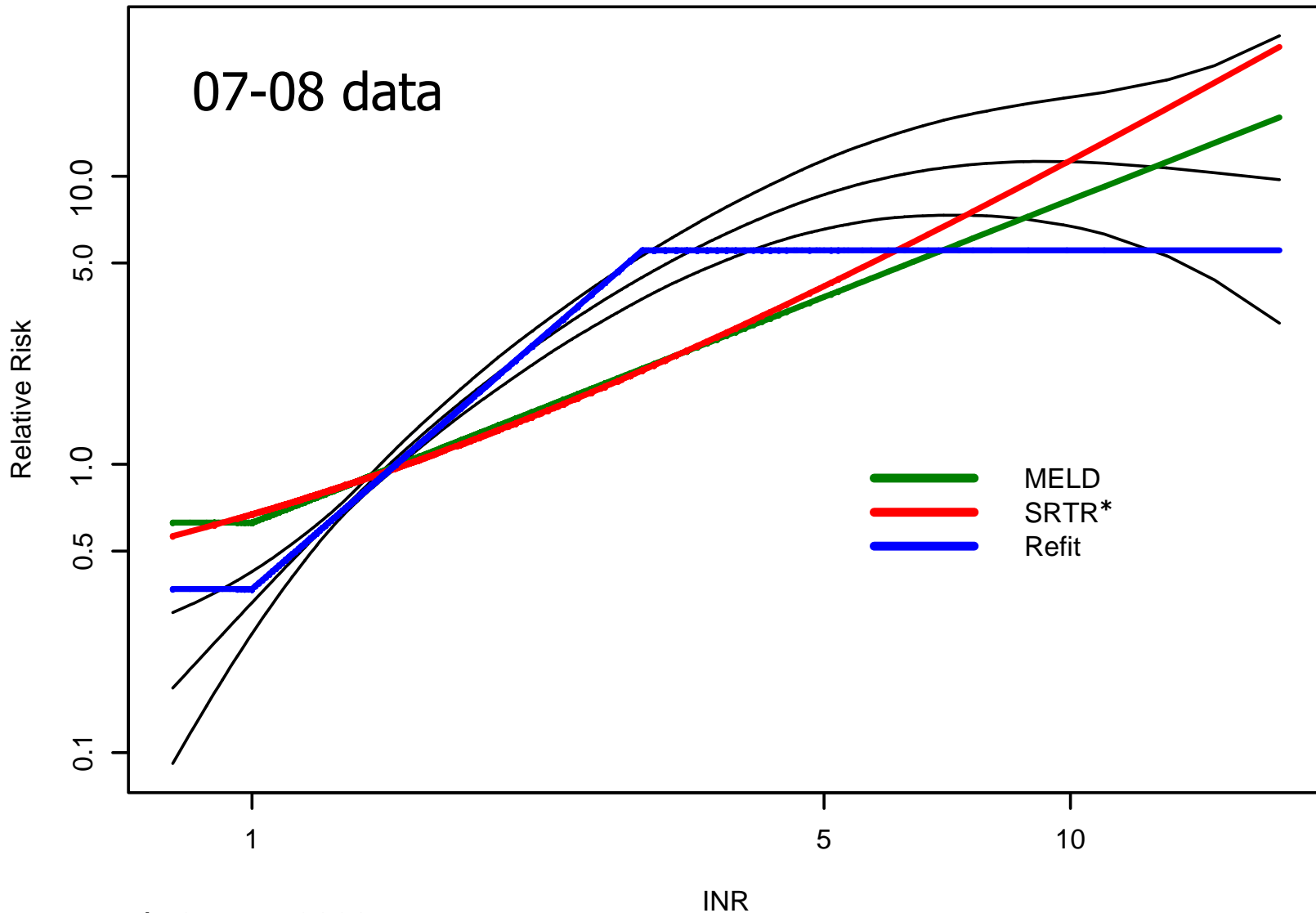
Adjusted for bilirubin and INR



\*Sharma et al. Gastro. 2008;1575

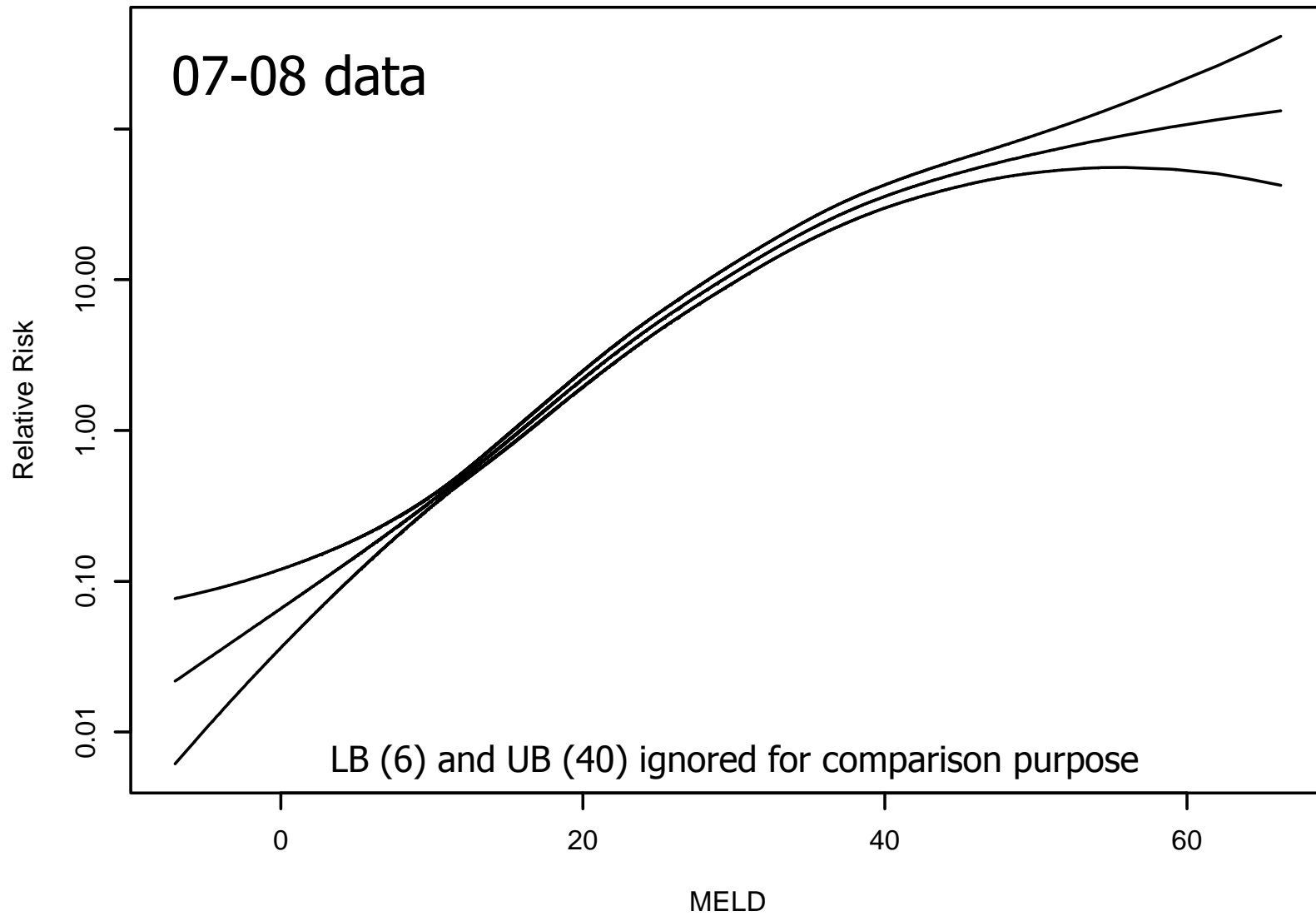
# Validation: INR

Adjusted for bilirubin and creatinine

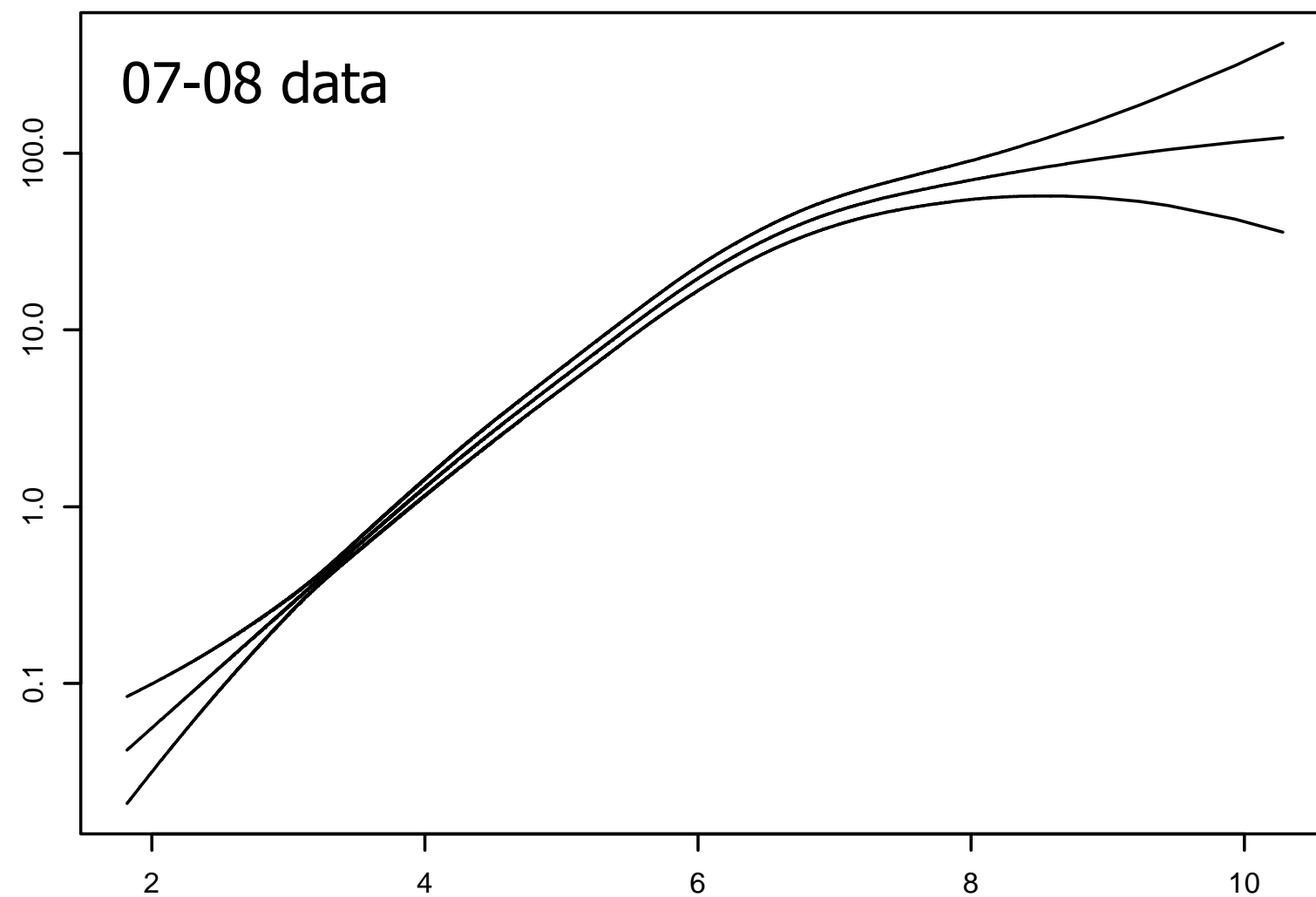


\*Sharma et al. Gastro. 2008;1575

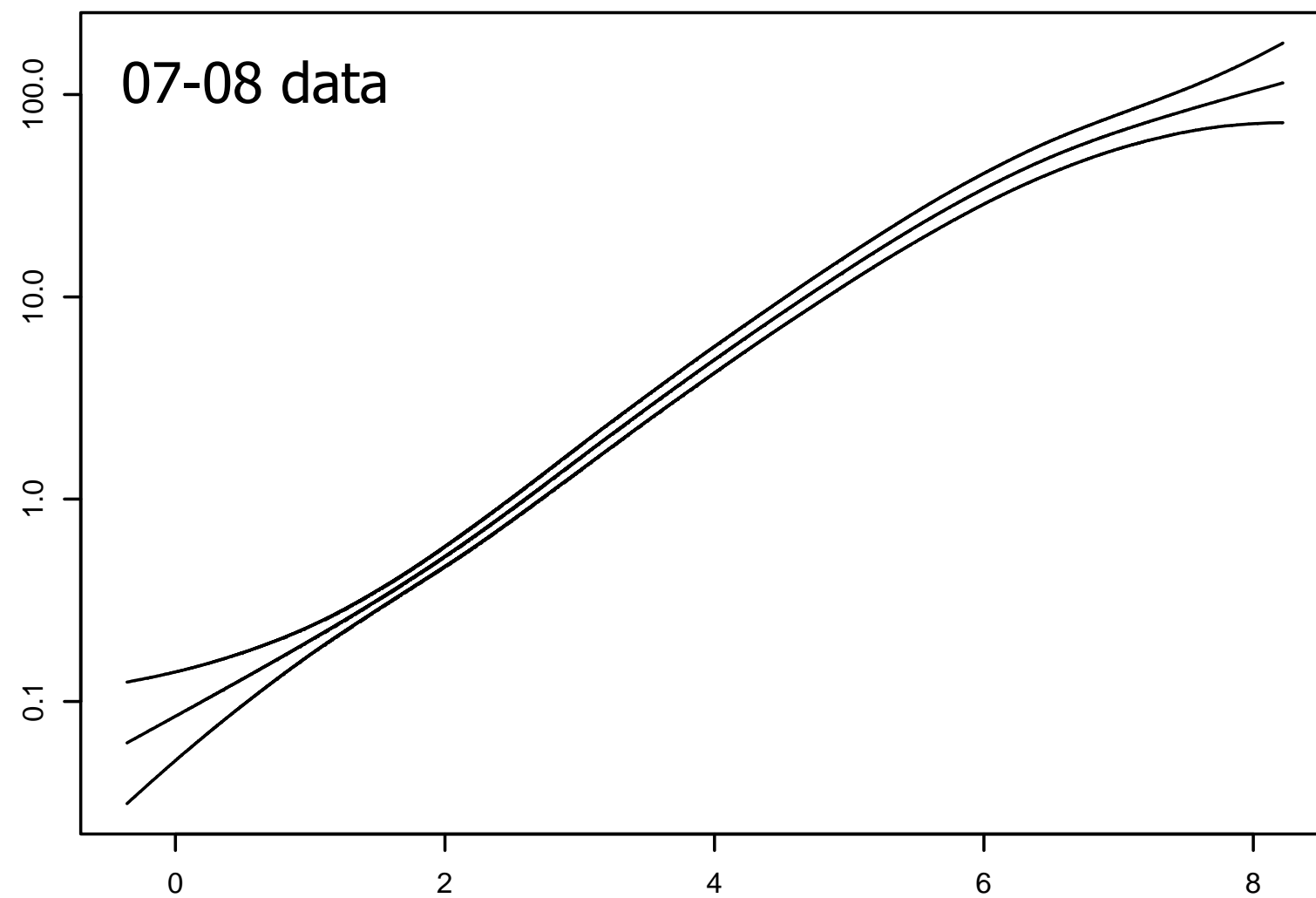
# Validation: MELD



# Validation: SRTR MELD



# Validation: Refit MELD(Na)



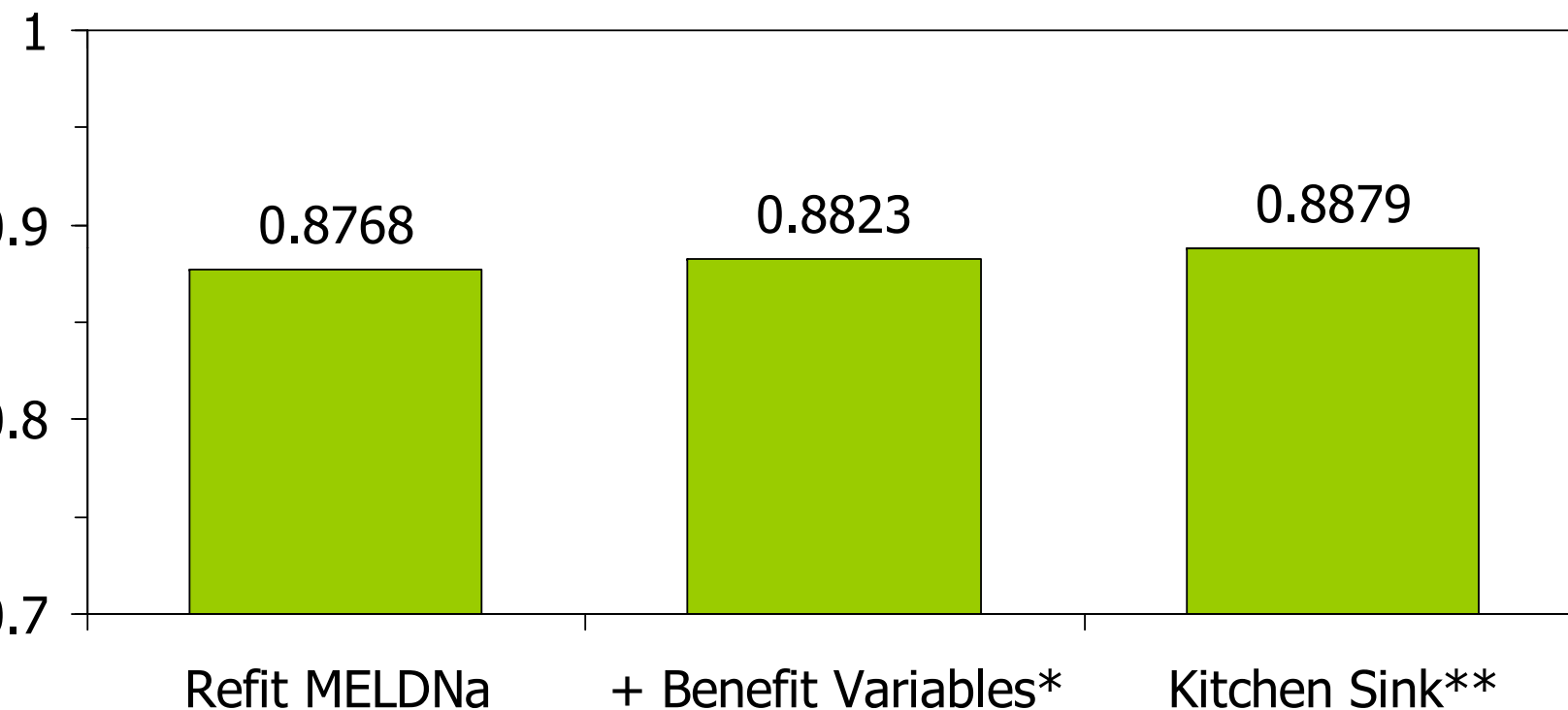
## The Bottom Line

Validation Set (2007-2008)	Model Chi-Square	Concordance (SE)
D	2263	0.8653 (0.0062)
R MELD	2055 (-8)	0.8581 (0.0063)
DNa	2370 (+7)	0.8758 (0.0059)
MELDNa	2374 (+11)	0.8768 (0.0058)



# 'Kitchen Sink' ≠ Crystal Ball

'supervised' incorporation of all potentially relevant variables



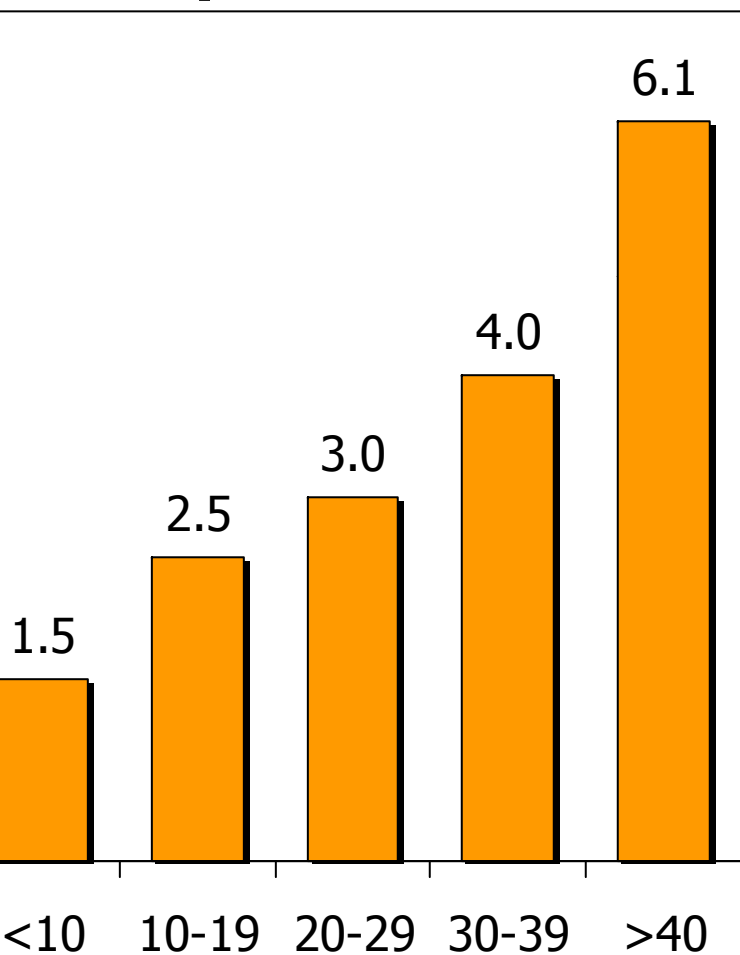
Variables: refit MELDNa, age, BMI, albumin, HCV, diabetes, prior malignancies

Variables: refit MELDNa, age, sex, race, albumin, HCV, HBV, diabetes, prior

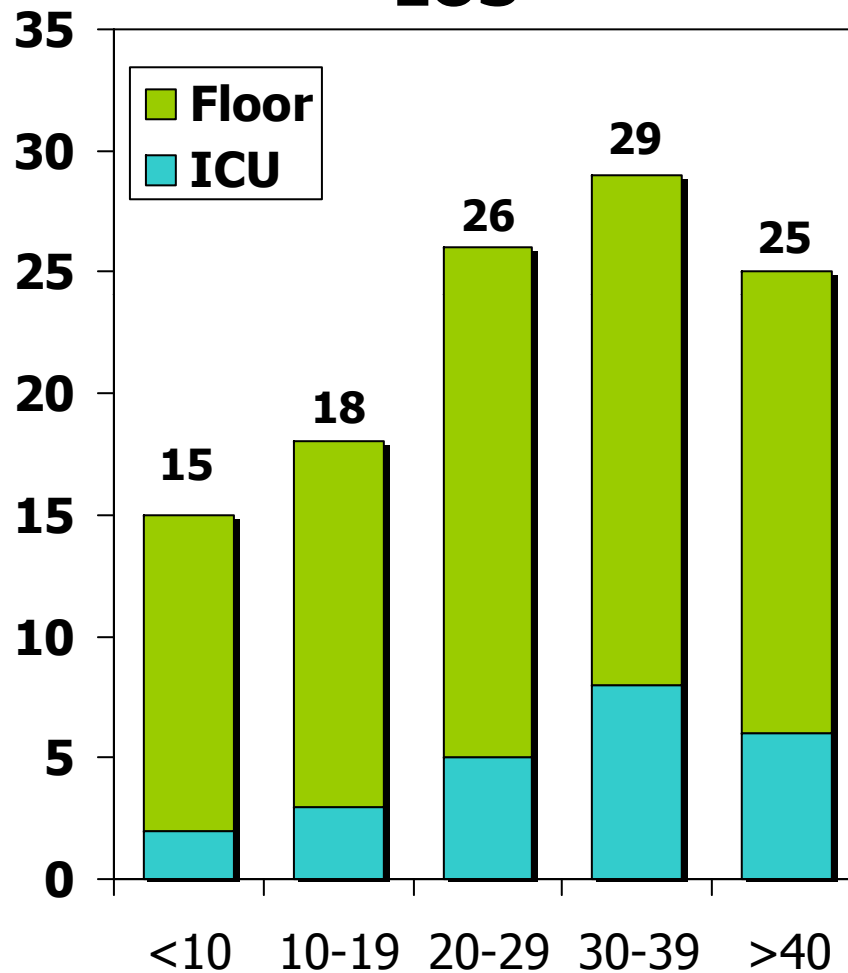
Variables: life support, encephalopathy, ascites, previous abdominal surgery

# MELD and Resource Utilization

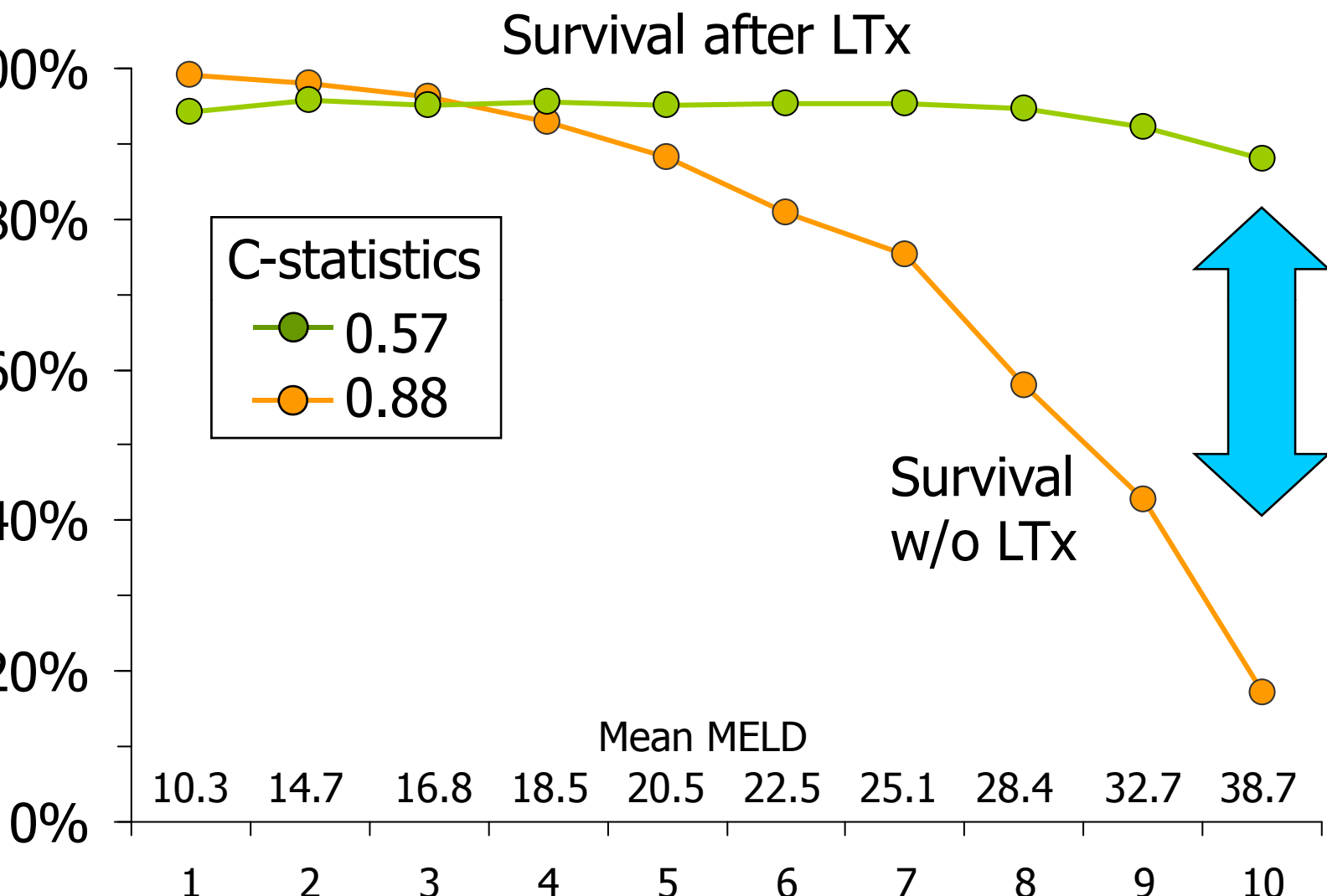
### pRBC



### LOS



# Transplant Benefit



## Conclusions

ways to improve prediction of waitlist mortality

- Add more variable: MELD Na
    - Represents a meaningful improvement
    - Big change in mortality in a subgroup of patients
  - Optimize model coefficients: Refit MELDNa
    - New upper and lower bounds:
      - Creatinine: 0.8-3.0
      - INR: 1.0-3.0
  - Limit to predictability
- MELD and post-transplant outcome
- Statistically significant impact on survival and resource utilization