Hepatic encephalopathy: Best practice and management

Jasmohan S Bajaj, MD
Division of Gastroenterology, Hepatology and Nutrition,
Virginia Commonwealth University and Richmond VA Medical Center,
Richmond, Virginia, USA

Outline

- Definition and Pathophysiology
- Overview of management and classification
- Covert/Minimal HE
- Inpatient therapy
- Prevention of recurrence
- Special situations
- Future management strategies

Definition of Hepatic Encephalopathy (HE)

- Hepatic encephalopathy is brain dysfunction caused by liver insufficiency and/or porto-systemic shunting
- It manifests as a wide spectrum of neurological/psychiatric abnormalities ranging from subclinical alterations to coma

AASLD EASL 2014 Guidelines Hepatol/*J Hepatol*.

Why should we care?

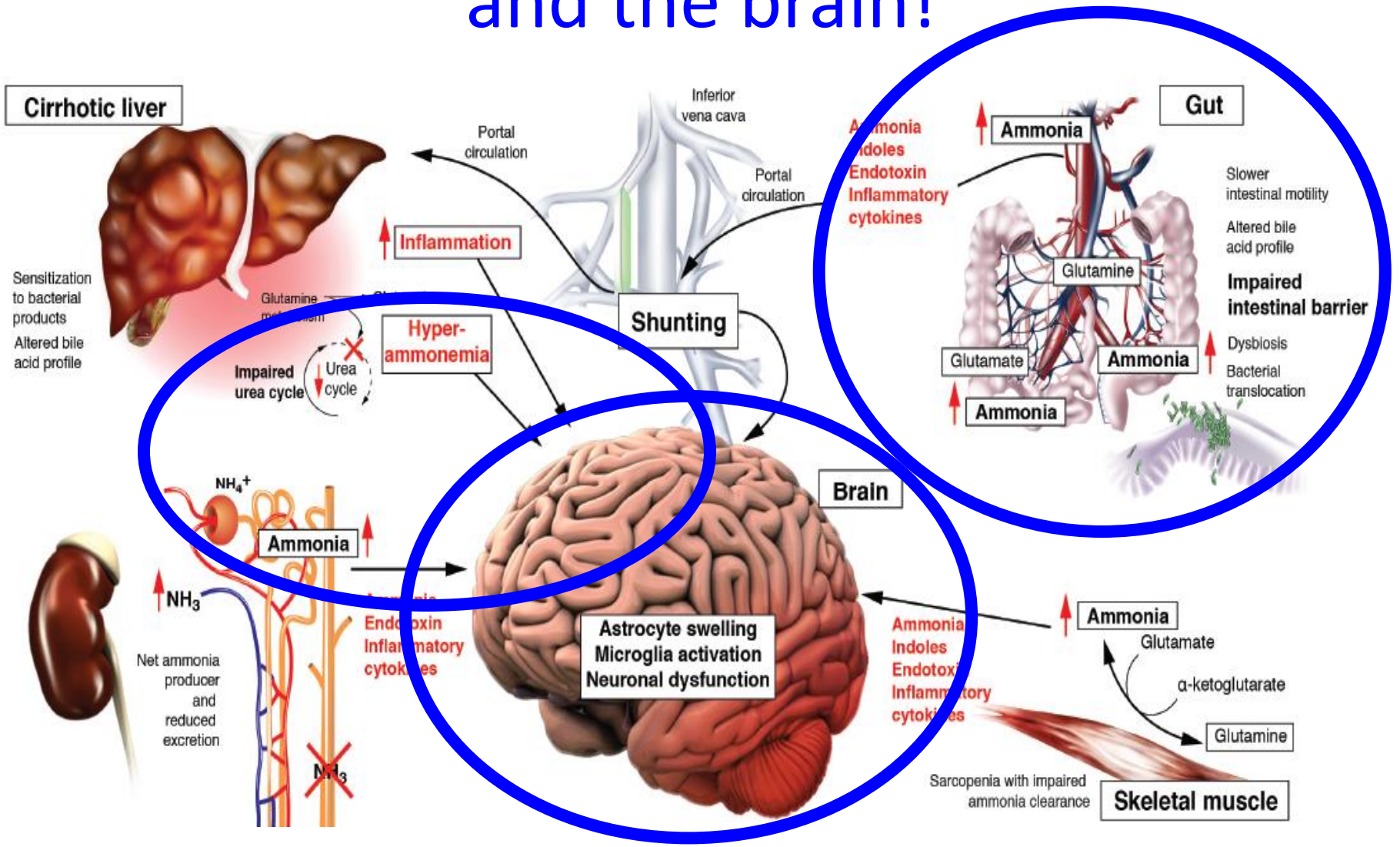
Comatose people with HE wake up after bowel movements!!

The best human model for the gut-brain axis in action!!!

The question is how and why?

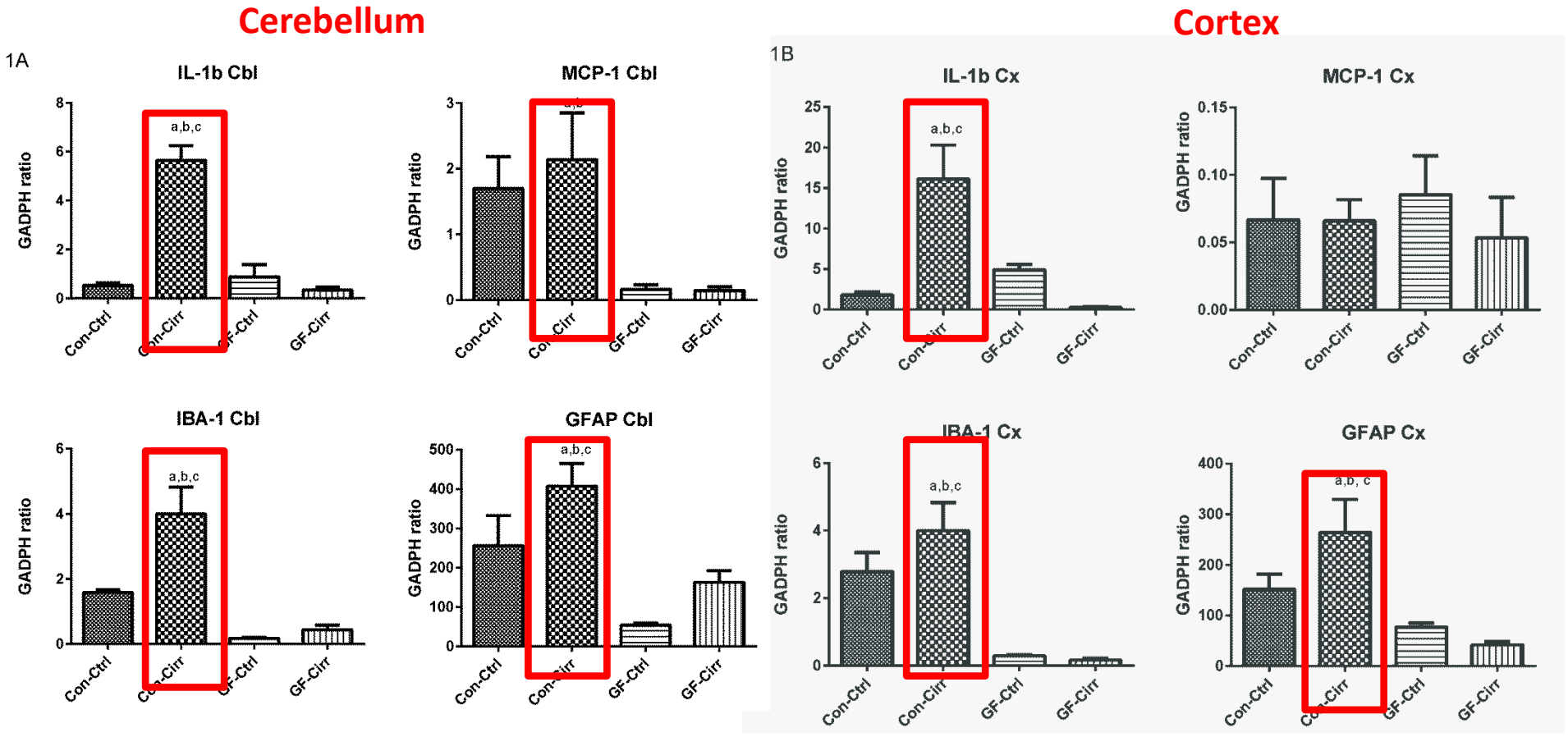
Bustamante et al J Hepatol 2009, Cordoba et al J Hepatol 2014, Bajaj et al CGH 2015, Bajaj et al Hepatol 2016, Rakoski et al Hepatol 2012, Volk et al Am J Gastro 2014, Bajaj et al Am J Gastro 2011, Ampuero et al Gastro 2014, Sanyal et al NEJM 2021

Pathophysiology of HE: not just the liver and the brain!



Bajaj JS Hepatology 2015, Dasarathy et al J Hepatol 2016

Gut microbiota are necessary for brain inflammation (microglial and glial) in cirrhotic mice

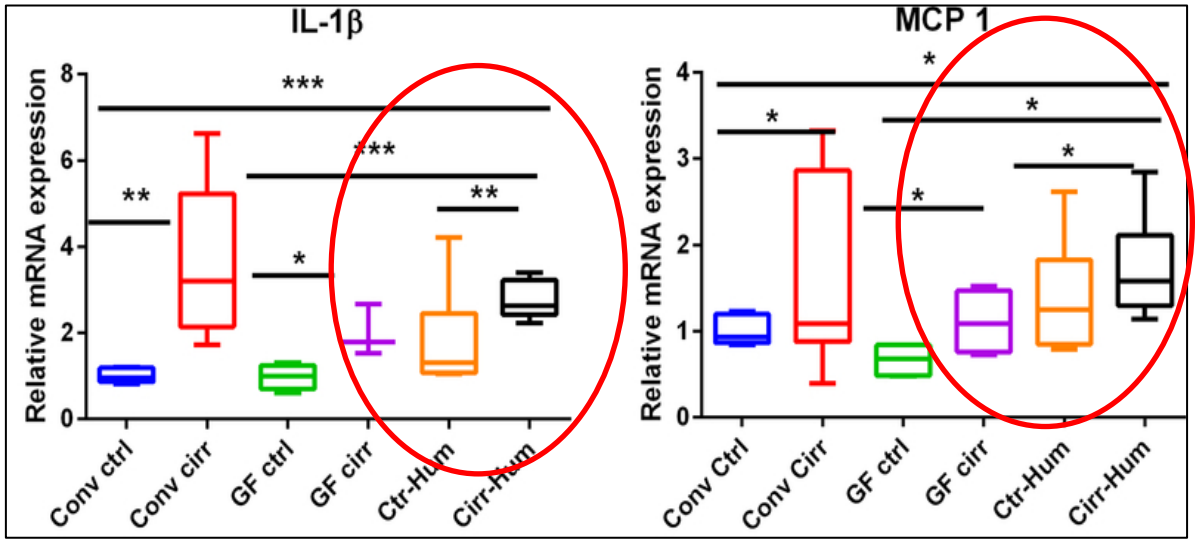


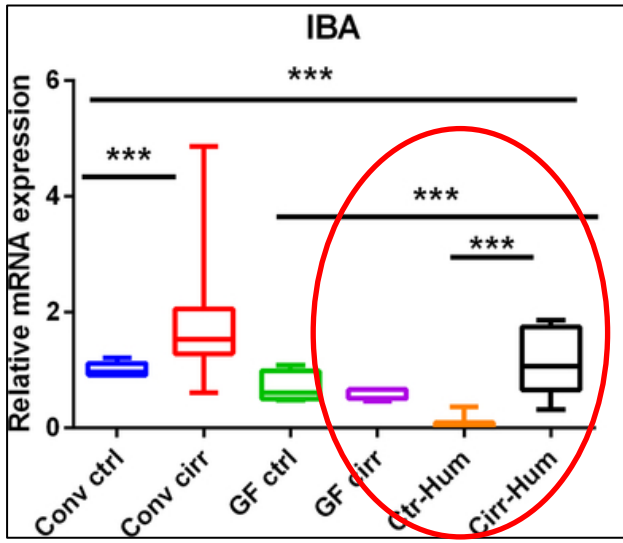
4 mouse groups: GF, GF made cirrhotic using CCL4 gavage, Conventional control and Conventional mice made cirrhotic using CCL4 gavage

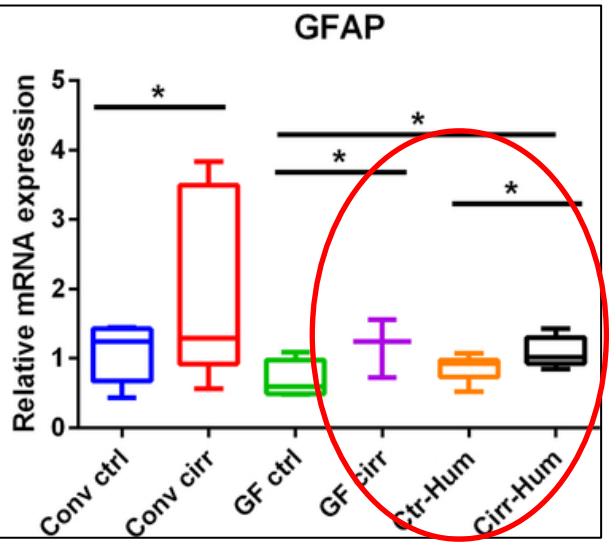
Kang, Bajaj et al Hepatology 2016

The brain is sensitive to the type of microbiota

HE pathogenesis is related to microbes with inflammatory potential



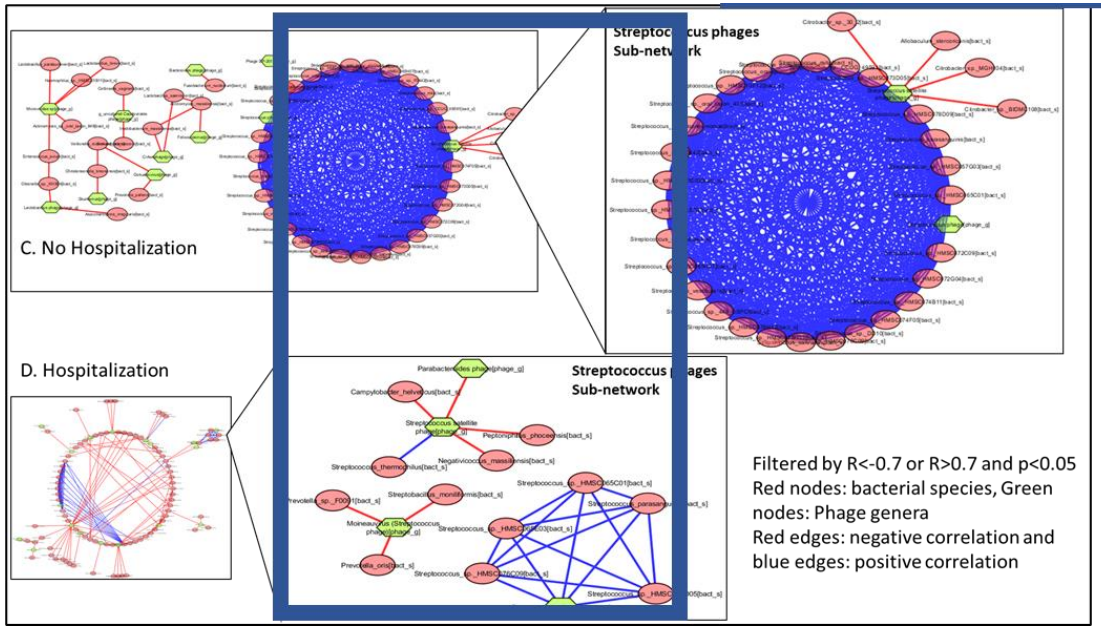


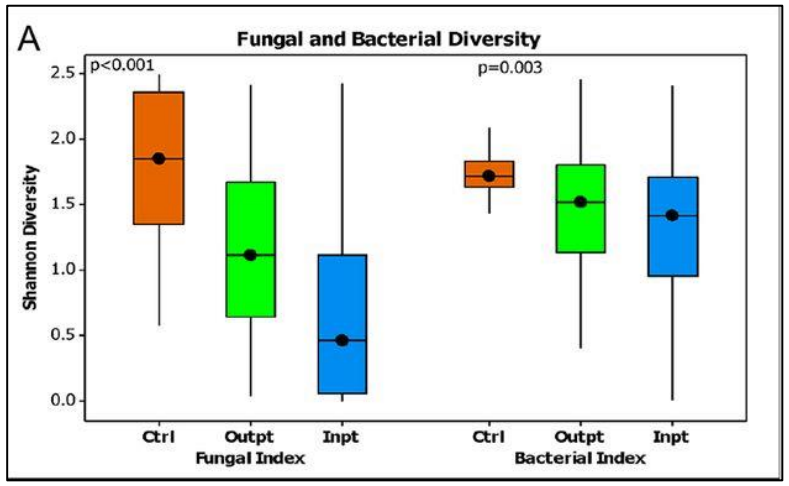


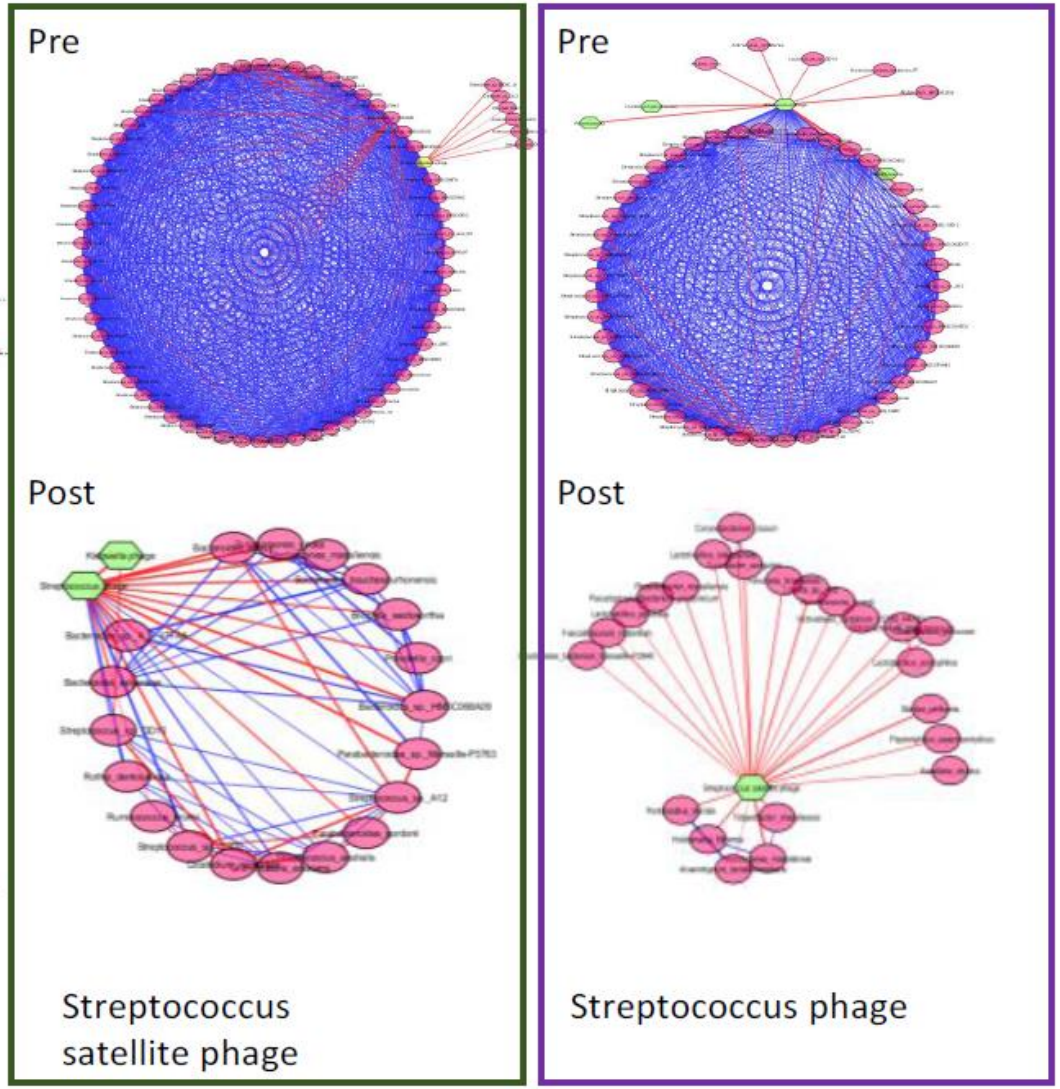
No impact of Germ-Free Supernatants

Kang et al Hepatol 2016, Liu et al Hepatol 2020

Non-Bacterial Kingdoms and HE



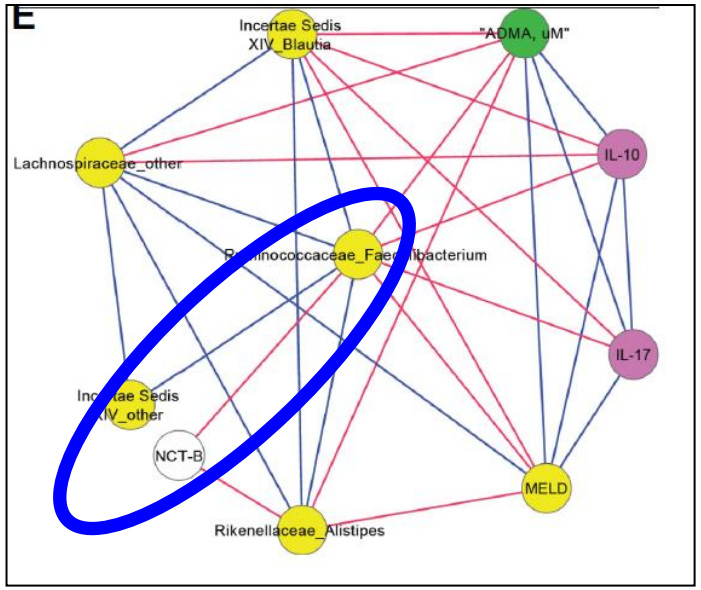




Bajaj et al Gut 2017, Bajaj et al Gut 2020

Hepatic Encephalopathy and Hospitalizations in Outpatients

Microbial changes related to brain dysfunction in **Hepatic encephalopathy (HE)**

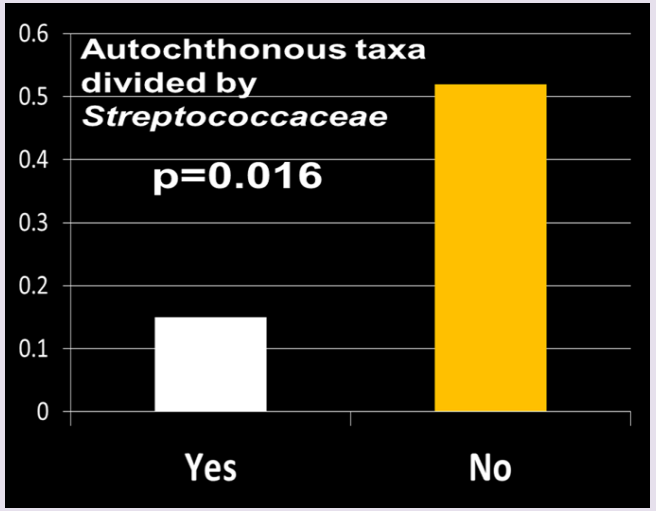


SCFA-producing bacteria= ↓ ammonia-related changes

Oral bacteria=↑ Inflammation-related changes

Hospitalizations in Outpatients

Saliva



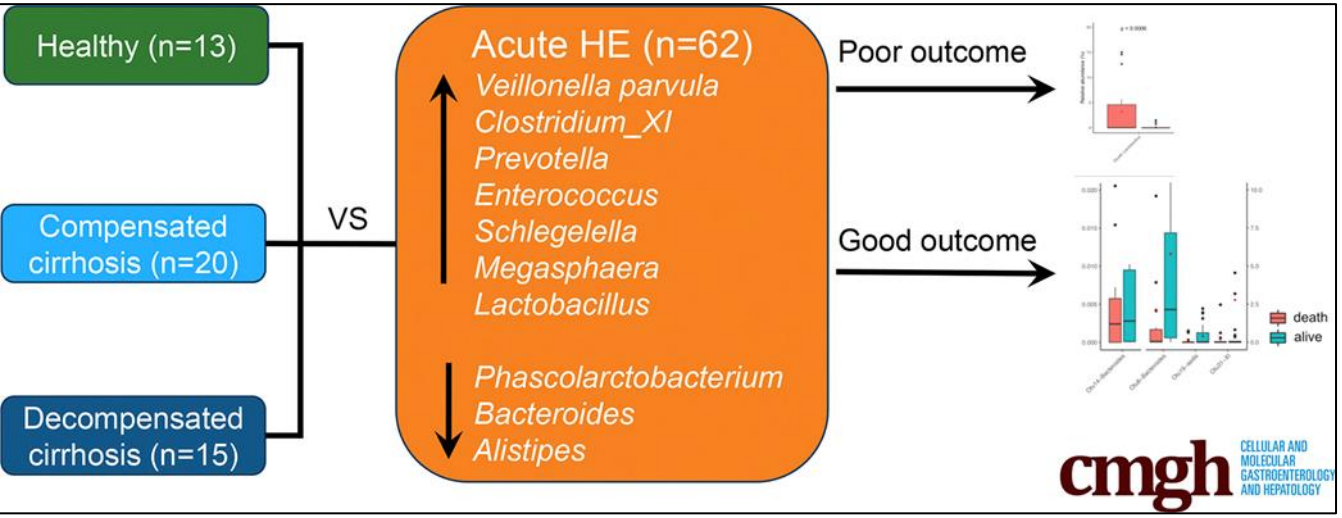
Stool: 278 patients, 37% hospitalized within 90 days

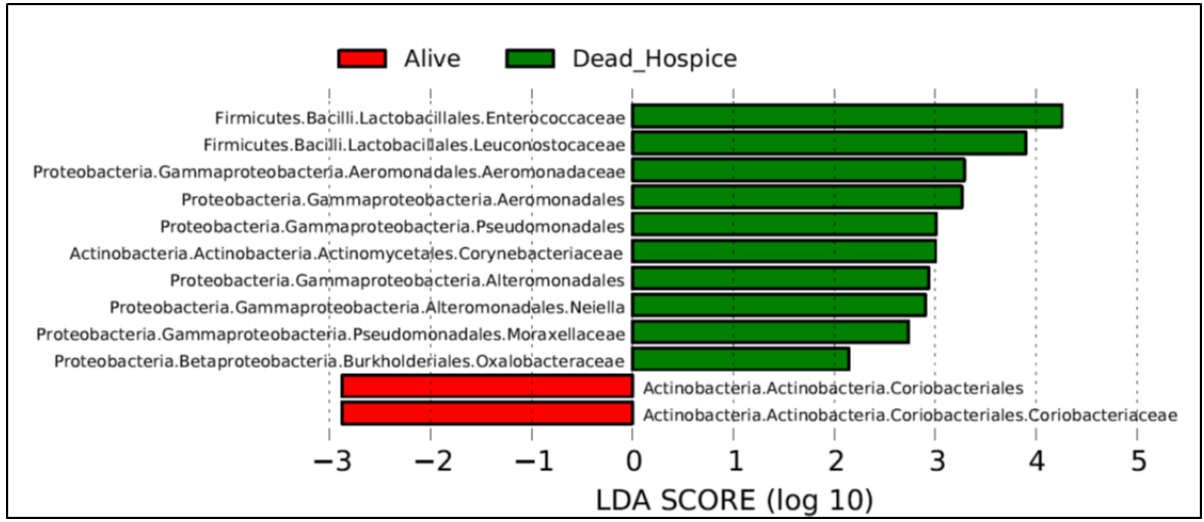
Predictors of hospitalization

- MELD score, PPI, HE PLUS
- **Clostridiales Cluster XIV and**
- ***Bacteroidaceae***

Bajaj et AJP 2011/2013, Chen et al J Gastro Hepatol 2015, Bajaj et al J Hepatol 2014, Bajaj et al Hepatol 2015, Ahluwalia et al Sci Rep 2016, Bajaj et al Am J Gastro 2019, Bajaj et al, Hepatology 2015, Bajaj et al Scientific Reports 2016

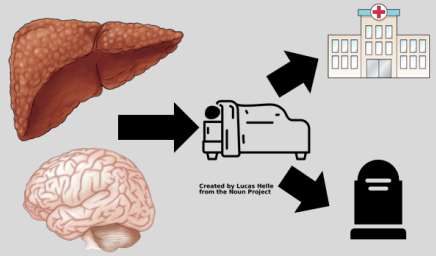
Microbiota and HE-related outcomes in Inpatients





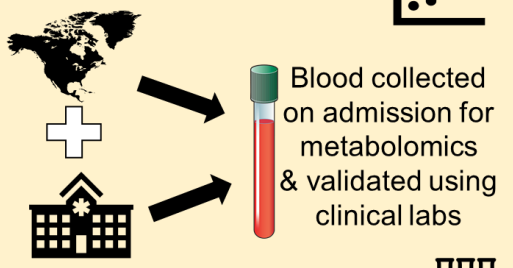
Admission Serum Metabolites and Thyroxine Predict Advanced Hepatic Encephalopathy in a Multi-center Inpatient Cirrhosis Cohort

Advanced (Grade 3-4) HE development is difficult to predict



Need better biomarkers to predict who will develop advanced HE

Multi-center derivation cohort of 602 inpatients



Validation cohort of 81 inpatients at 2 sites

↑ Microbial metabolites ↓Thyroxine

-Predict advanced HE despite clinical factors
-↓Thyroxine levels validated using clinical laboratories

Low admission thyroxine predicts advanced HE

Bajaj JS et al NACSELD 2022

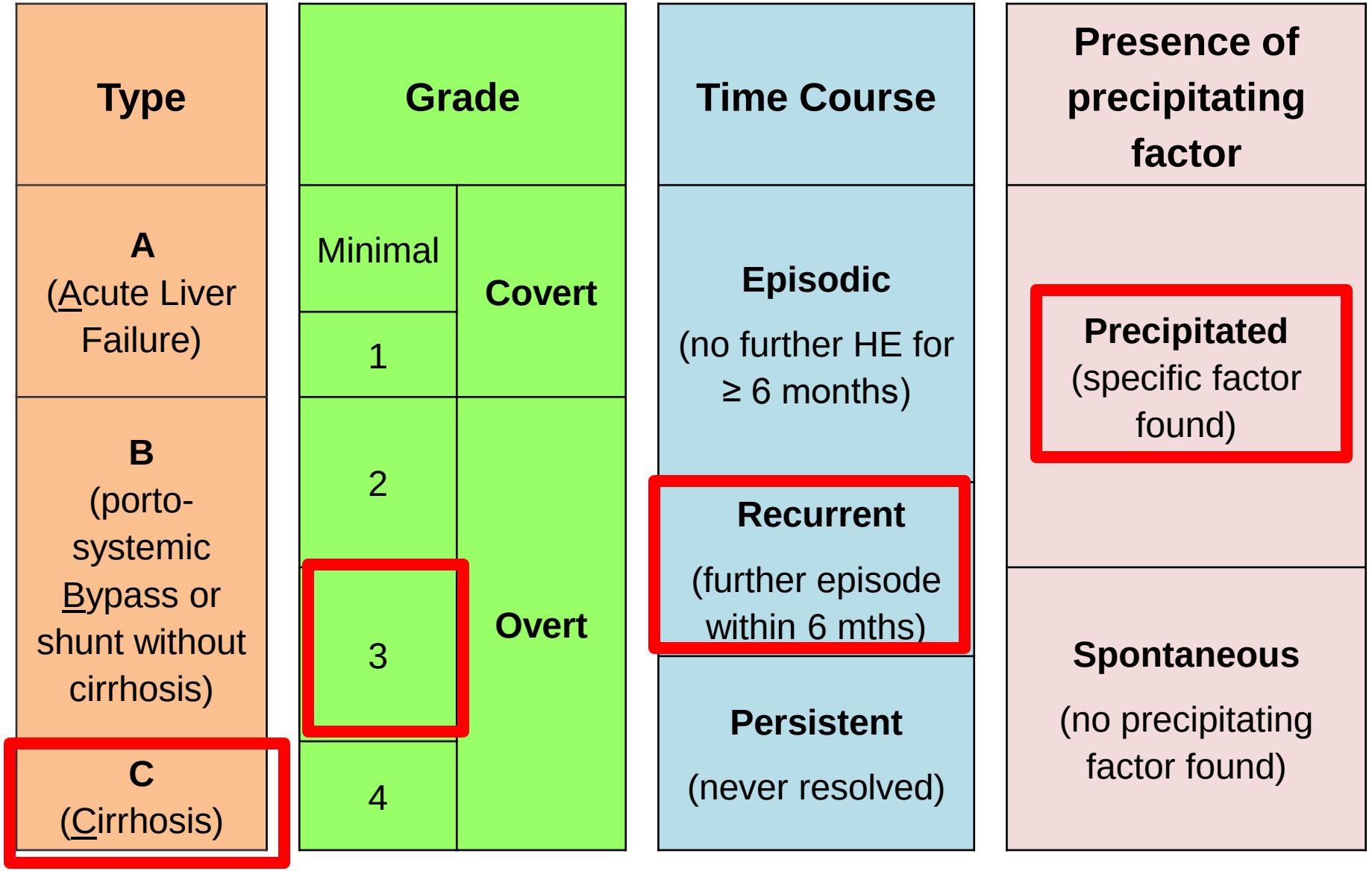
Microbial composition and metabolites can predict

A. Death
B. ACLF
C. ICU transfer
D. Who develops grade 3-4 HE
E. Recovery and recurrence of HE

Lin et al CMGH 2019, Chen et al J Gastro Hep 2015, Bajaj et al J Hepatol 2014, Bajaj et al Clin Gastro Hep 2018, Bajaj et al CGH 2022

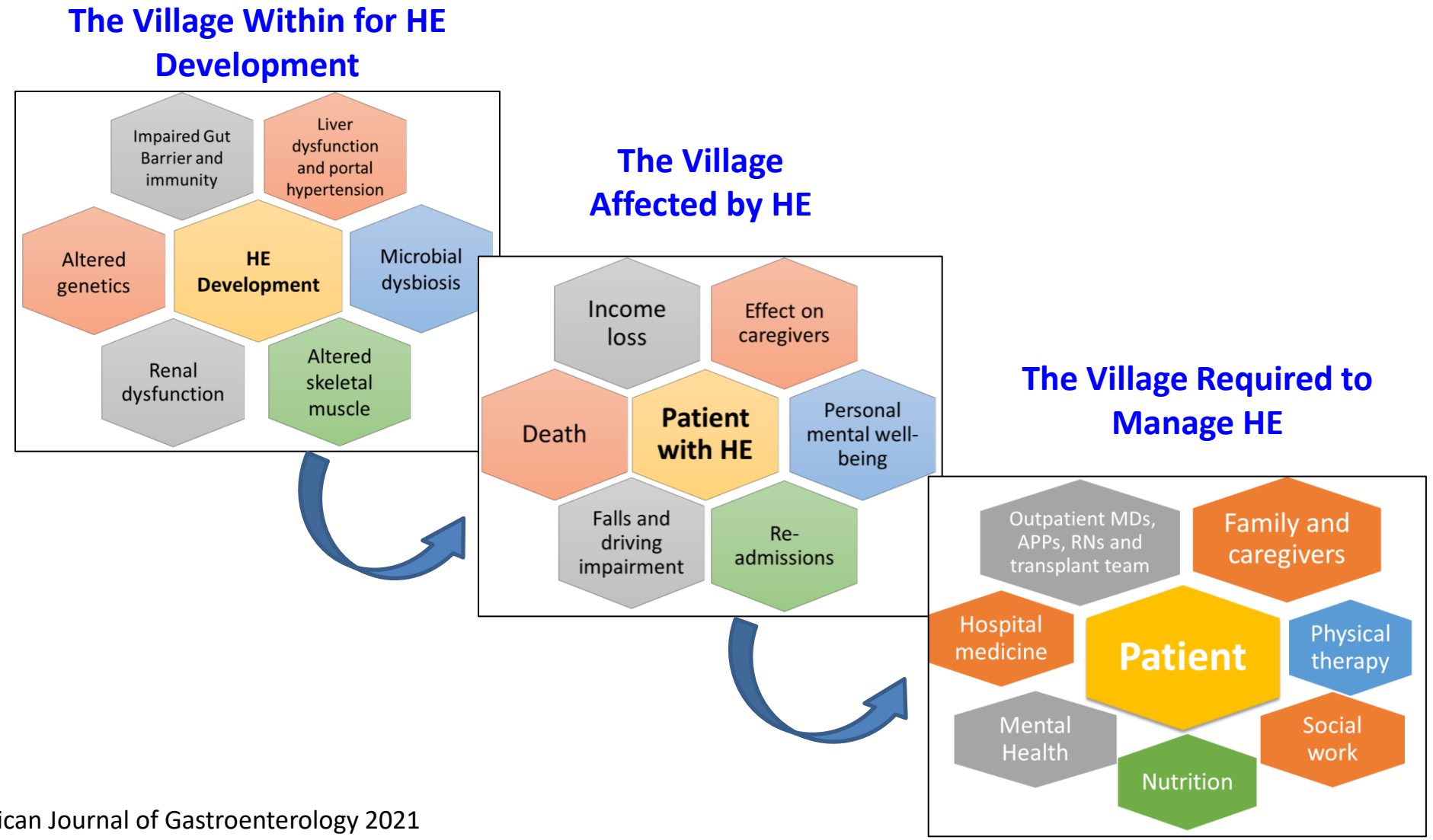
Clinical Classification of HE

Overall Classification of HE: Four Axes



EASL/AASLD Hepatic Encephalopathy guidelines Hepatology 2014

Multi-disciplinary Approach: The Three Villages of Hepatic Encephalopathy



Bajaj JS American Journal of Gastroenterology 2021
doi: 10.14309/ajg.0000000000001212

- **Covert HE**
- **Inpatient Management**
- **Preventing Recurrence**

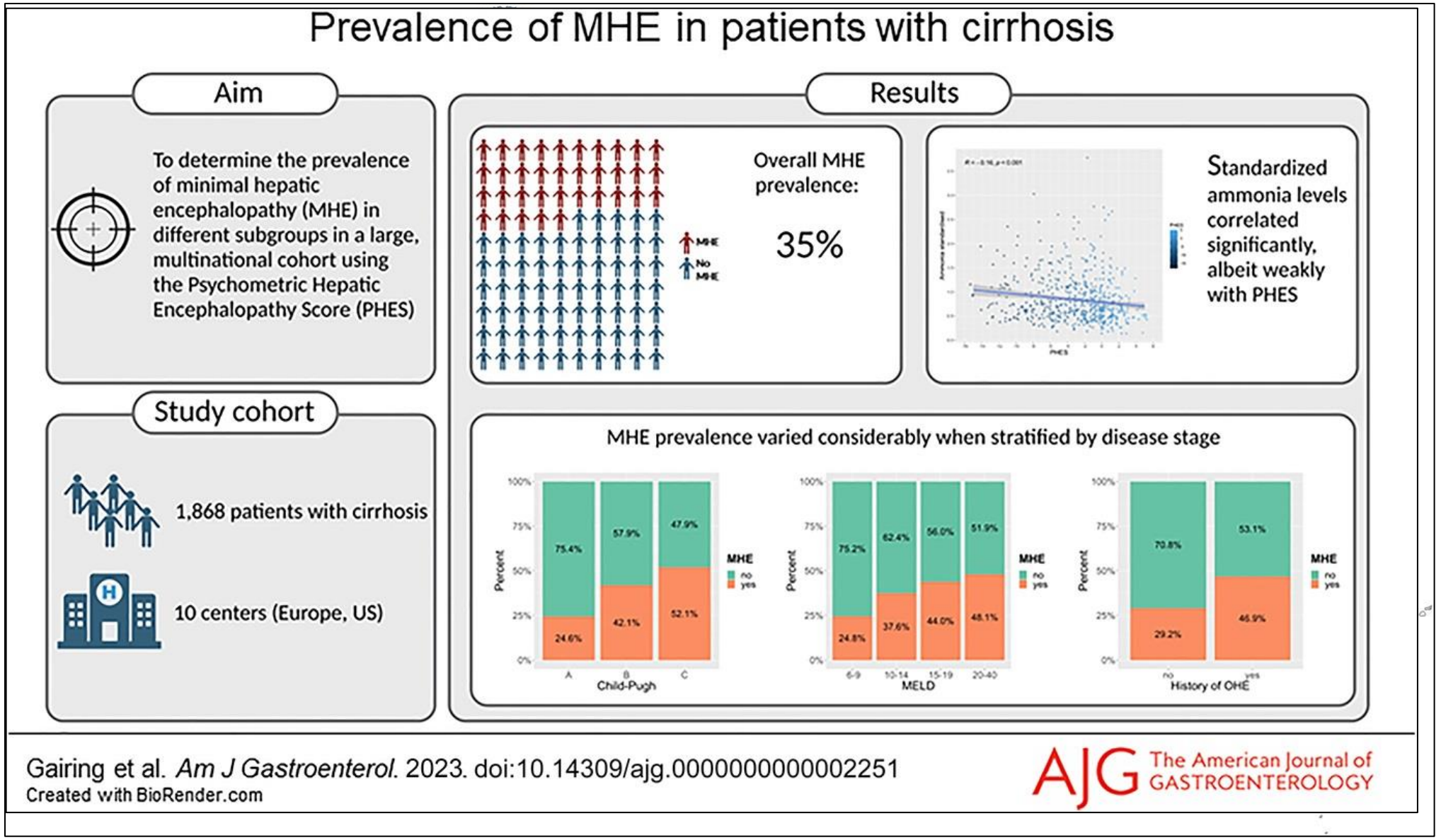
Diagnosing patients earlier

Covert HE

Covert HE is important to our patients

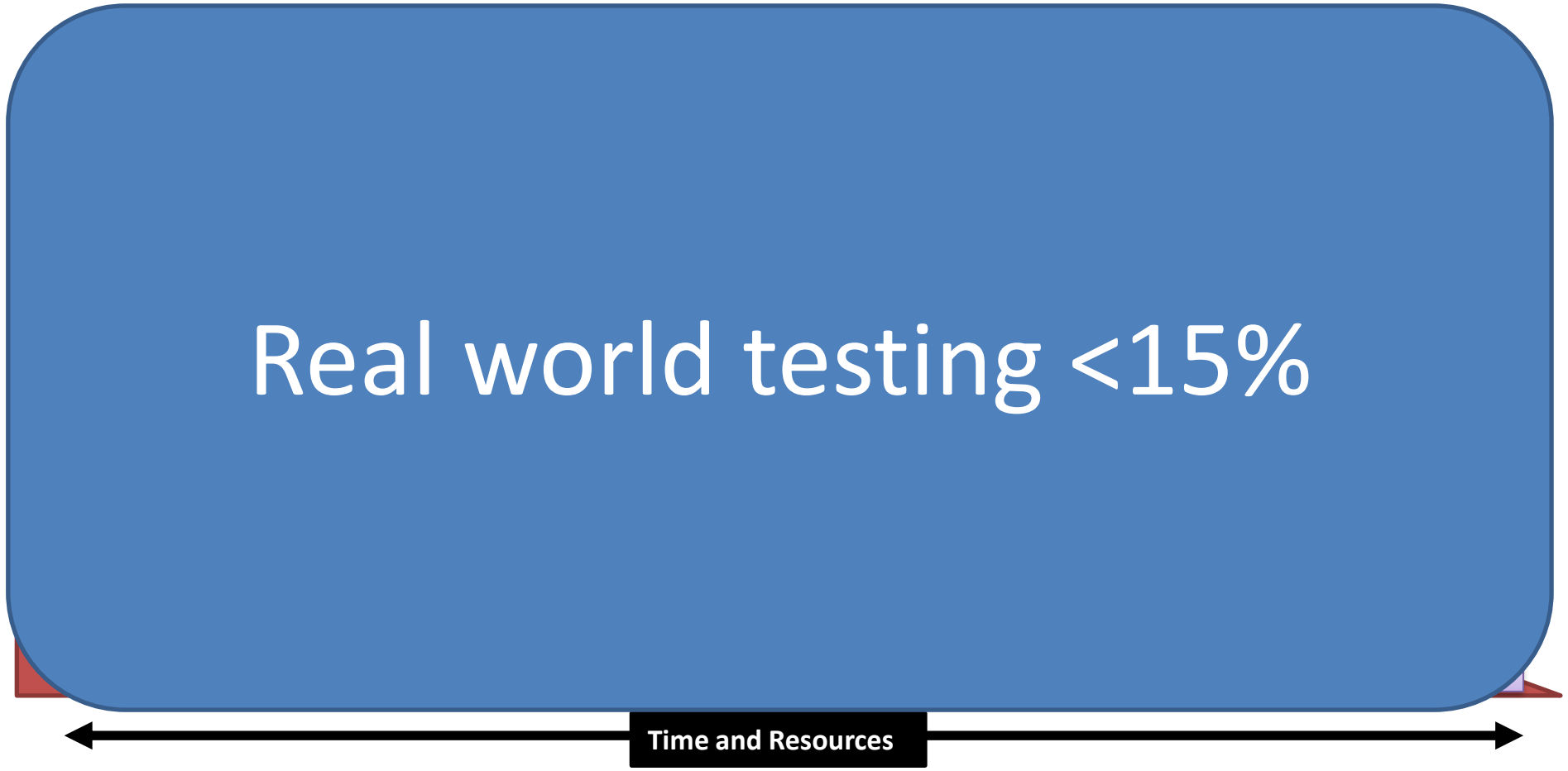
Outcomes in cirrhotic patients	Affected?
Progression to overt HE	✓
Health-related Quality of life	✓
Driving impairment and accidents	✓
Overall Survival	✓
Socio-economic status	✓
Can be tested for	✓

Covert/Minimal HE is present in almost 40% of patients



Gairing et al Am J Gastro 2023, Lv et al Am J Gastro 2023

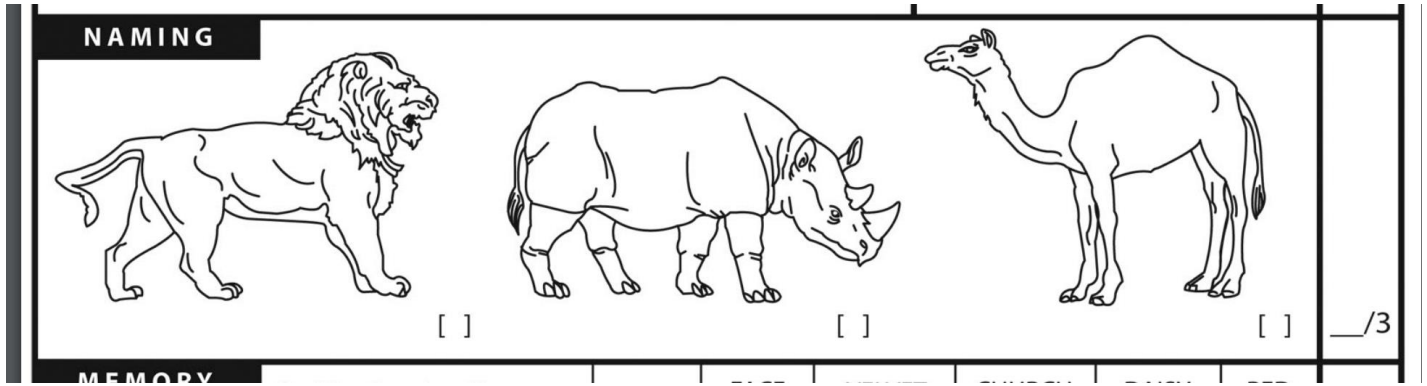
Covert HE testing time & resource requirements

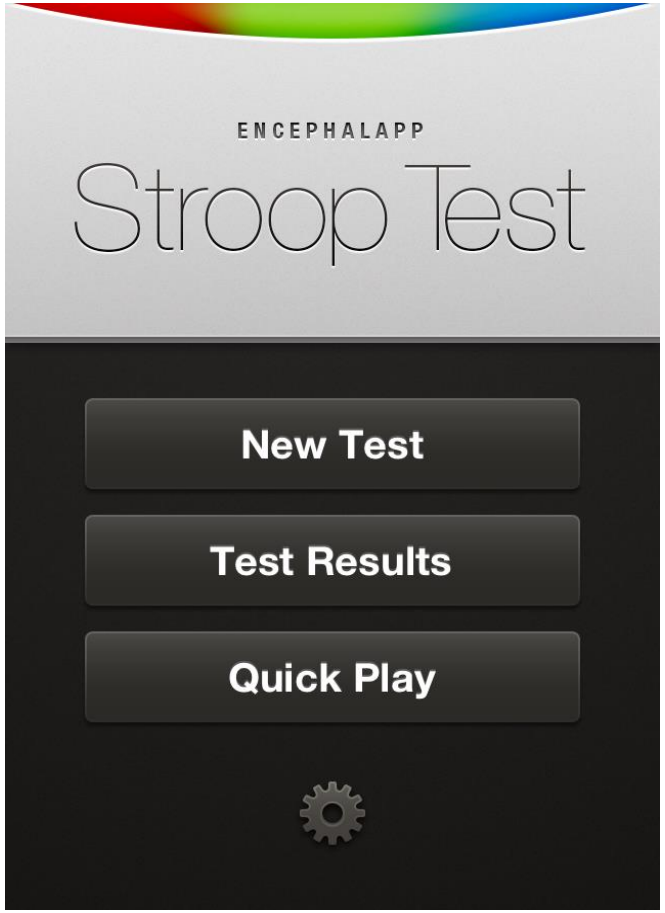


Real-World Settings

HRQOL, Animal Naming and EncephalApp Stroop can be used to diagnose covert/minimal HE

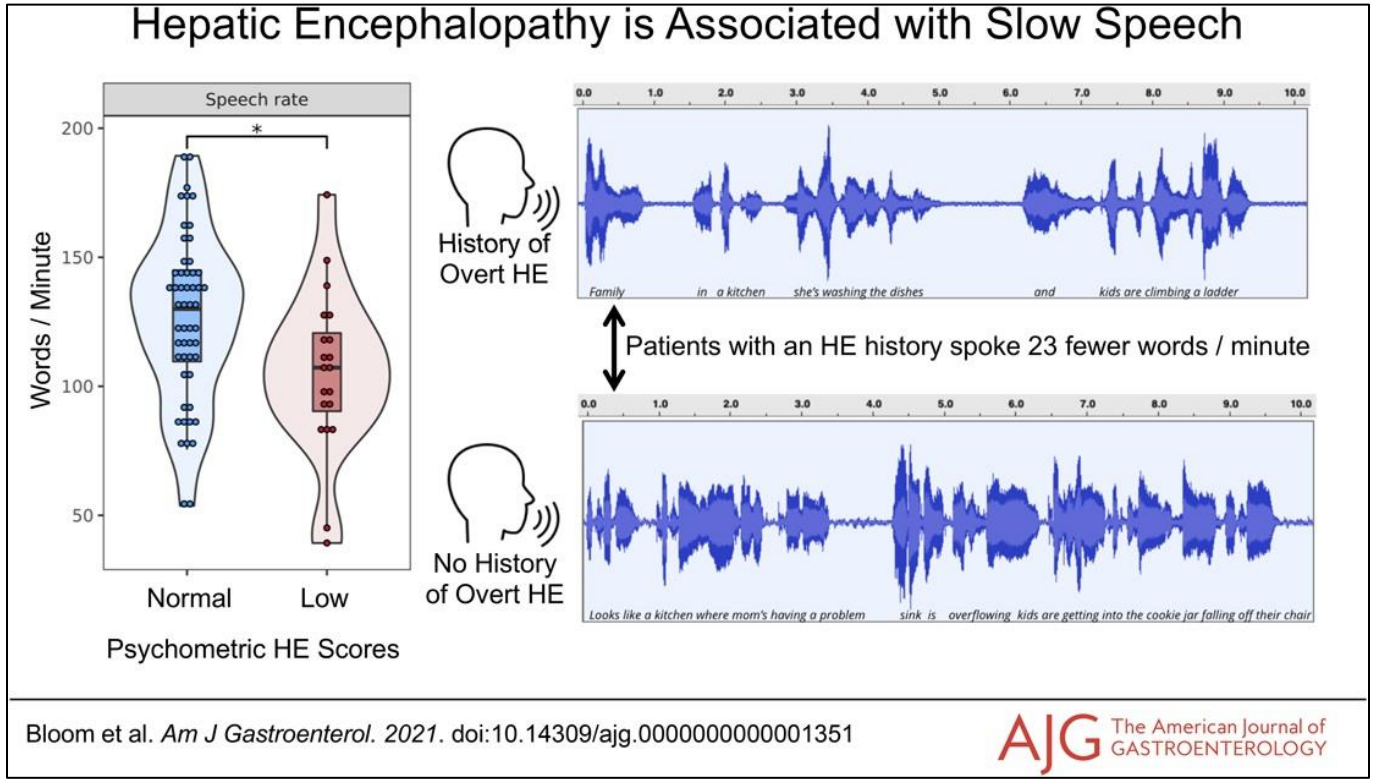
I do not maintain balance
I act irritable or impatient with myself
I am not doing any of my usual physical recreation or activities
I am eating much less than usual



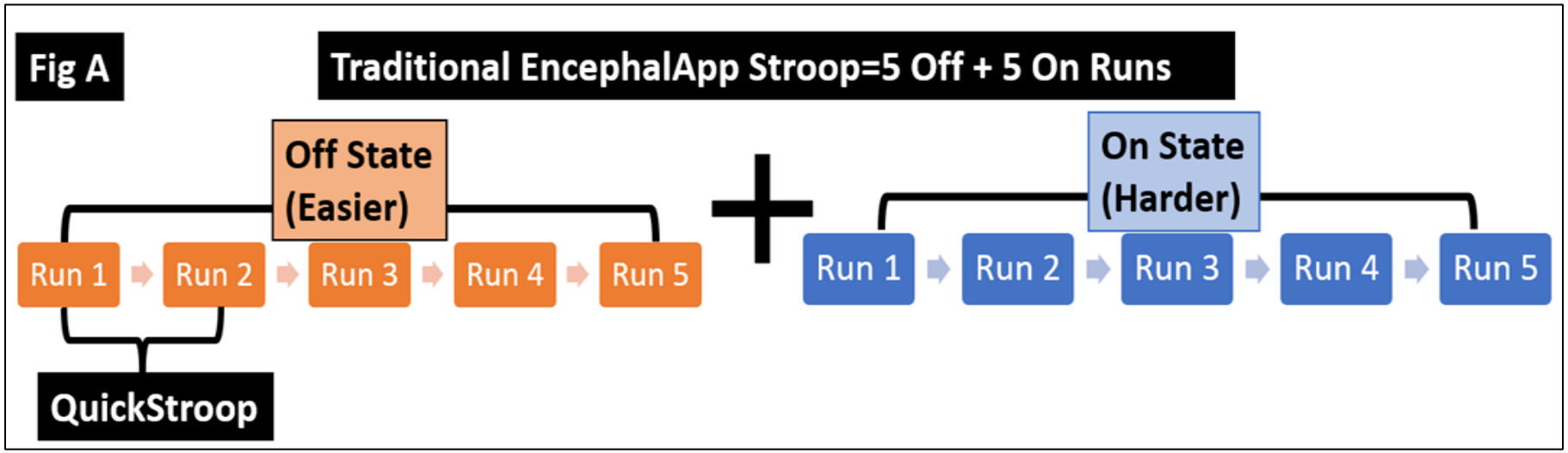


Nabi et al . Clin Gastroenterol Hepatol 2014;12:1384–9, Lauridsen et al . Hep Communications 2020,
Bajaj JS et al Hepatology 2013, Clin Gastro Hep 2015, Allampati et al Am J Gastro 2015, Campagna et al Hepatology 2017

Slow Speech

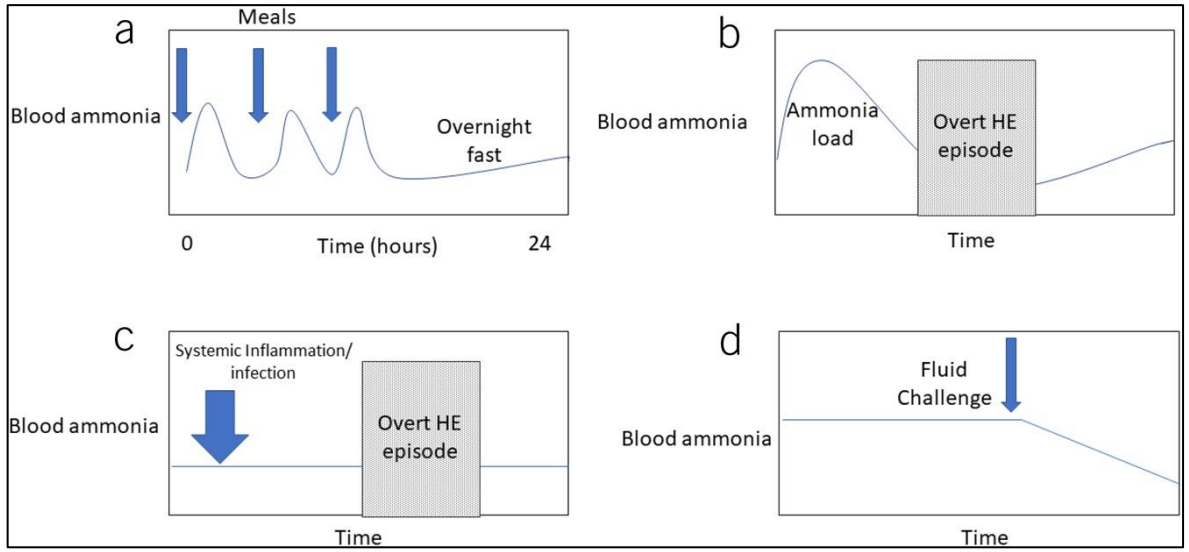


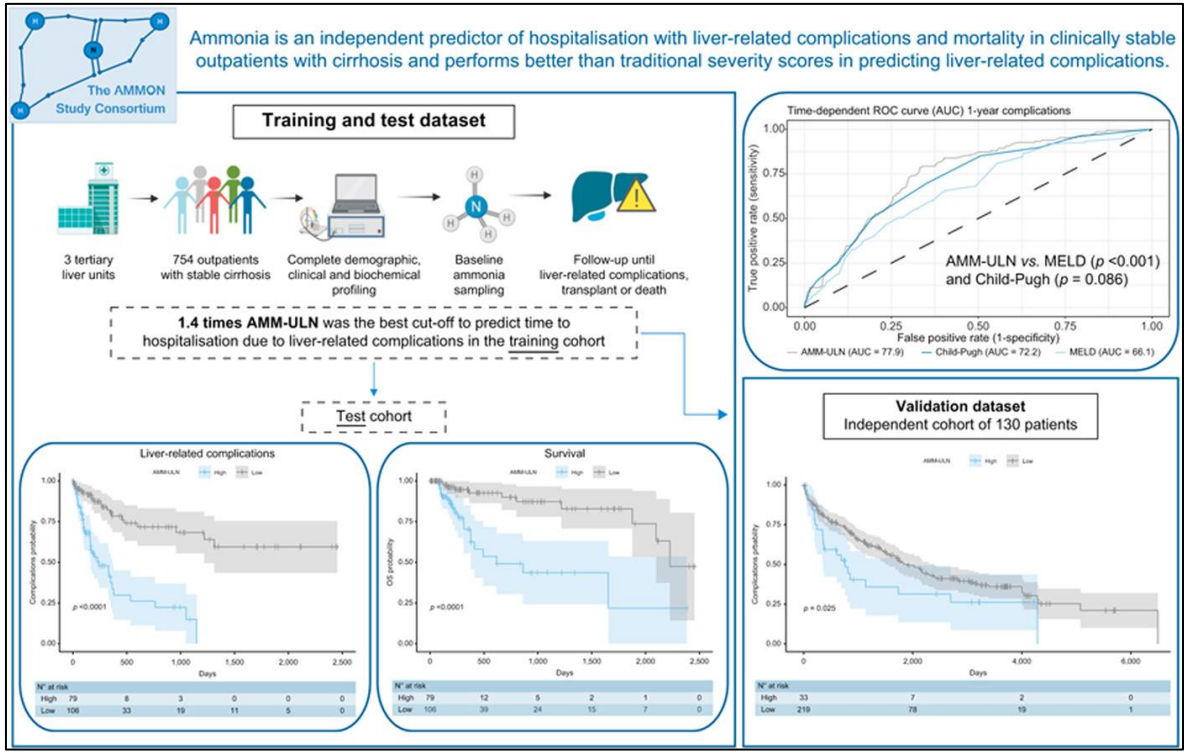
QuickStroop

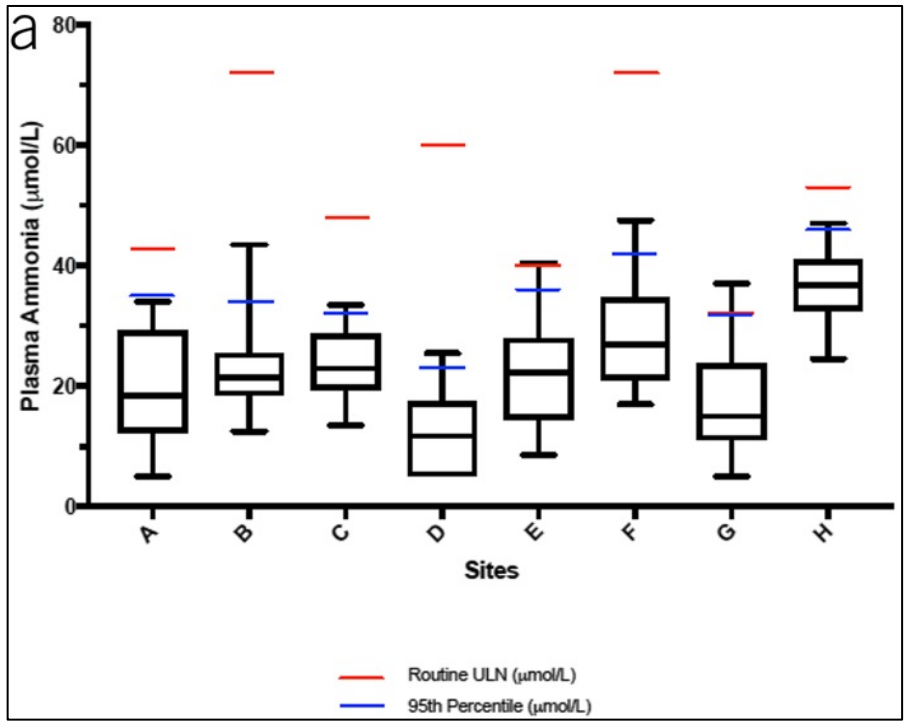


Bloom et al Am J Gastro 2021, Acharya et al Clin Gastro Hep 2022, Kanagalingam and Park et al CGH 2023

Ammonia levels?

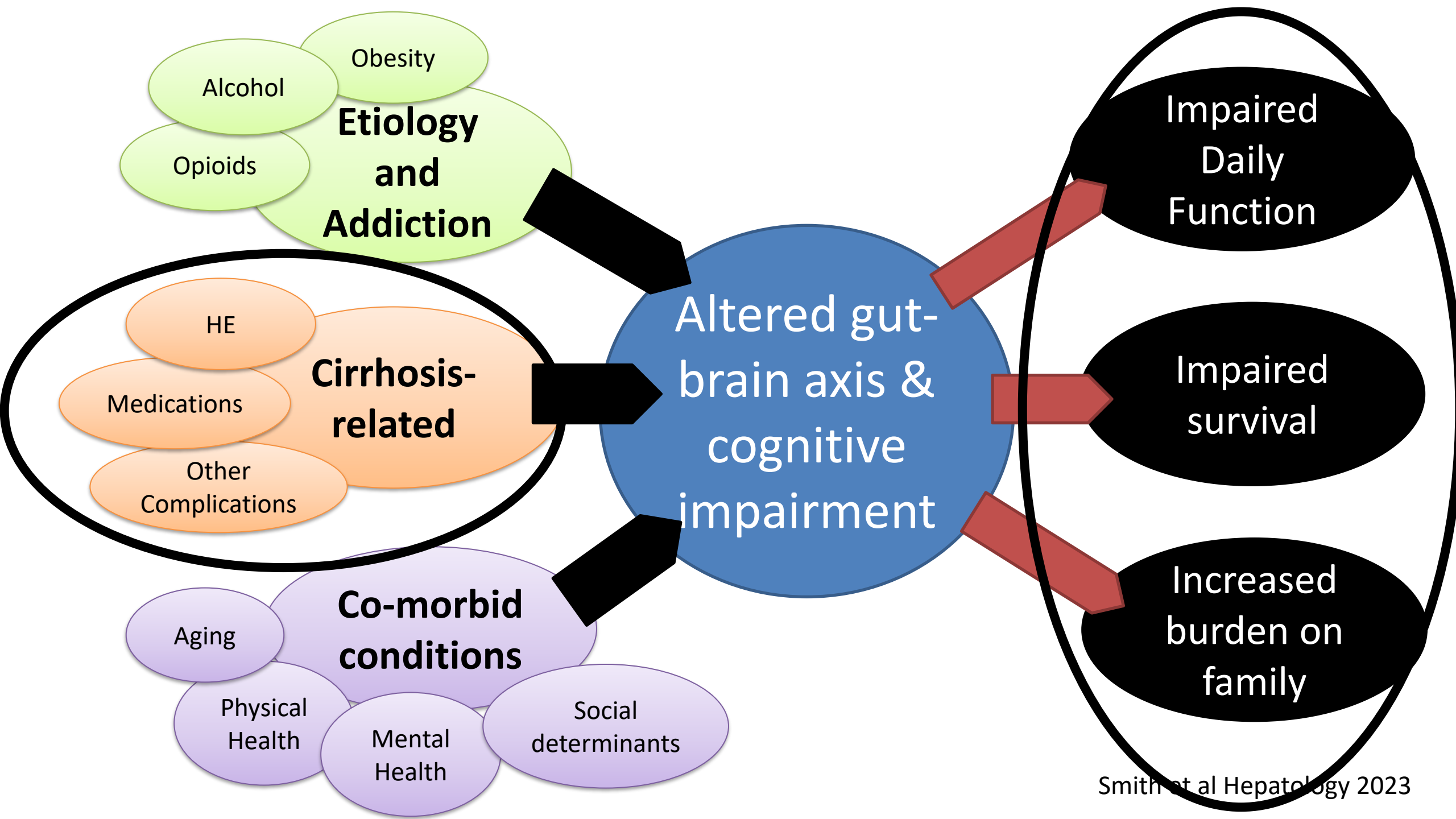






- Exclusionary for HE if normal; not diagnostic if high
- Could be prognostic
- Vary with dehydration, meals, and methods of drawing blood
- Upper limit of normal varies between laboratories

AASLD/EASL 2014 HE Guidelines, EASL HE CPG 2021, Bajaj JS et al Am J Gastro 2019, ISHEN Consensus Am J Gastro 2020, Tranah et al J Hepatol 2021



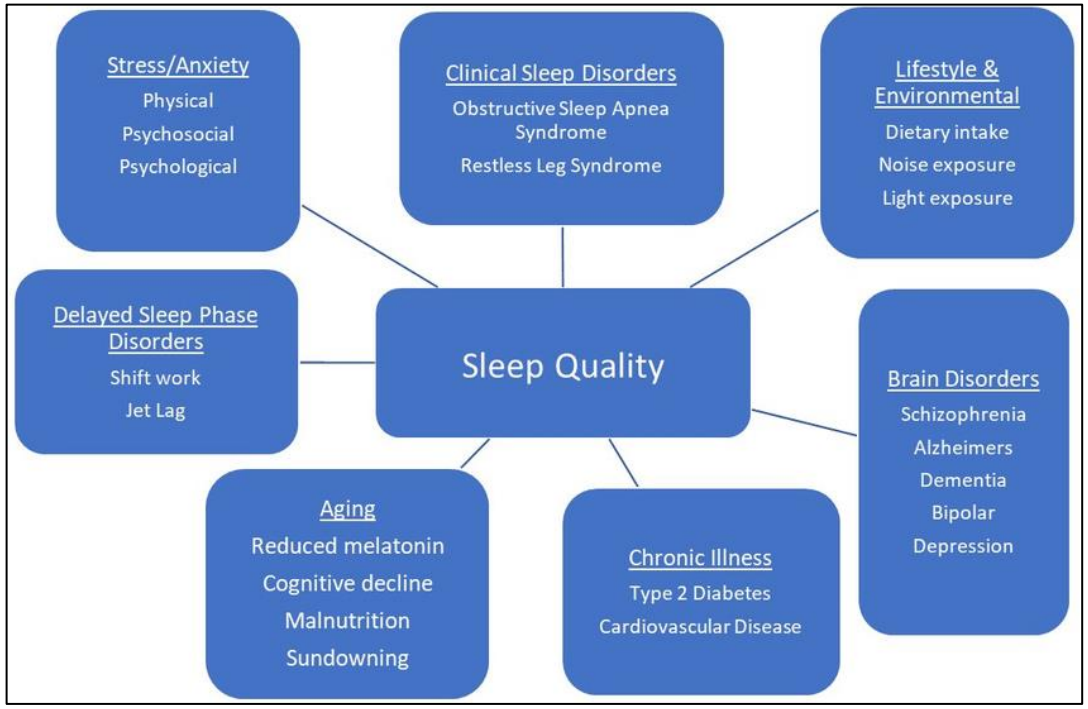
Smith et al Hepatology 2023

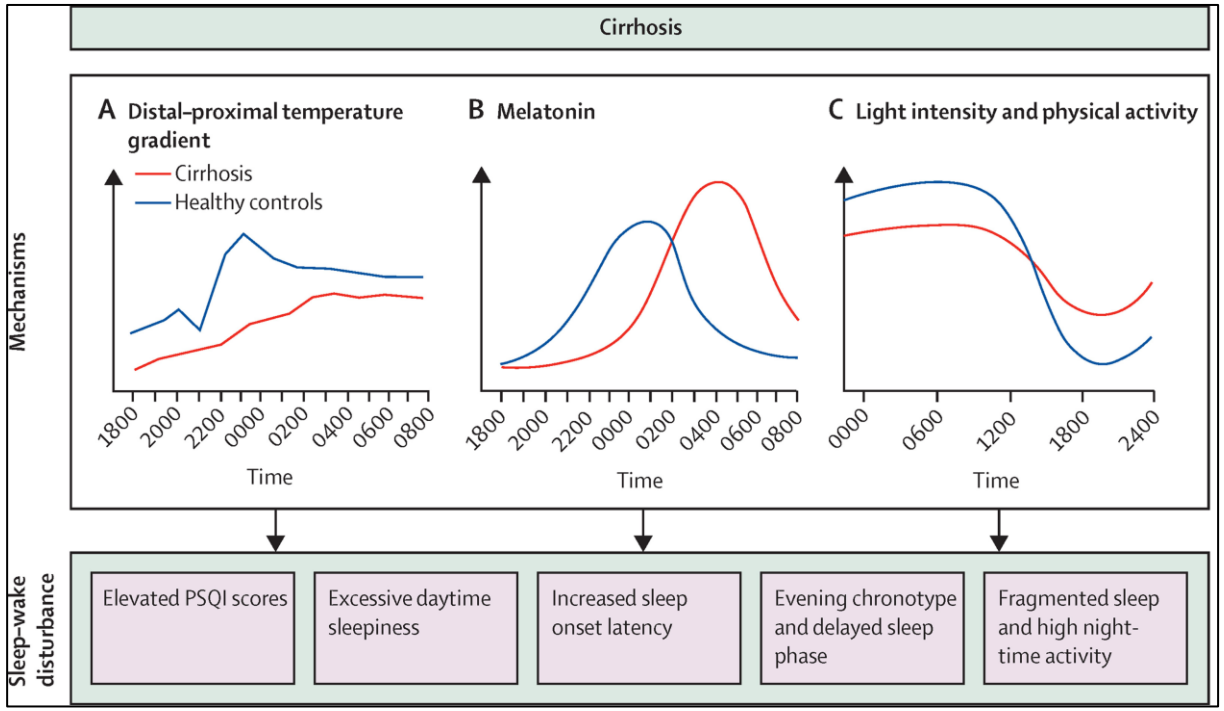
Are all cognitive complaints in cirrhosis HE?

<50% of patients with cognitive complaints seen in the specialized clinic had Covert or Minimal HE

- **Dementia/MCI**
- **Obstructive sleep apnea**
- **Alcohol-related**

What about sleep as an indicator for HE? Not a slam dunk!





Sleep alterations alone are inadequate to diagnose HE and HE-treatment does not resolve sleep problems

Also consider:

- **Obstructive sleep apnea**
- **Alcohol-related or medication-related issues**

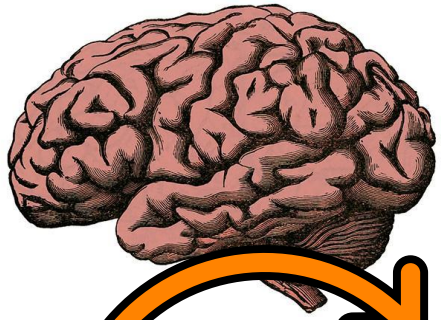
Montagnese et al Hep 2014, Marjot et al Lancet GH 2021, Bajaj et al CGH 2015, Kappus et al J Clin Sleep Med 2013, Buckholz et al Hep Comm 2022

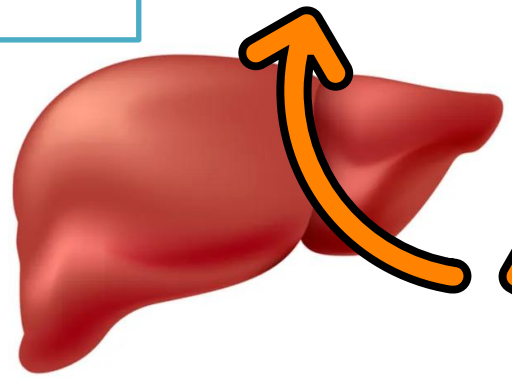
HE therapies overview

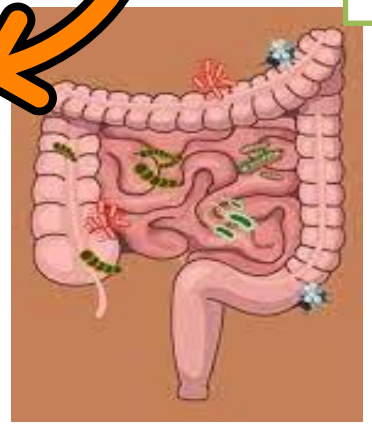
Focus on the gut-brain axis

Indirect: Fixing the cirrhosis etiology directly

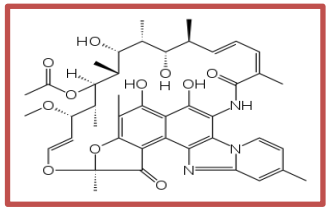
Indirect: Fixing the cirrhosis through microbes; FMT for endogenous and Exogenous alcohol

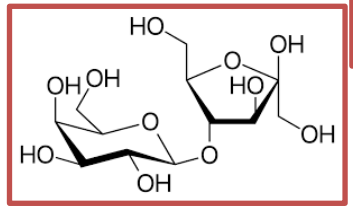




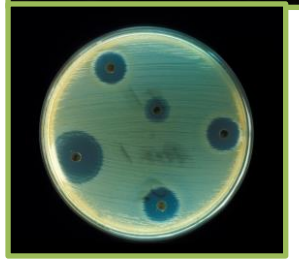


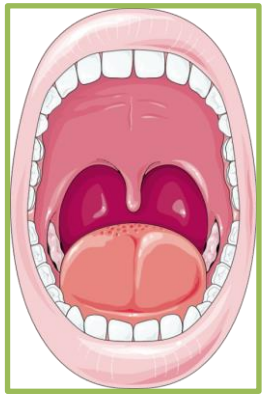
Direct: Adding something beneficial





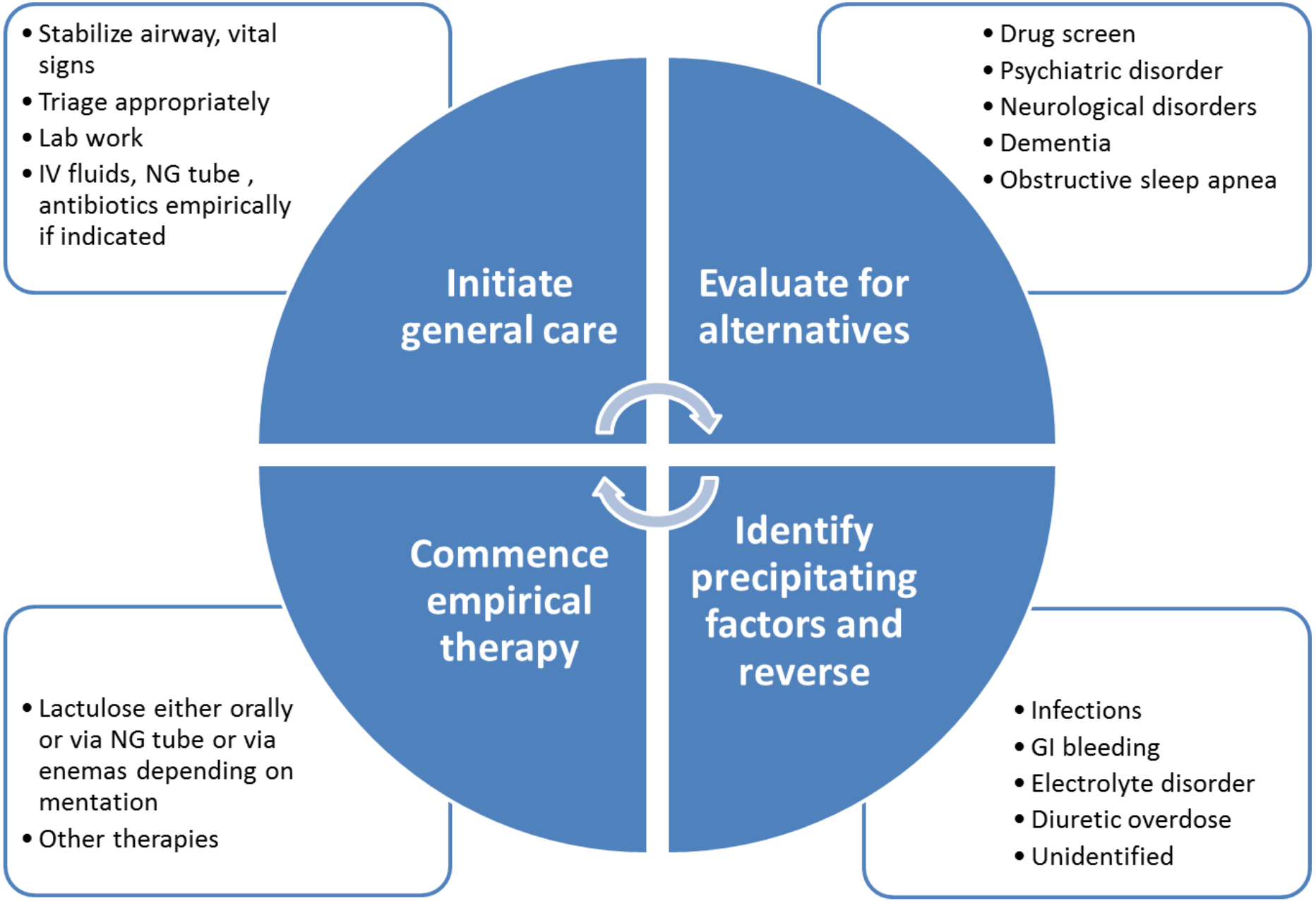
Direct: Removing something harmful





Leclerq et al PNAS 2014, Wellhoner et al Hepatol 2021, Hsu et al Hep Comm 2022, Bajaj et al Hepatol 2020, Ren et al Hepatol 2017, Allegreti et al Am J Gastro 2019, Bajaj Idilman et al Hepatology 2018, Bajaj, Torre et al Liver Intern 2019, Alvares da Silva et al CGH 2022, Bass et al NEJM 2010, Bajaj, Matin et al AJP GI Liver 2018, Bajaj et al Am J Gastro 2018, Badal et al Hepatology 2023

Optimization of Inpatient Therapy

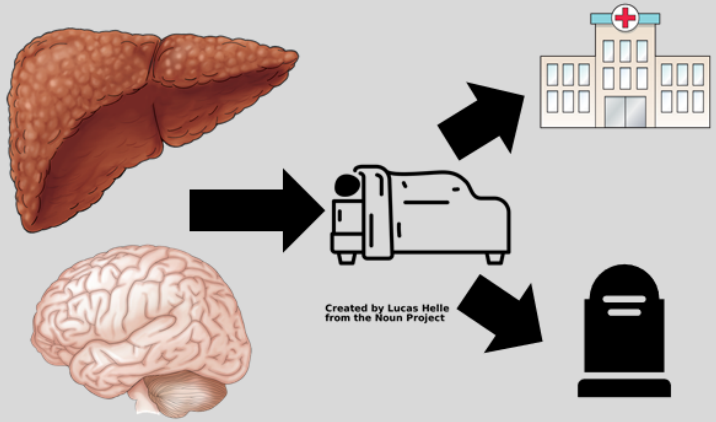


Acharya et al Am J Gastro 2018

Who will develop advanced HE?

Admission Serum Metabolites and Thyroxine Predict Advanced Hepatic Encephalopathy in a Multi-center Inpatient Cirrhosis Cohort

Advanced (Grade 3-4) HE development is difficult to predict



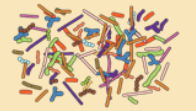
Need better biomarkers to predict who will develop advanced HE

Multi-center derivation cohort of 602 inpatients

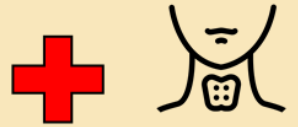
Blood collected on admission for metabolomics & validated using clinical labs

Validation cohort of 81 inpatients at 2 sites

↑ Microbial metabolites



↓Thyroxine

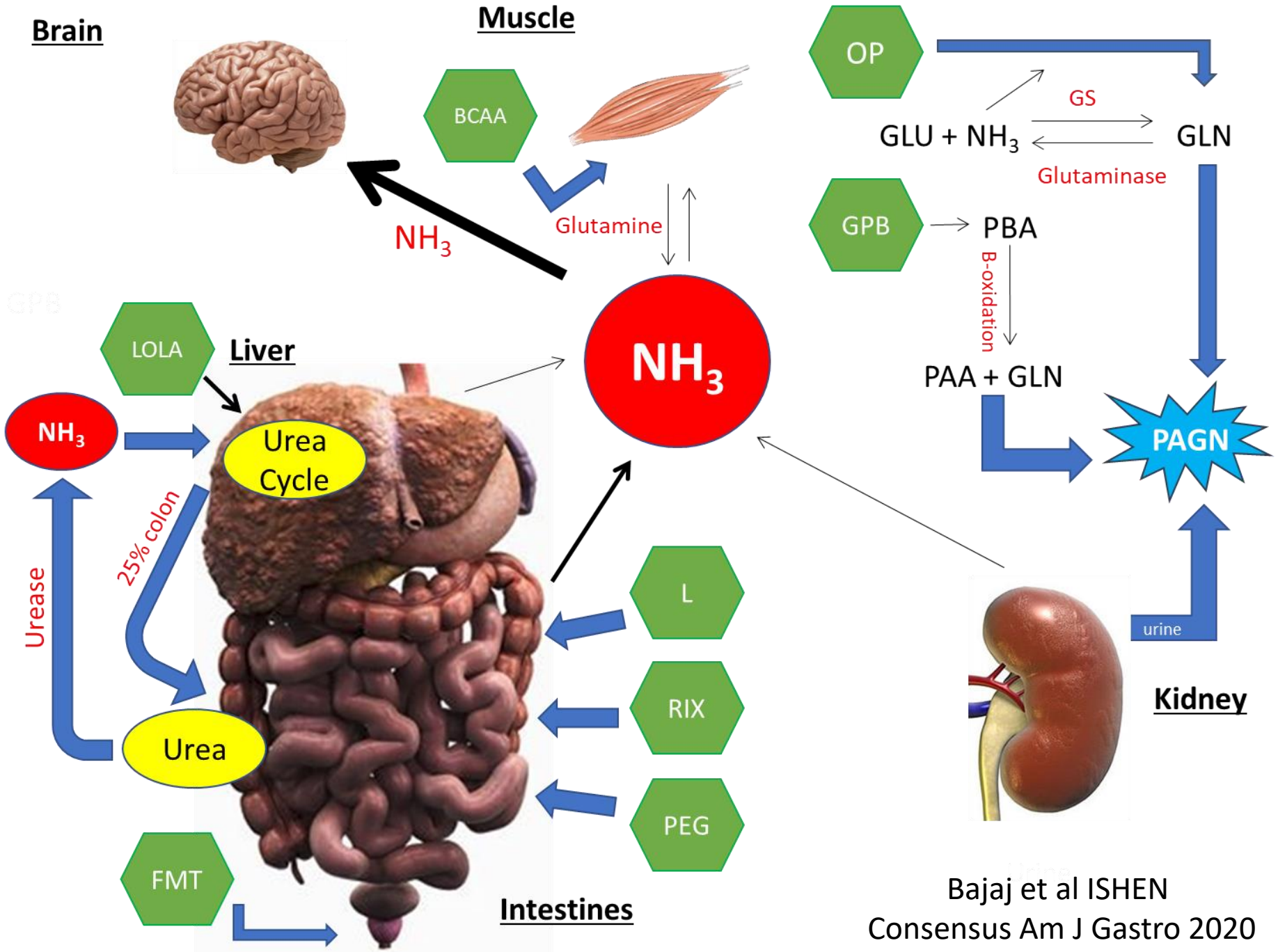


-Predict advanced HE despite clinical factors
-↓Thyroxine levels validated using clinical laboratories

Low admission thyroxine predicts advanced HE

Bajaj JS et al NACSELD 2022

Bajaj JS et al NACSELD Clin Gastro Hep 2022



Bajaj et al ISHEN
Consensus Am J Gastro 2020

Drugs for Acute HE episodes

Agent	Mechanism of Action/Comments	Potential AEs and challenges
Nonabsorbable disaccharides	Potential shifting of microbes from urease- to non-urease-producing bacteria; exerts a cathartic effect	• Aspiration pneumonia • Dehydration • Hypernatremia • Severe perianal skin irritation
Rifaximin	Reduces NH_3 by eliminating NH_3-producing colon bacteria; indicated for reducing risk of OHE recurrence in adults	• None major compared to placebo • Cost considerations
Zinc	Enhances urea formation from NH_3 and amino acids	• None but not efficacious alone
PEG 3350-electrolyte solution	Purgative; causes water to be retained in the colon, produces a watery stool	• Needs more study

Leise MD, et al. Mayo Clin Proc. 2014;89(2):241-253; Flamm SL. Ther Adv Gastroenterol. 2011;4(3):199-206; Lynn AM, et al. Liver Transpl. 2016 Jun;22(6):723-31; Elwir S, et al. J Clin Transl Hepatol. 2017;5(2):142-151., Bajaj et al Am J Gastro 2020

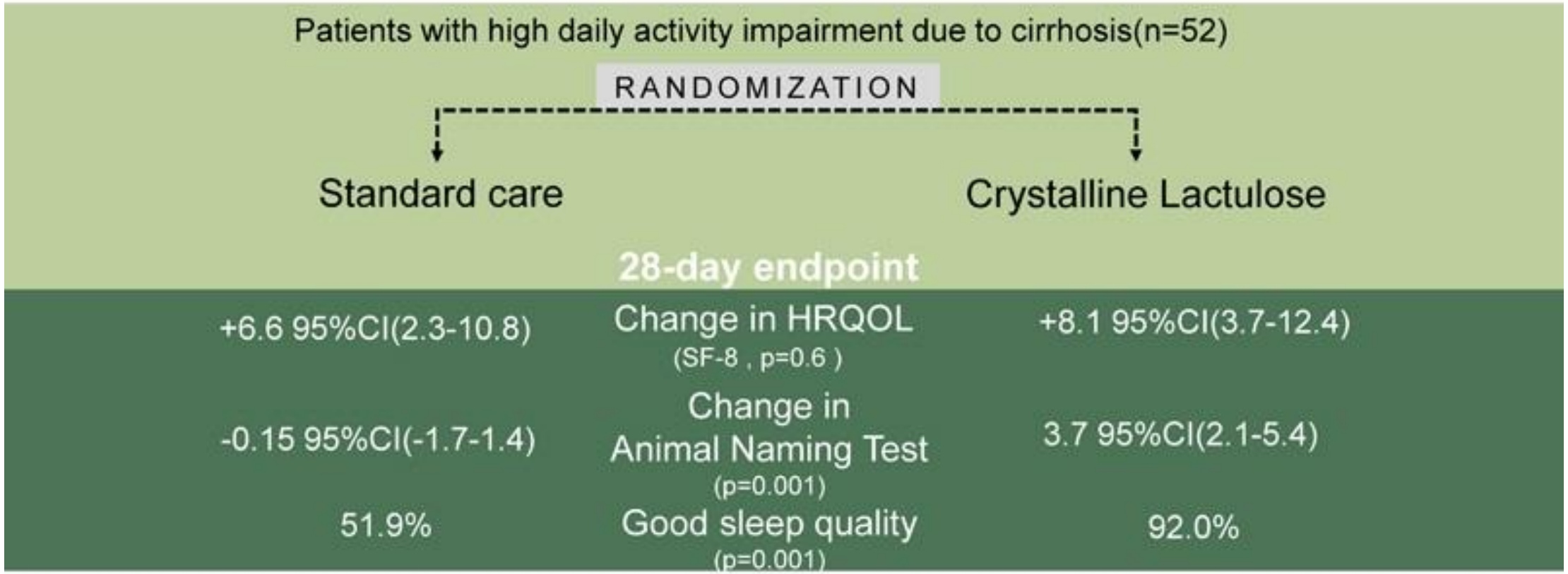
Prevention of HE Recurrence

1. Medication-related approaches
2. Other approaches

Checklist at discharge

Topics	
Does the patient know the change in their prognosis and daily function and tested for covert HE?	✓
Does the patient and family know signs of recurrence and ways to get in touch?	✓
Do they have a scheduled appointment for follow-up?	✓
Do they have medications to prevent HE recurrence with instructions in hand?	✓
Have potential recurring precipitating factors been investigated?	✓
Are they candidates for transplant?	✓

The MiKristal RCT: Lactulose therapy for patients with cirrhosis, portal hypertension, and poor patient reported outcomes

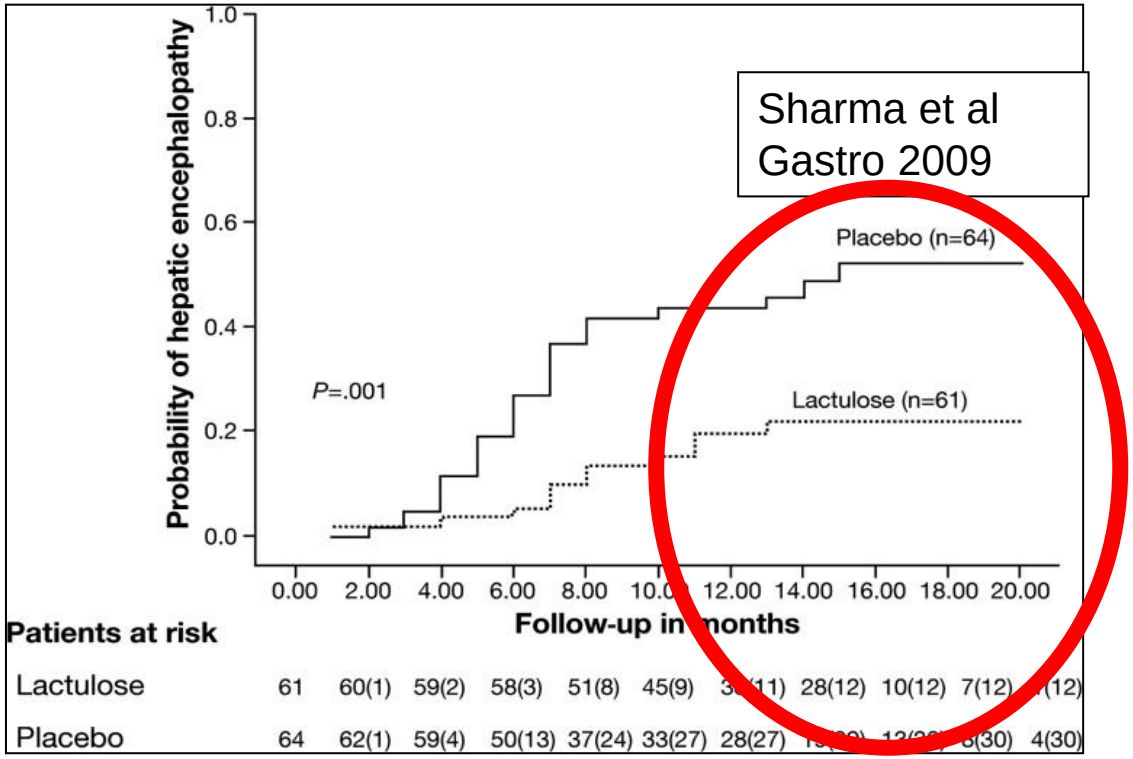


Tapper, et al. *Hepatology.*

HEPATOLOGY

Bloom et al Hep Comm 2023

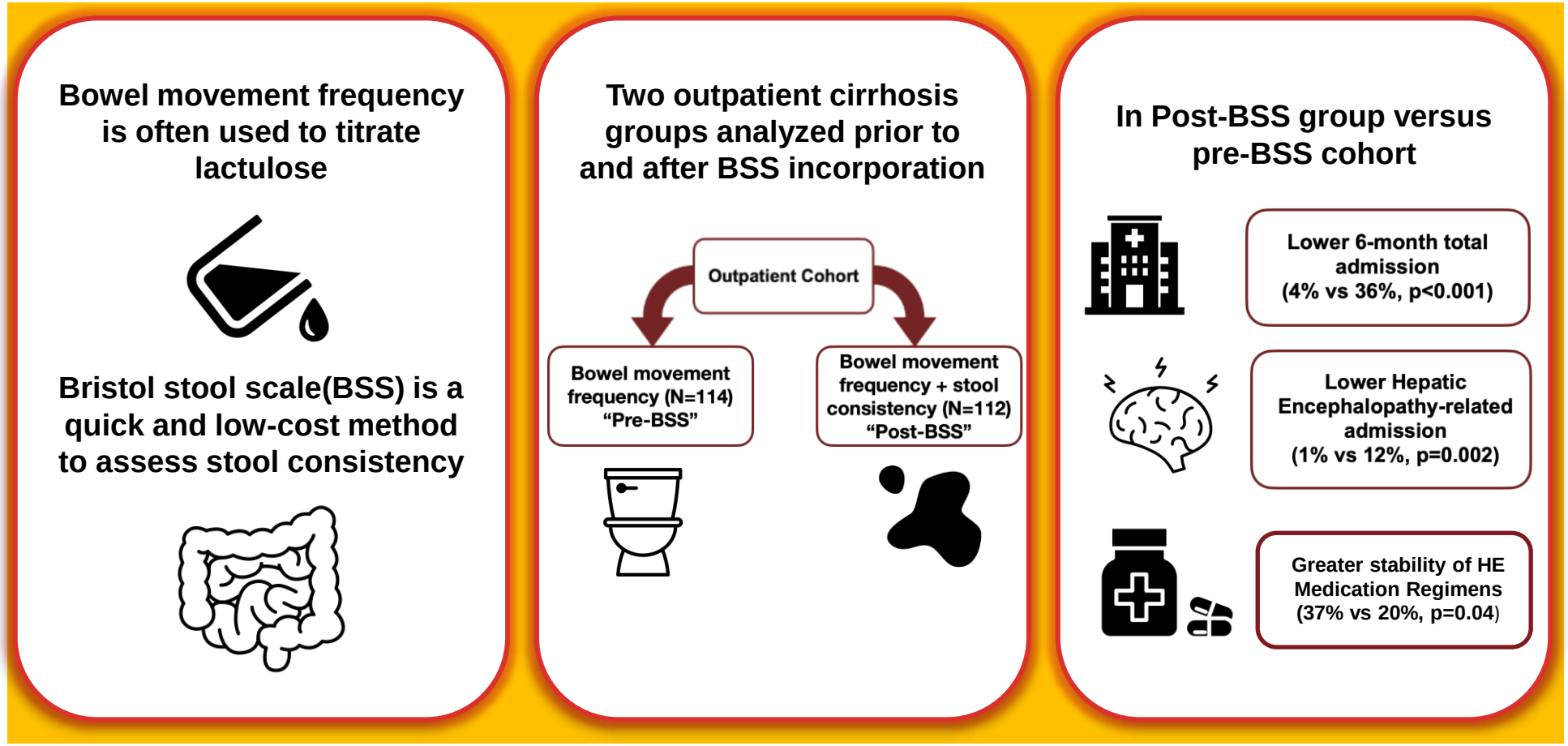
Prevention of Overt HE recurrence: Lactulose



- Minimal change in microbiome structure or function
- Poorly tolerated and Western countries have poor acceptance
- Lactulose non-adherence is the #1 reason for HE-related readmissions

Sharma et al Gastro 2009, Wang et al JDD 2019, Rathi et al JCEH 2018, Bajaj et al NACSELD APT 2019

Quality not just Quantity of Stools: Bristol Stool Scale for HE



Improves stability of HE Rx and prevents recurrence

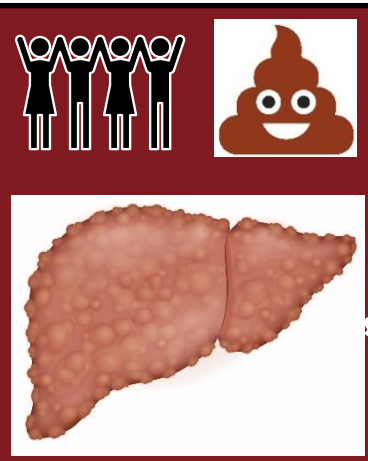
If BSS≥5 = don't increase lactulose dose or initiate it

Duong et al. *Am J Gastroenterol. 2021*

Dieta App to Manage Hepatic Encephalopathy in Cirrhosis

Using Bristol Stool Scale (BSS) rather than simple Bowel movement Numbers can reduce lactulose dose fluctuation but could be difficult to gauge in patients with Hepatic Encephalopathy

AI-based Dieta App calculates BSS using stool pictures & transmits back to users securely



Patients with Cirrhosis & Controls with Cross-sectional & Longitudinal Analysis with and without AI communication

Outcomes

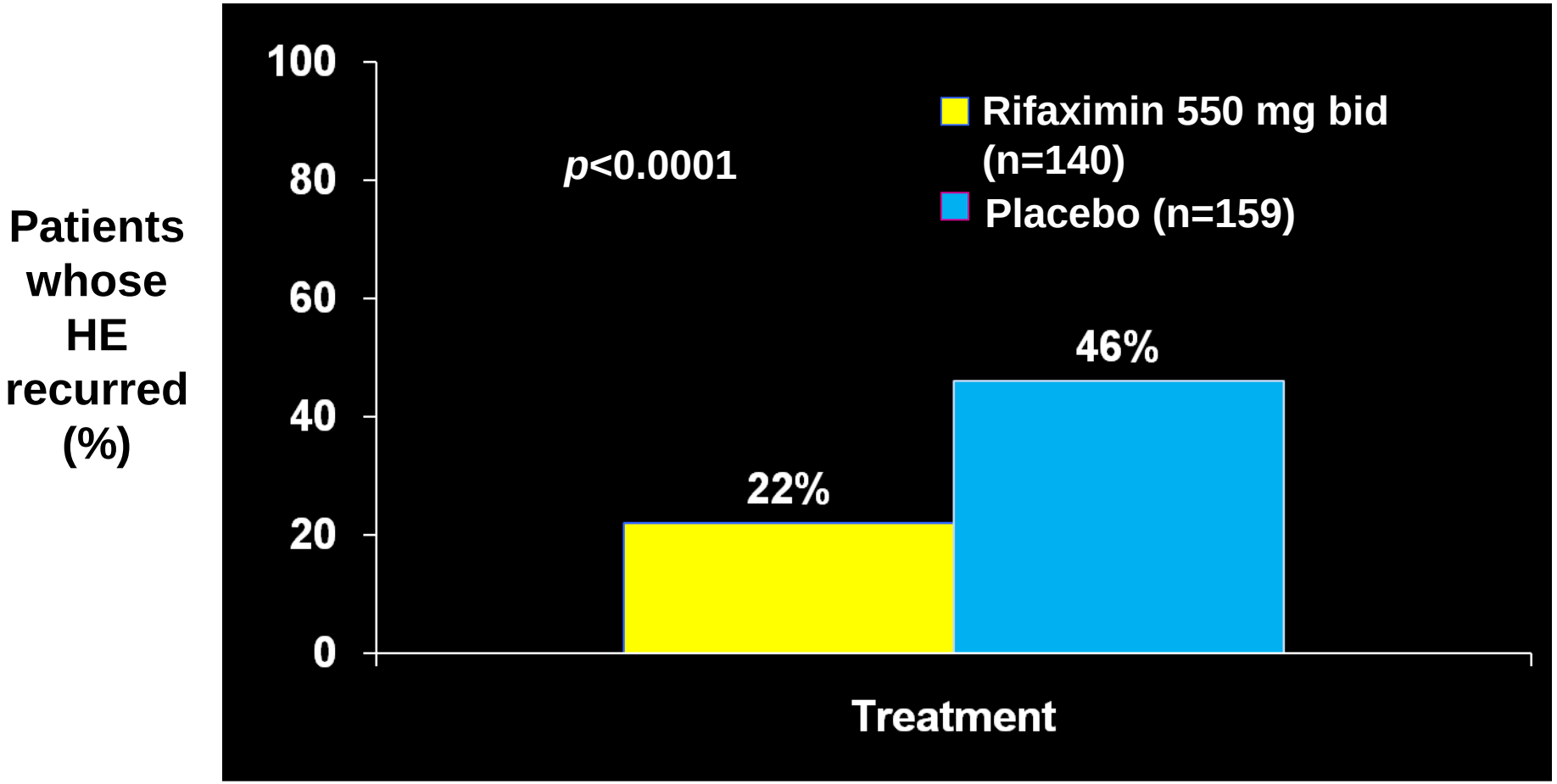
- **Comfort with App and taking stool pictures**
- **Lactulose dose adjustment when AI generated BSS was communicated or not**
- **Correlation of self and AI-generated BSS**

- Most subjects were comfortable with the App and taking pictures
- AI and Self-generated BSS correlations increased over time
- Self-titration of lactulose was ↑ when AI communication was switched on

Fagan et al. *Am J Gastroenterol. 2024*. [doi]

AJG The American Journal of GASTROENTEROLOGY

Prevention of Overt HE recurrence: Lactulose + Rifaximin



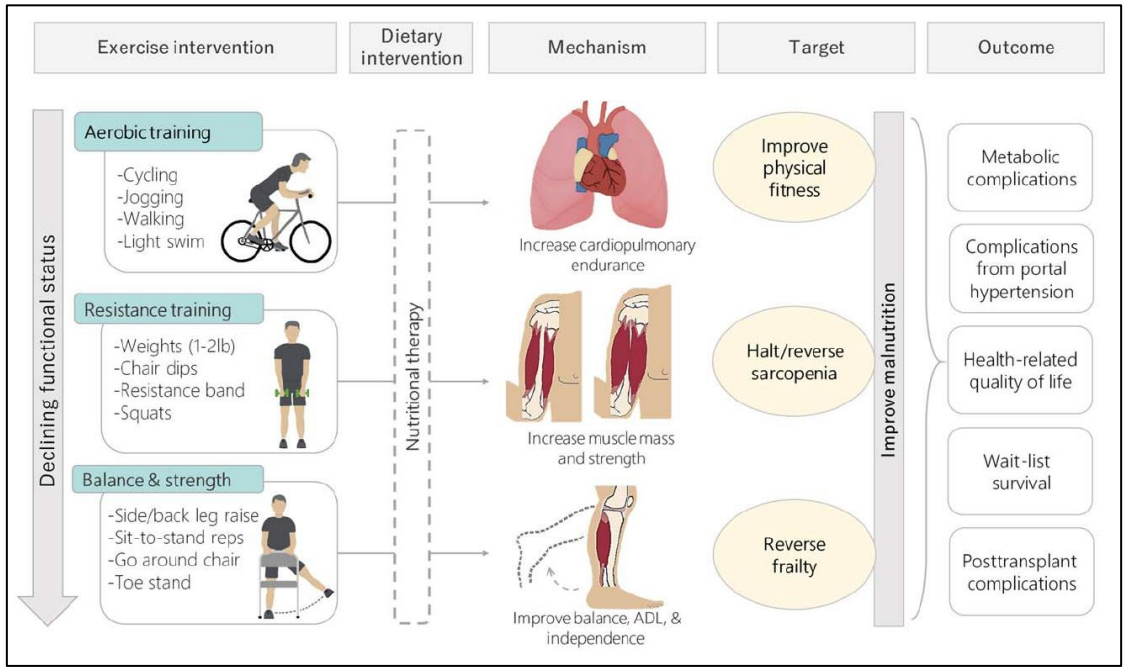
*Patients who had ≥2 episodes of HE within 6 months prior to screening and who were in remission at trial start

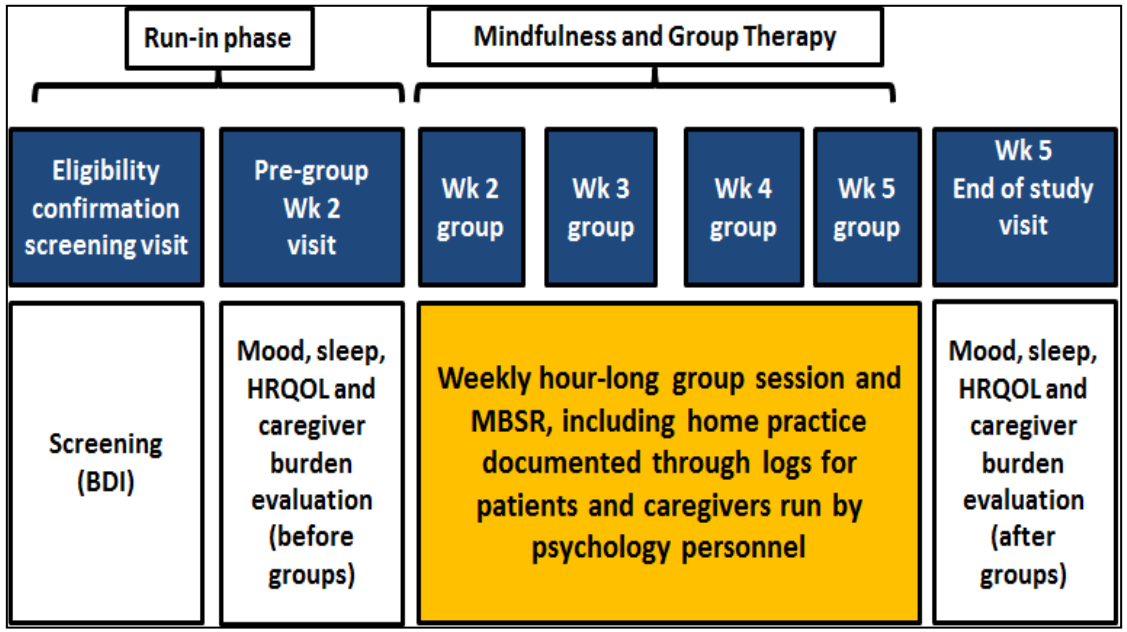
Bass N et al. NEJM 2010, Sharma et al Gastro 2009

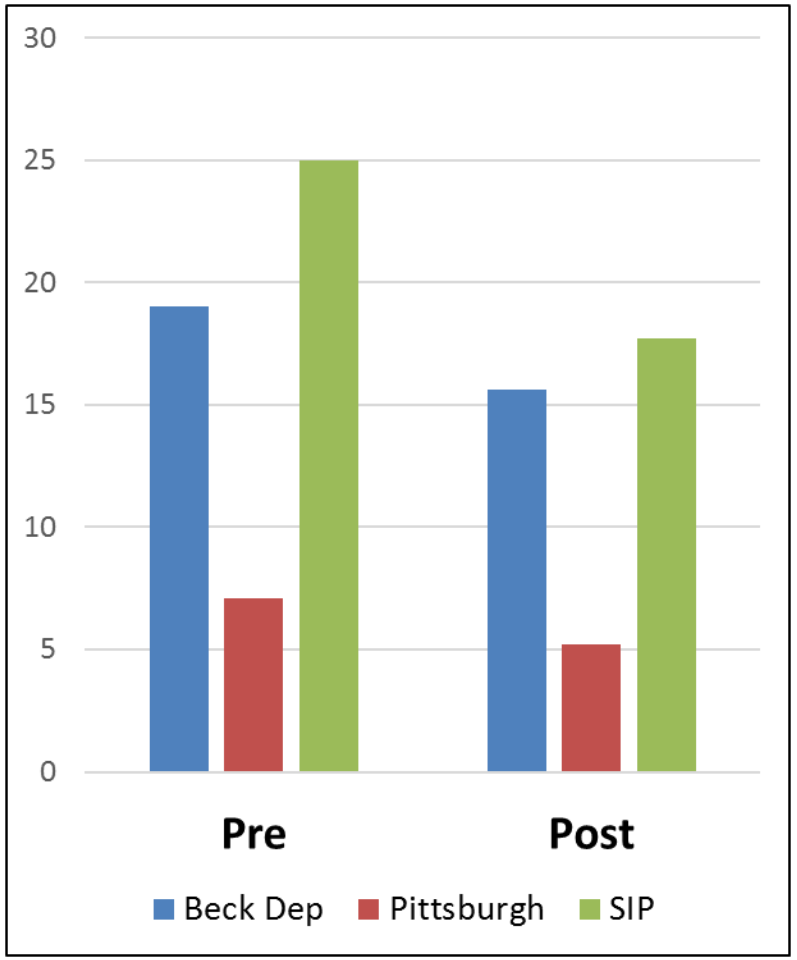
Challenges:

1. Needs bile to solubilize for optimal bio-availability
2. Expensive in certain countries, which can be a barrier
3. Not available in some countries, which is also a barrier

Work the body and mind







In patients with cirrhosis and depression, Mindfulness decreased depression, Sleep impairment, improved QOL and Caregiver burden

Duarte-Rojo et al Liver Transpl 2017, Bajaj JS et al Clin Transl Gastro 2017

Co-morbid conditions and drugs affect cognitive test results and HE risk differently

Affecting HE risk

PPIs ↑

Opioids ↑

Statins ↓

Beta-blockers ↑

Other neuro-active drugs (benzodiazepines, gabapentin) ↑

Affecting cognitive tests

Age Impairs

Opioids Impairs

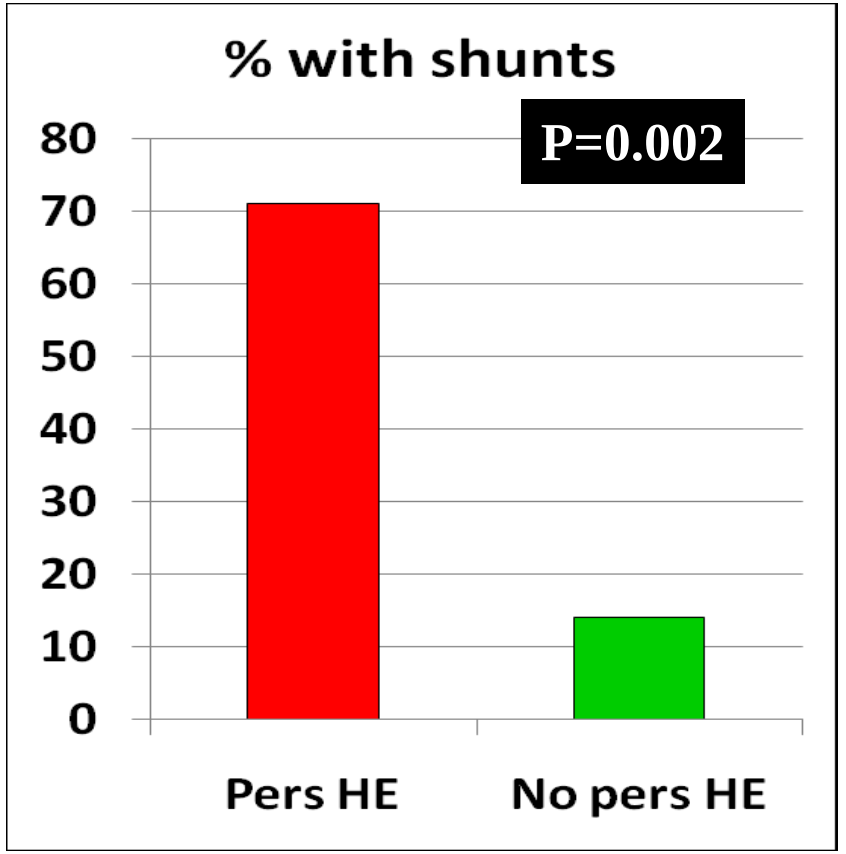
Antidepressants Improves

Diabetes ~

Renal Impairment ~

Tsai et al Gastro 2017, Tapper et al Hepatol 2017, Dam et al Hepatol 2016, Metab Brain Dis,
Bajaj et al Liver Transpl 2012, Acharya et al Am J Gastro 2021

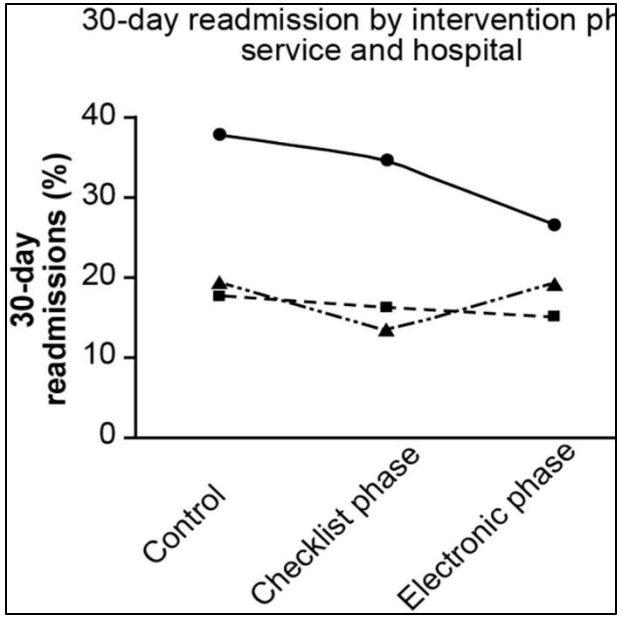
Persistent HE may be associated with shunts

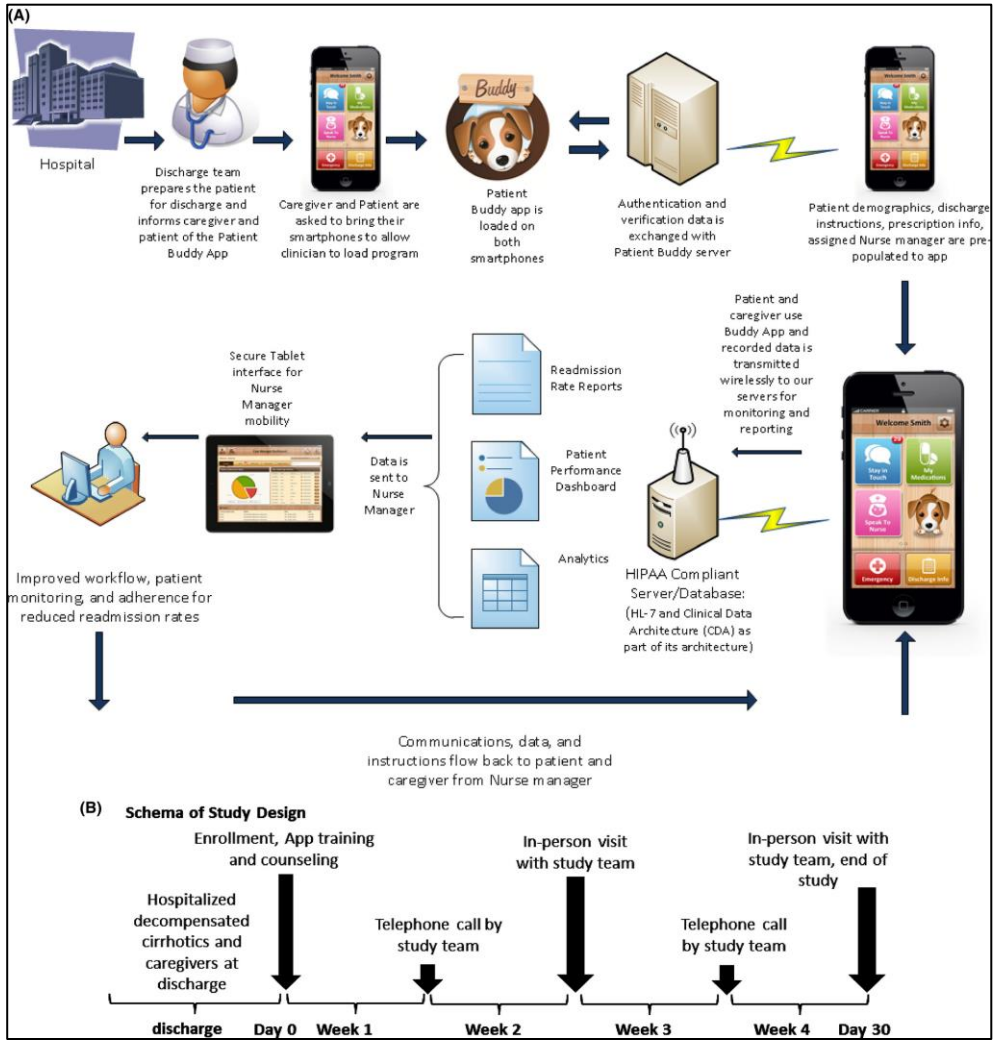


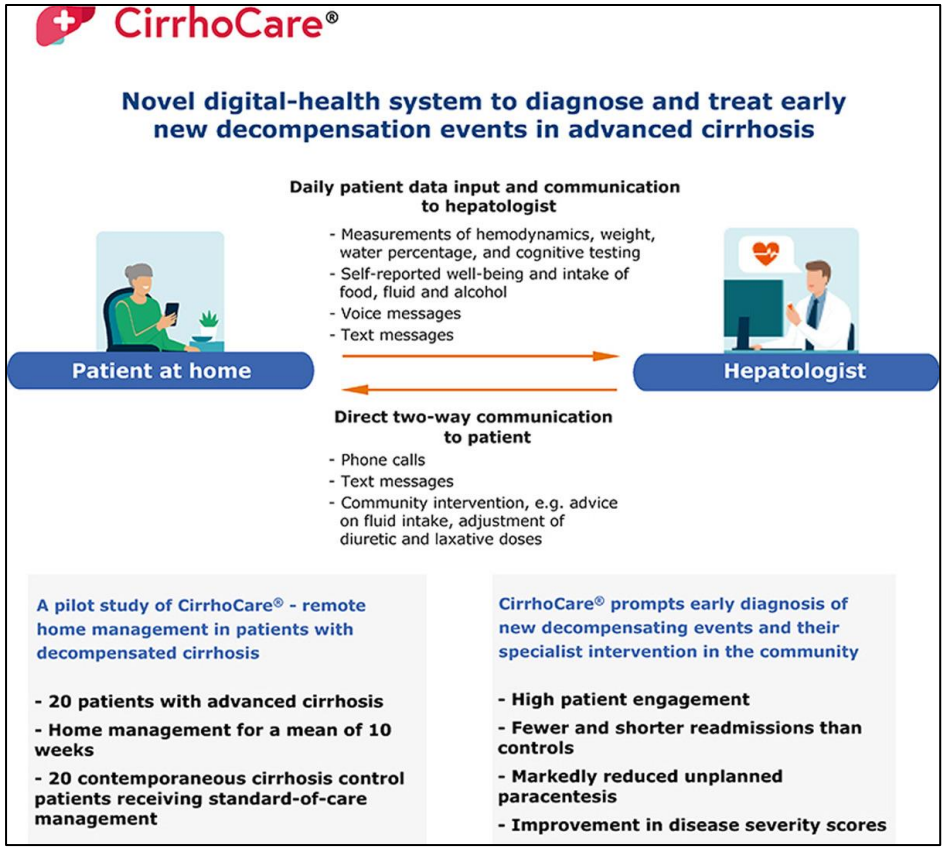
Embolization of these shunts can improve the course of HE
Especially with low MELD <11 and a single shunt

Riggio et al Hepatol 2005 , Sakurabayashi Cardiovasc Intervent Radiol 1997, Laleman et al Hepatol 2013

Enforce Checklists and Keep in Touch with Patients To prevent Readmissions







Ganapathy et al Liver Int 2017, Tapper et al CGH 2016, Kazankov et al J Hepatol 2022

In addition to optimizing medications, further recurrence needs a multi-disciplinary approach

A. Interventional Radiology (embolize SPSS)

B. Nutrition (inpatient and outpatient consultation)

C. Physical and occupational therapy (exercise, driving)

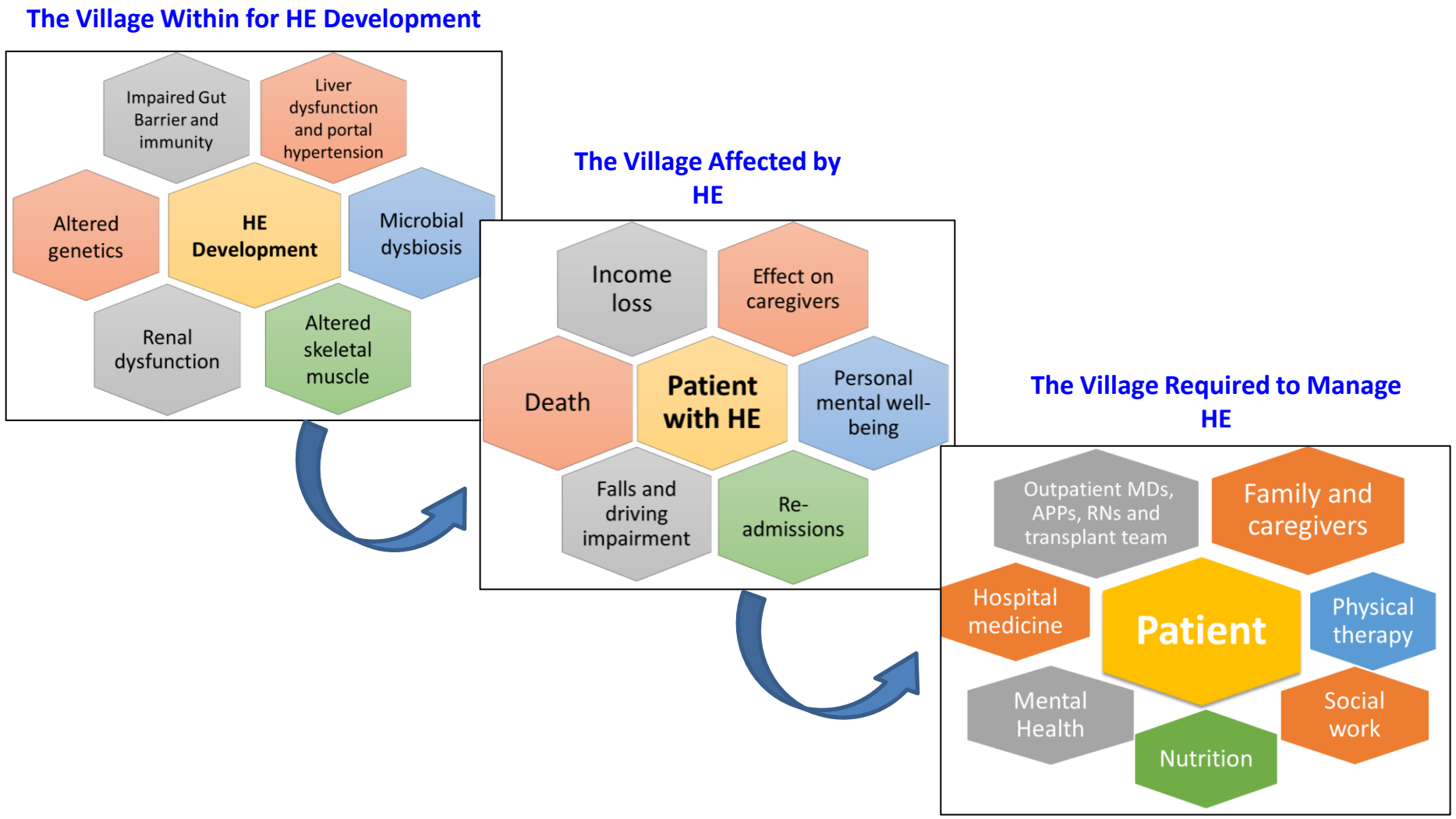
D. Mental health (psychotherapy, mindfulness, mood disorders and substance abuse assessment)

E. Oral health (attention towards gum disease and inflammatory foci in the mouth; clean teeth!)

F. System changes(Checklists, Apps and other modes of communication)

G. Driving safety

The Three Villages of Hepatic Encephalopathy



Bajaj JS American Journal of Gastroenterology 2021
doi: 10.14309/ajg.0000000000001212

Special Situations

- TIPS

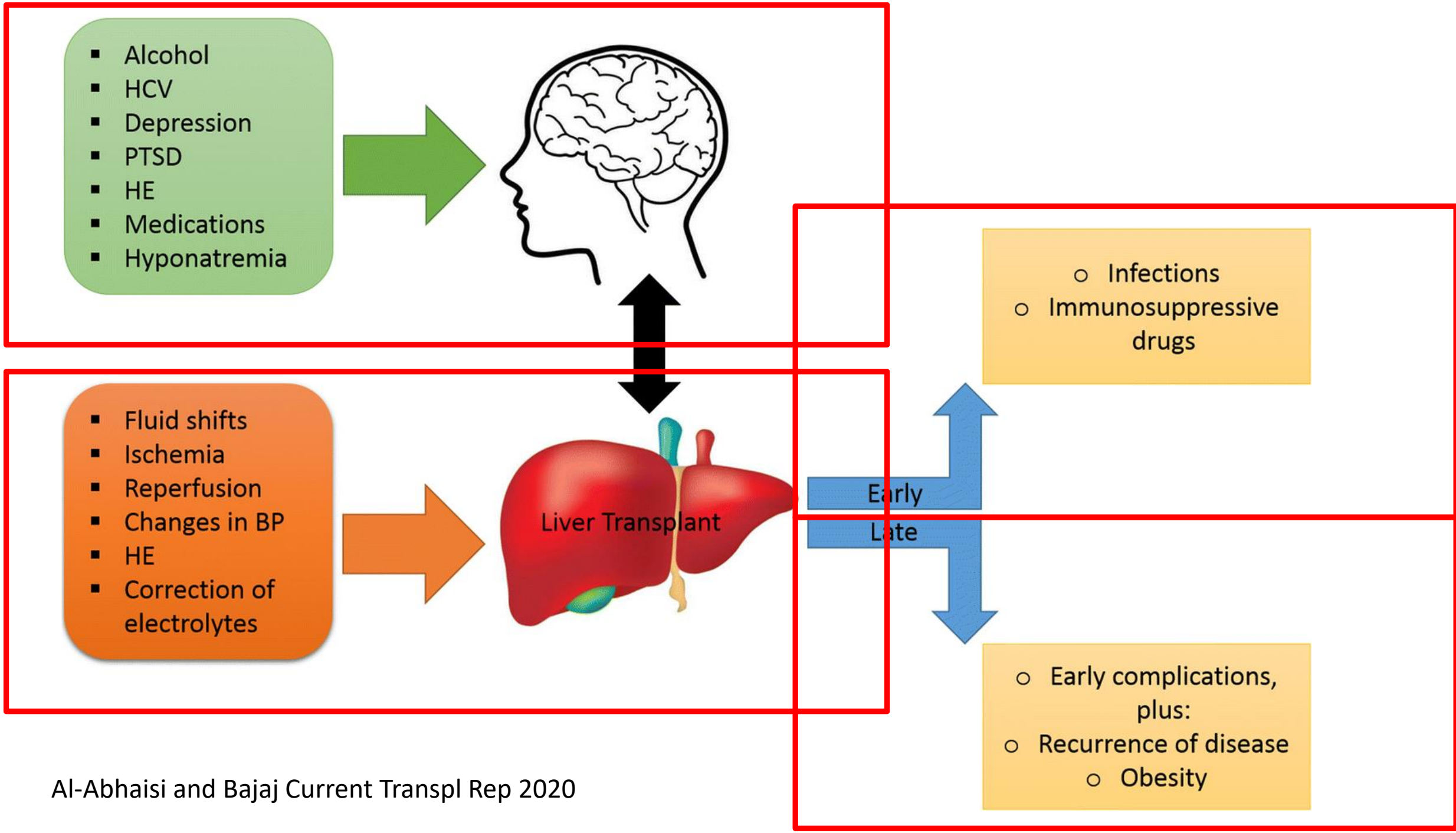
-Driving

- Post Liver Transplant

Liver transplant

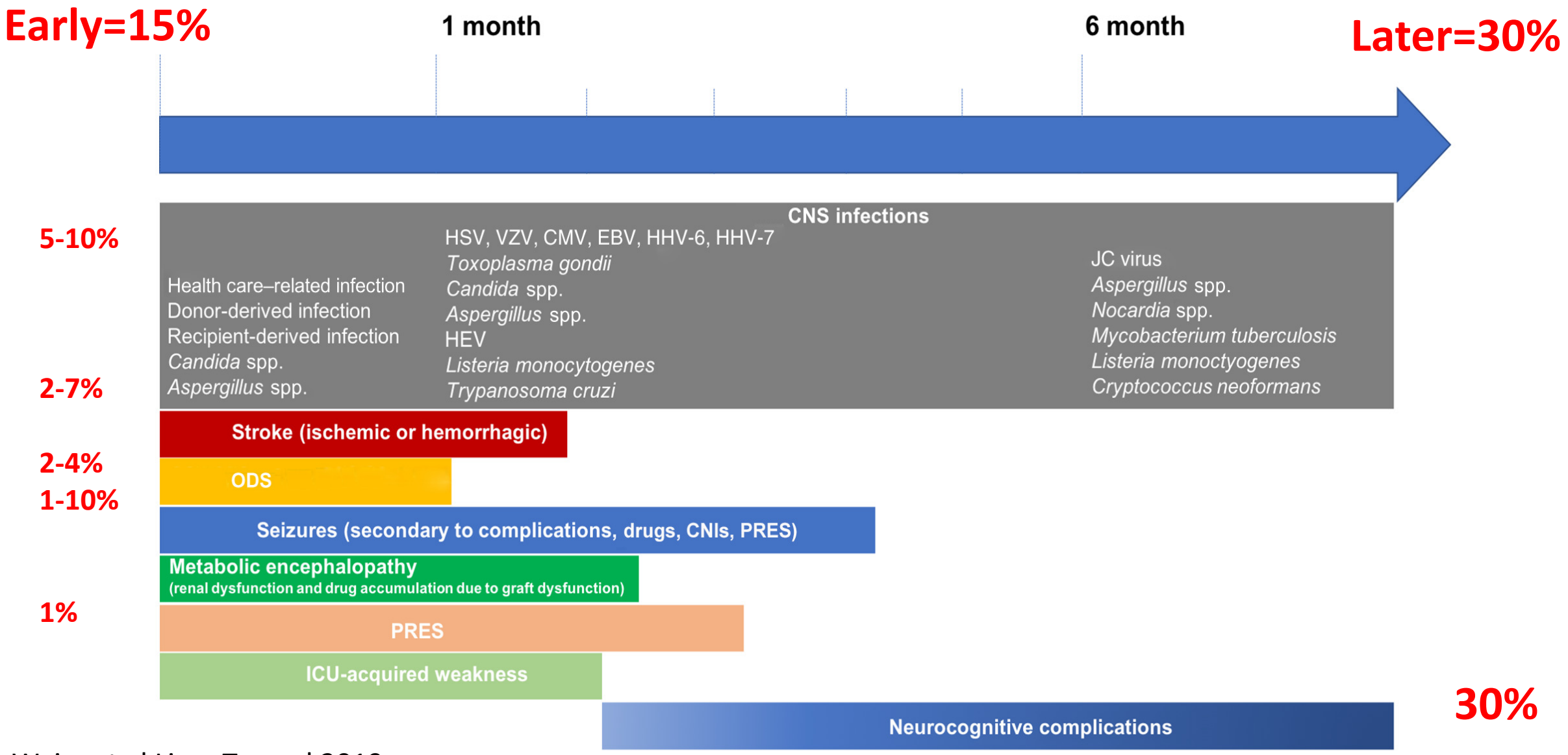
Do things get better once the diseased liver is replaced by a healthy new liver?

It’s complicated because
LT is not a perfect model



Al-Abhaisi and Bajaj Current Transpl Rep 2020

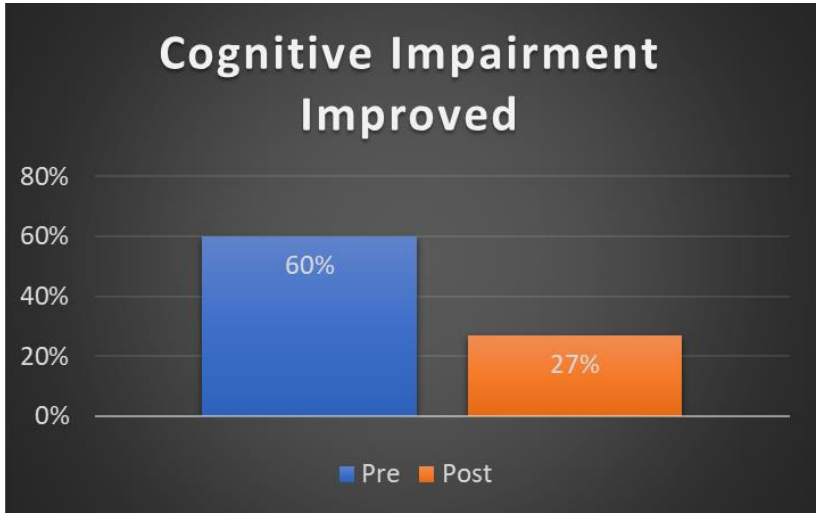
Substantial Burden of Neurological Complications Post-LT

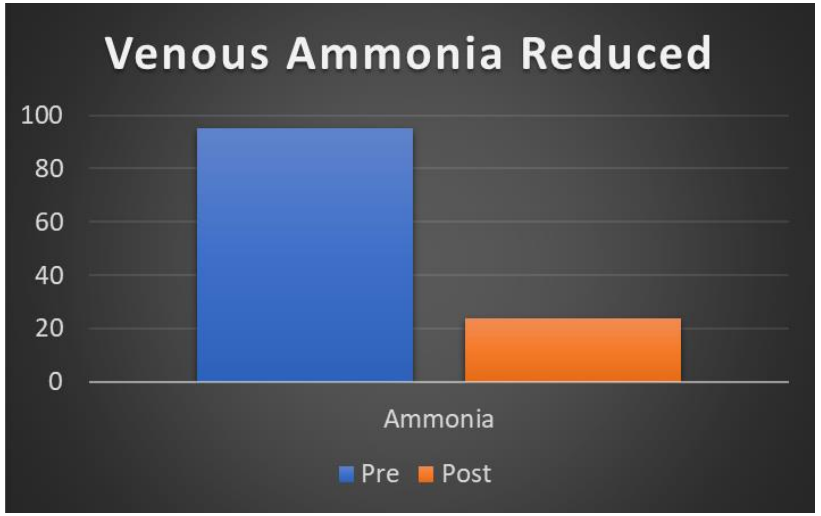


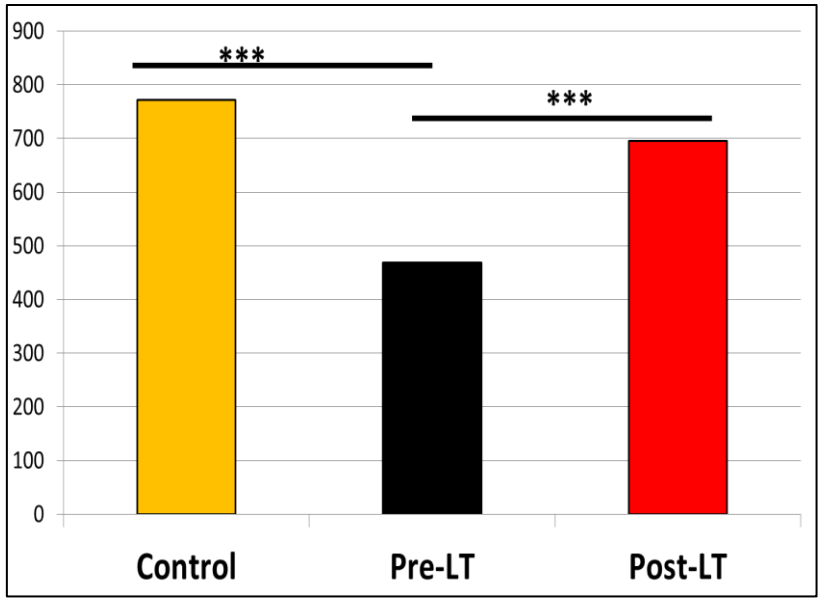
Weiss et al Liver Transpl 2019

Microbial diversity & function, and Cognition recovers post-LT

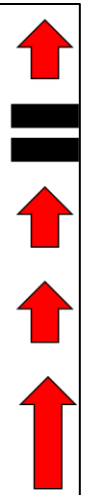
- ✓ **Cognitive function Improves** and is linked with **change in gram-negative bacteria**
- ✓ **Intercurrent events:** Microbiota are **disrupted** by infections, surgical issues and rejection
- ✓ **Stability after 6 mths:** Better diversity and **return of microbial function**







1. Total Fecal BAs
2. Deconjugation
3. Oxo-bile acid formation
4. Iso-bile acid formation
5. 7 alpha de-hydroxylation to form secondary BAs



Bajaj JS et al Liver Transplantation 2017 and 2018, Sun et al Scientific Reports 2017, Lai et al Front Physiol 2022

High Burden of HE after TIPS

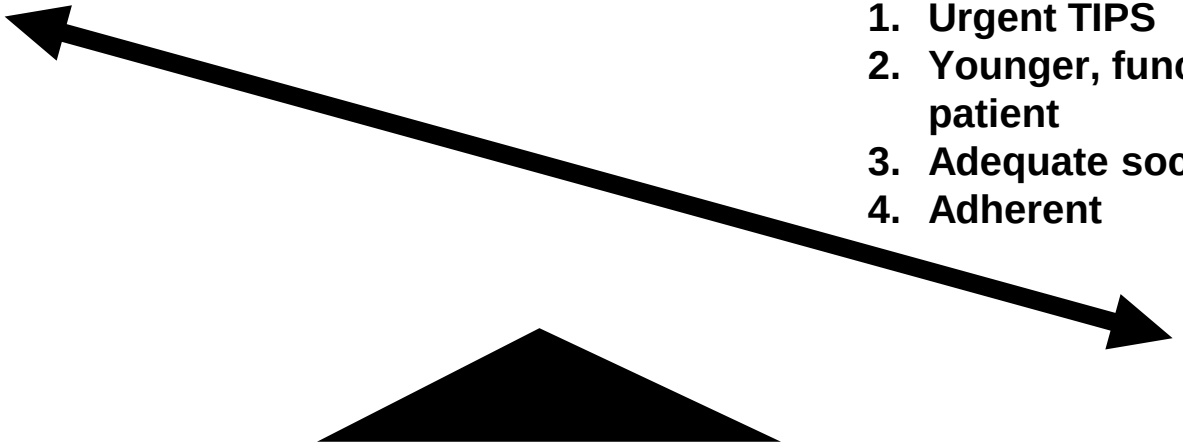
- Overall, all comers =25-45%
- New or worsened?=13-36%
- Cause of 50% of readmissions post-TIPS
- Can result in multiple episodes
- Major reason for poor HRQOL post-TIPS
- However, should not stop one from putting one in for variceal bleeding

Riggio et al Clin Liver Dis 2012, Bajaj ISHEN consensus Am J Gastro 2020, Riggio et al Am J Gastro 2008, Vozzo et al Gastro Rep 2017, Campbell et al Hepatol 2005, Rudler et al Gut 2022

Predictors and Decision Points

RISK HIGH

1. **Older patient without social support**
2. **Prior Overt HE**
3. **Current Cognitive Impairment**
4. **Sarcopenia**
5. **Advanced liver disease**
6. **Elective TIPS with alternatives**

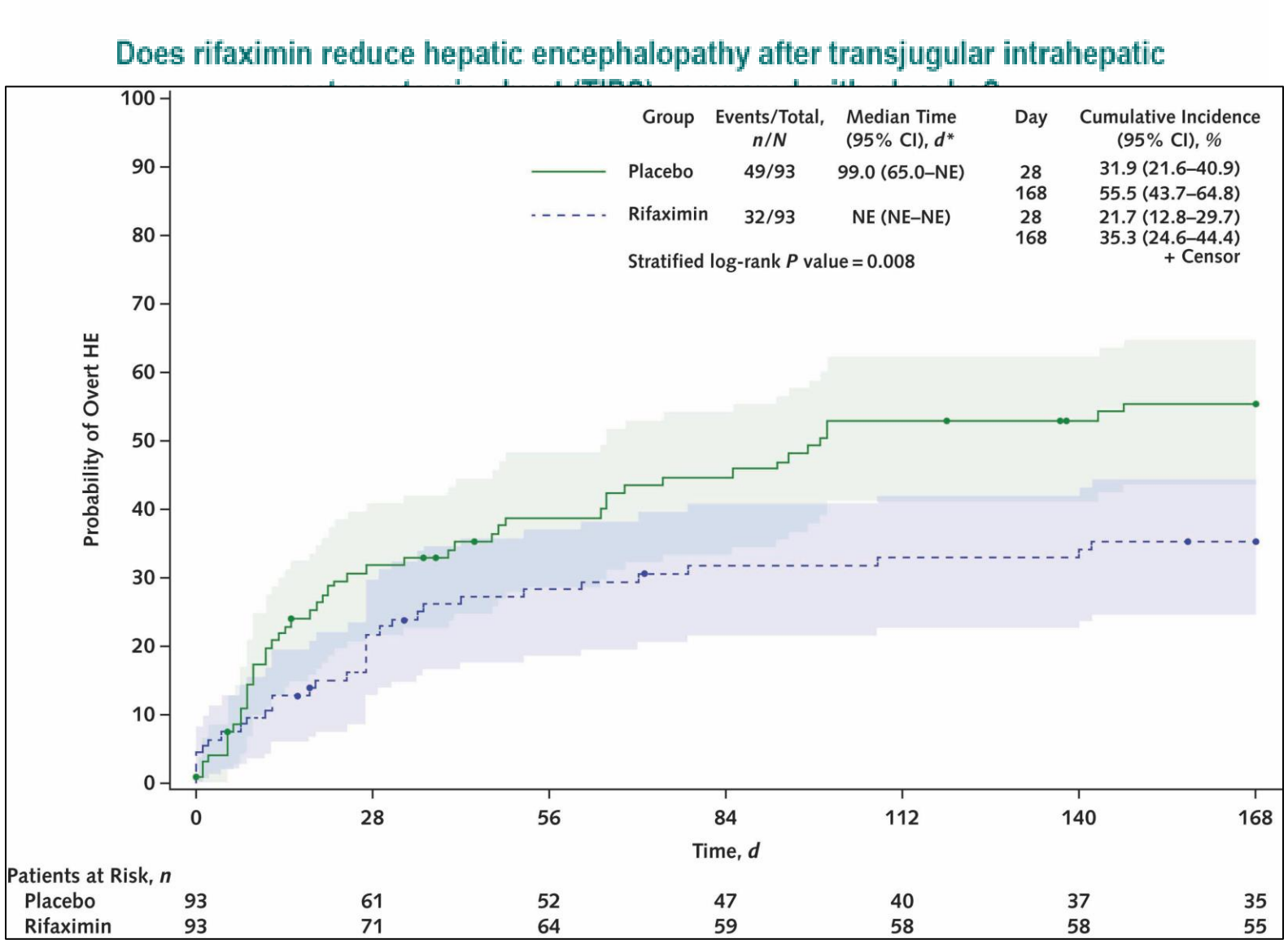


BENEFIT HIGH

1. **Urgent TIPS**
2. **Younger, functional patient**
3. **Adequate social support**
4. **Adherent**

Riggio et al Clin Liver Dis 2012, Bajaj ISHEN consensus Am J Gastro 2020,

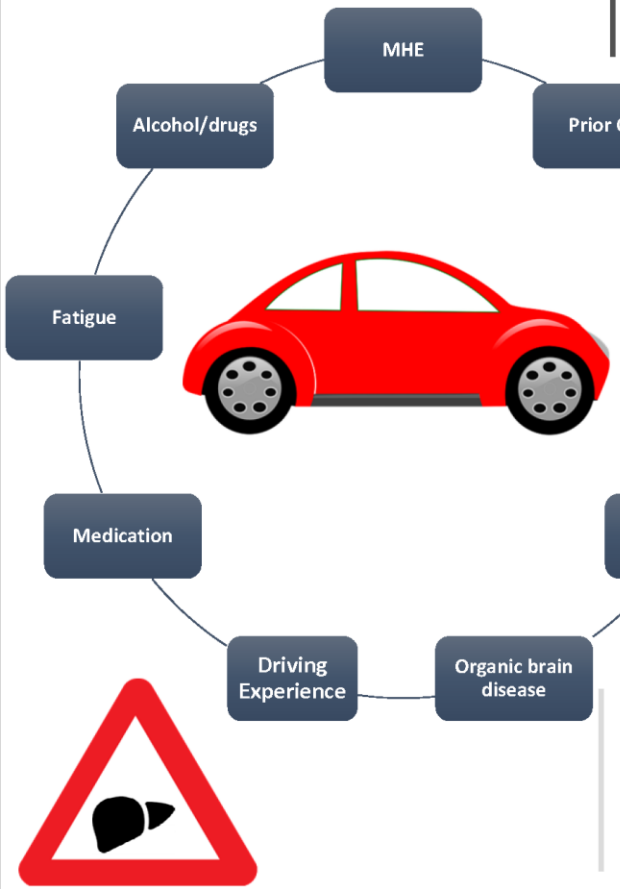
Rifaximin ↓HE after Elective TIPS Placement



Bureau C et al Annals Int Med 2021

Figure 1: Hepatic Encephalopathy and Fitness to Drive

Influences Driving

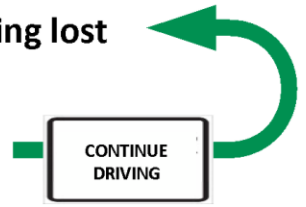


Consequences

Accidents

Near misses

Getting lost



Isolation

Lower self-sufficiency

Damage to patient-doctor relationship

Driving assessment

Short driving history should be taken at every visit

On-road driving test

Driving simulation

Driving History

Cognitive Testing

CAUTION

- Physicians do not have legal authority to withdraw a patient's drivers licence.
- Physicians may be obliged to report an unsafe driver to authorities.

Management

Advise patients not to drive ~3 months after last overt HE episode

No evidence to support a driving ban to all with CHE/MHE without prior overt HE, also take driving history into account

Initiate or optimize HE treatment

Avoid/withdraw/decrease sedative medications

Optimize treatment of comorbid diseases

Refer to authorities for formal testing for resuming driving privileges

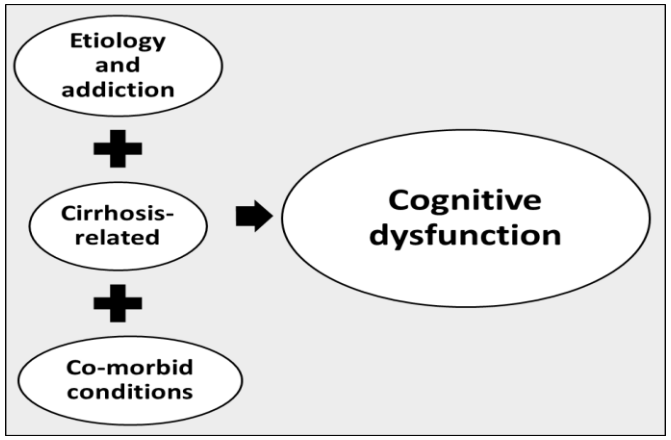
Bajaj JS et al ISHEN Consensus Am J Gastro 2020

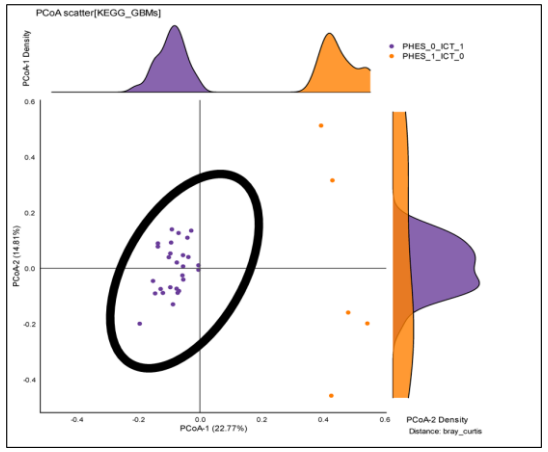
What's being tested for HE diagnosis and treatment now?

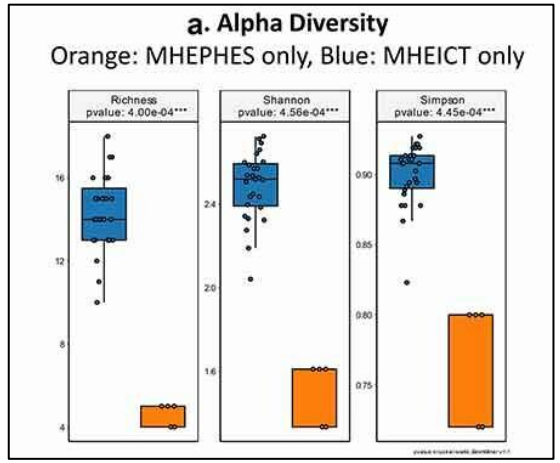
Newer Therapies

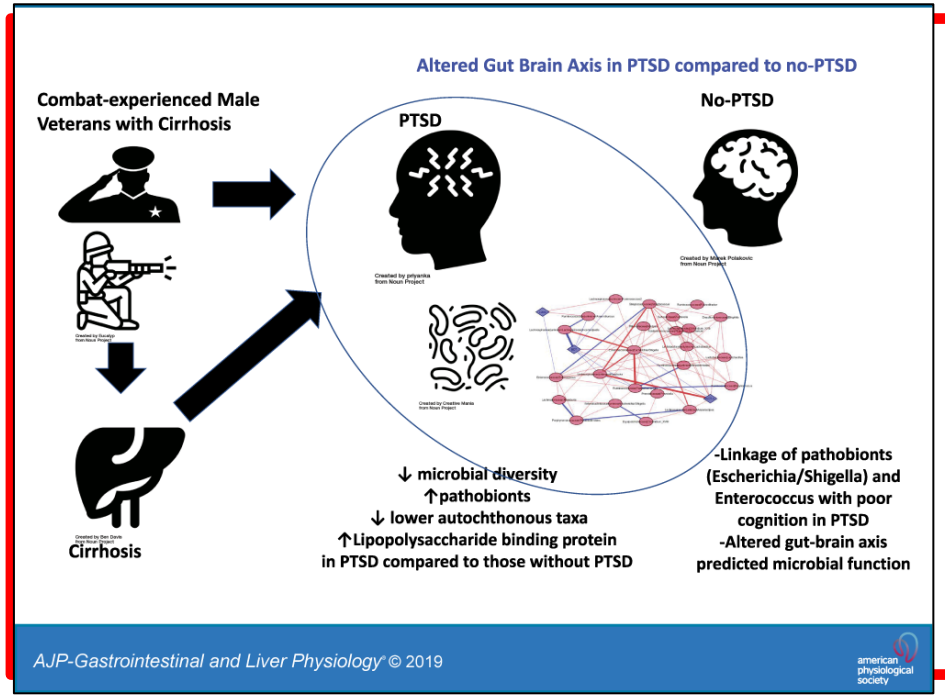
- Rifaximin SSD
- Rifamycin SV MMX
-FMT
- Golexanolone
-Albumin

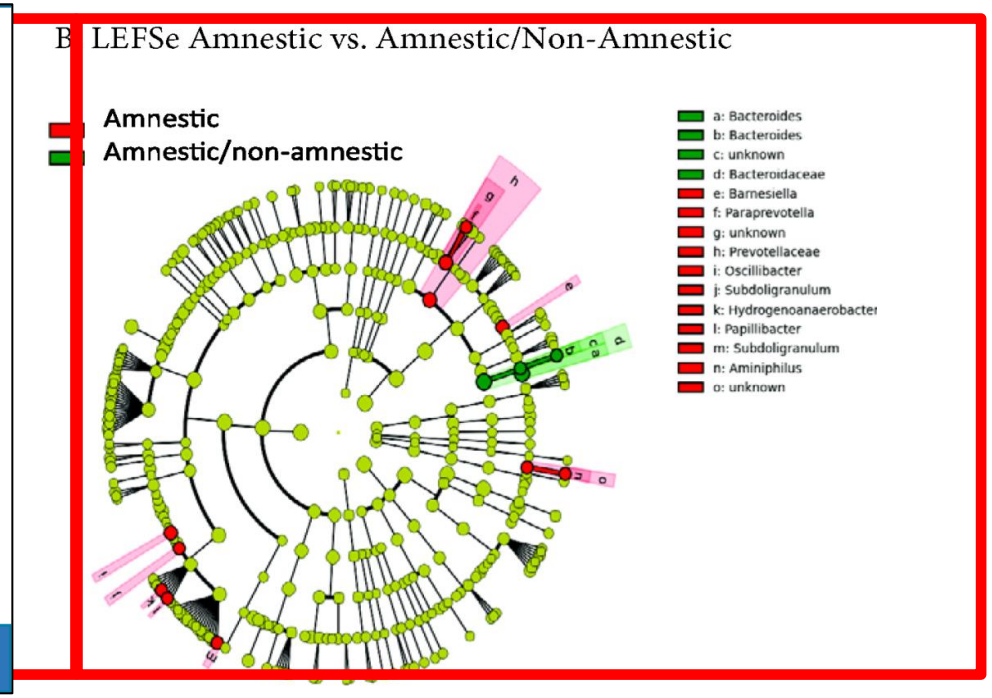
Microbial Profiles Can Exclude MHE and Determine Impact of Addiction, Aging and PTSD





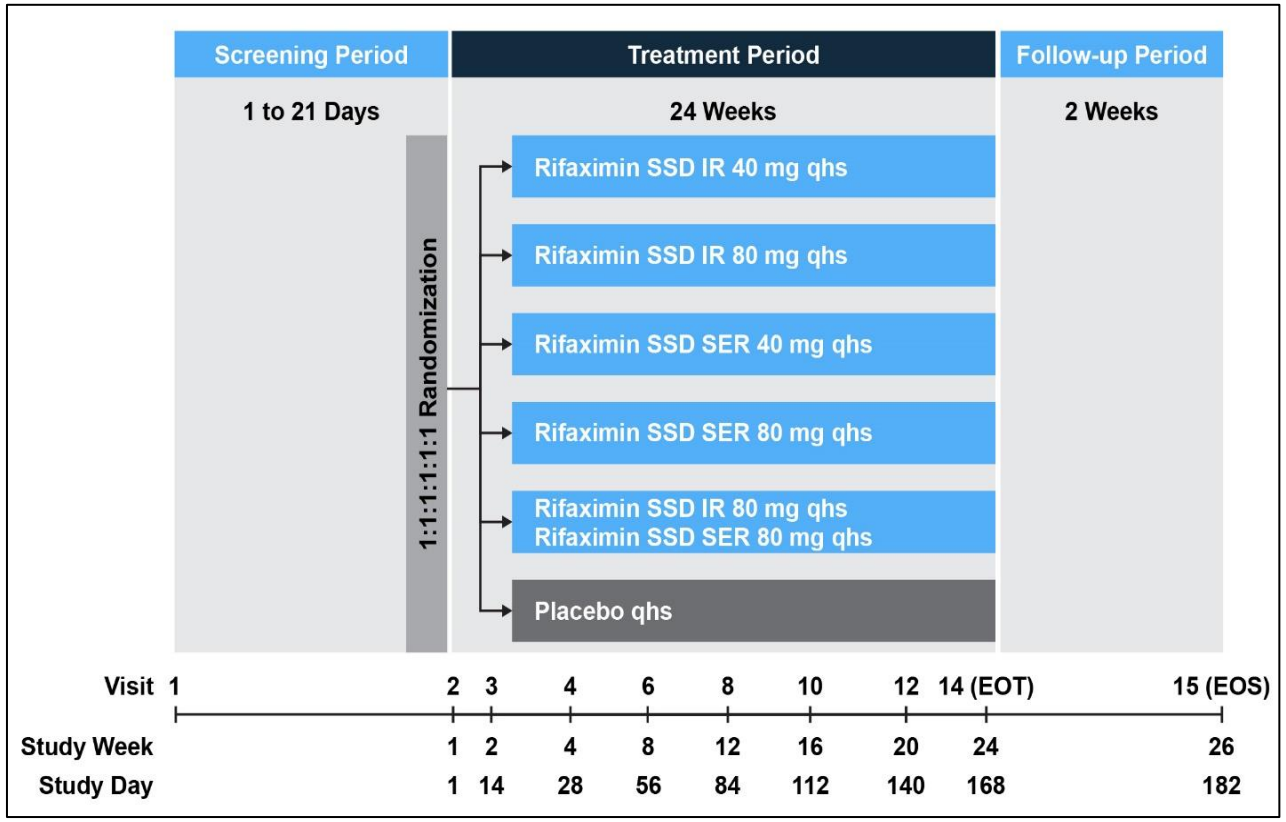


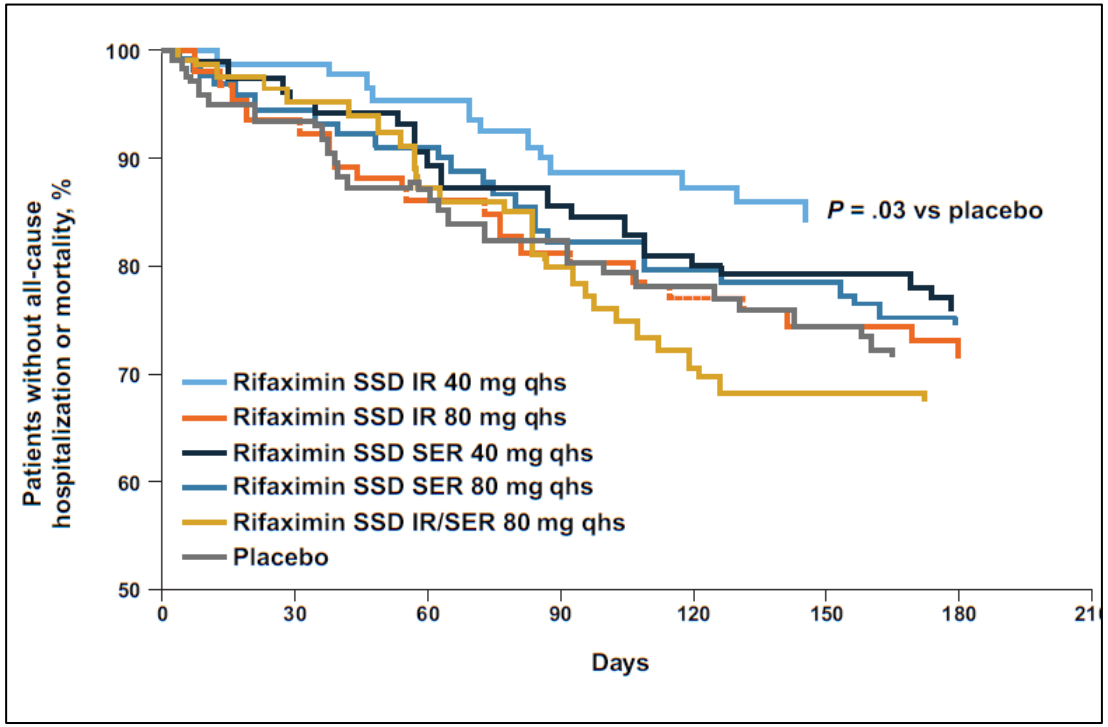


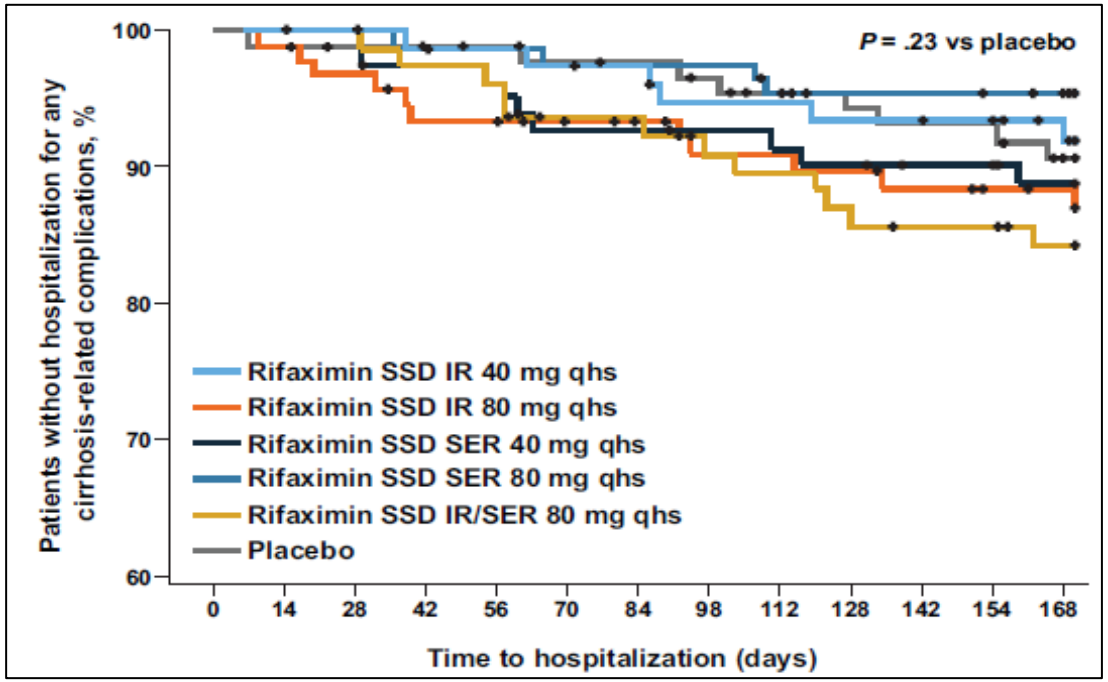


Bajaj et al Scientific Reports 2016, Bajaj et al Am J Gastro 2019, Bajaj et al Gut Microbes 2021, Bajaj et al Am J Physiol 2019

Rifaximin SSD for outpatients with controlled ascites to prevent mortality or hospitalizations

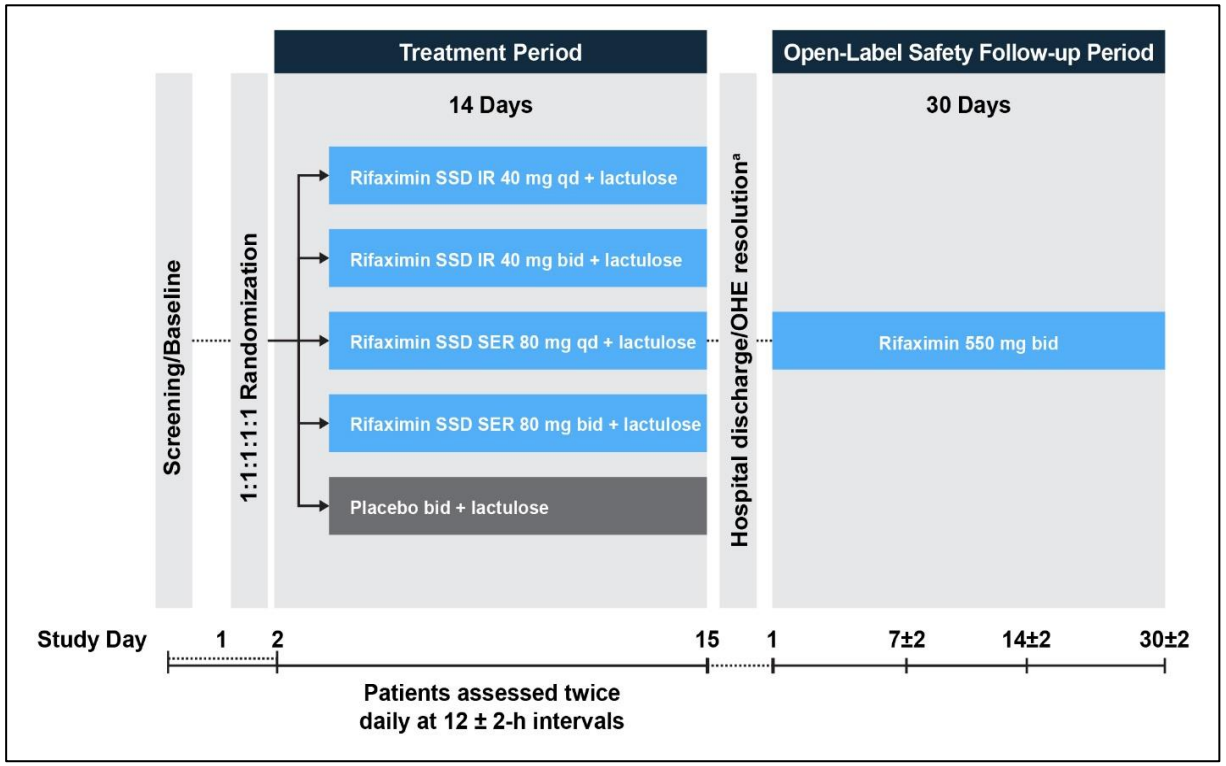


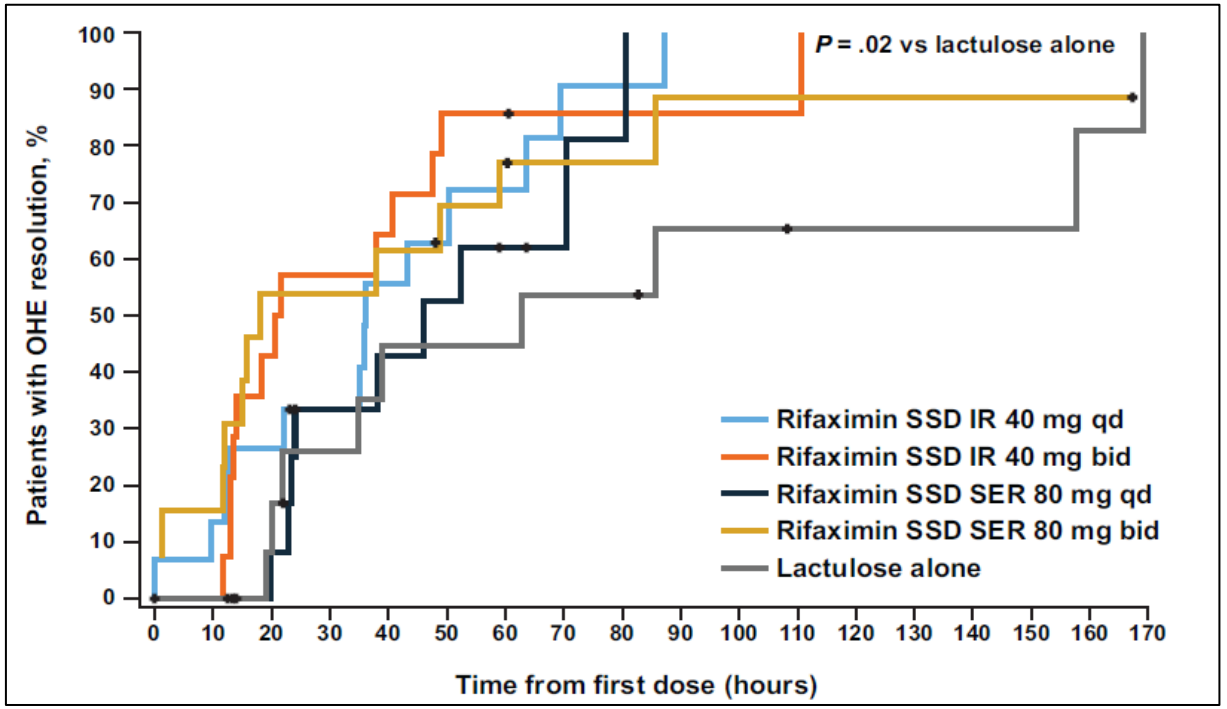


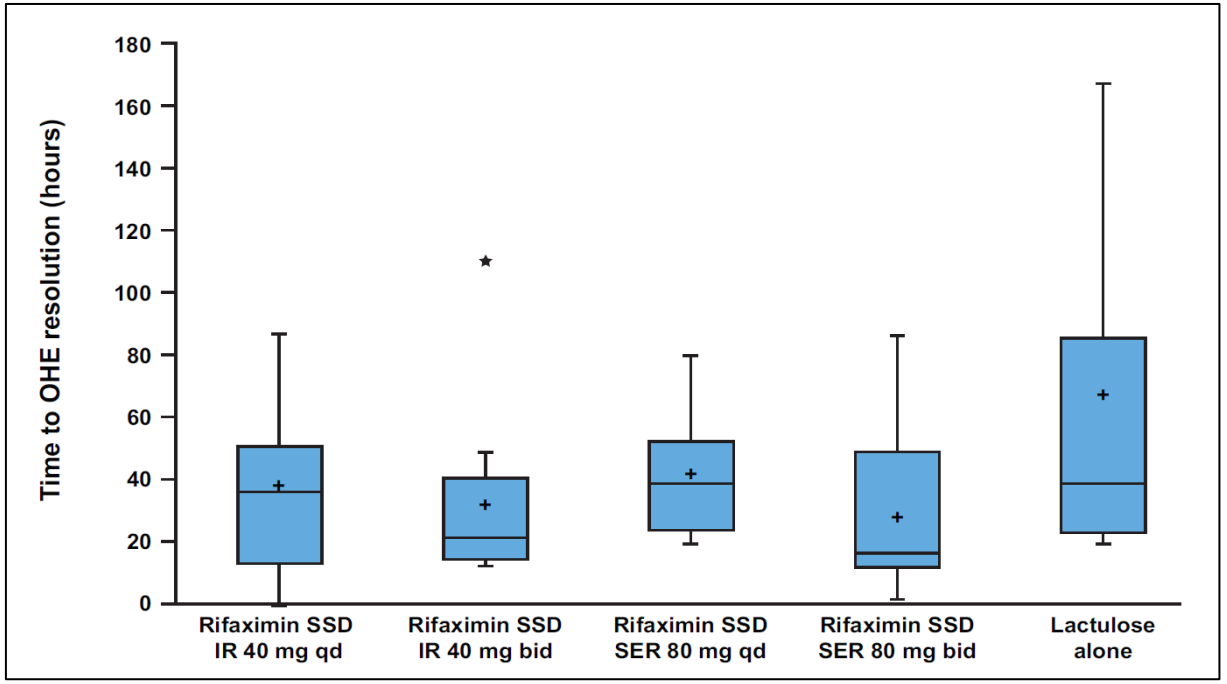


Bajaj JS et al Clin Gastro Hep 2022

Rifaximin SSD for inpatients with overt HE to hasten resolution of confusion

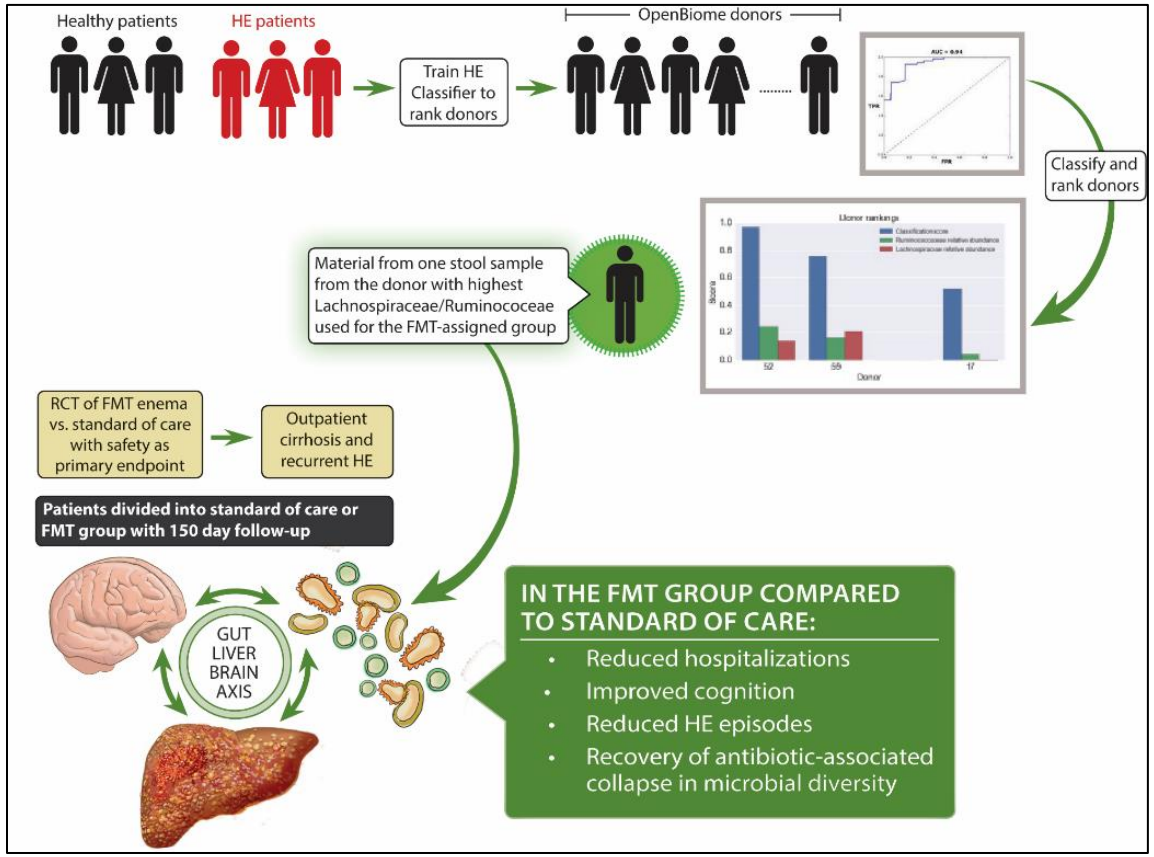


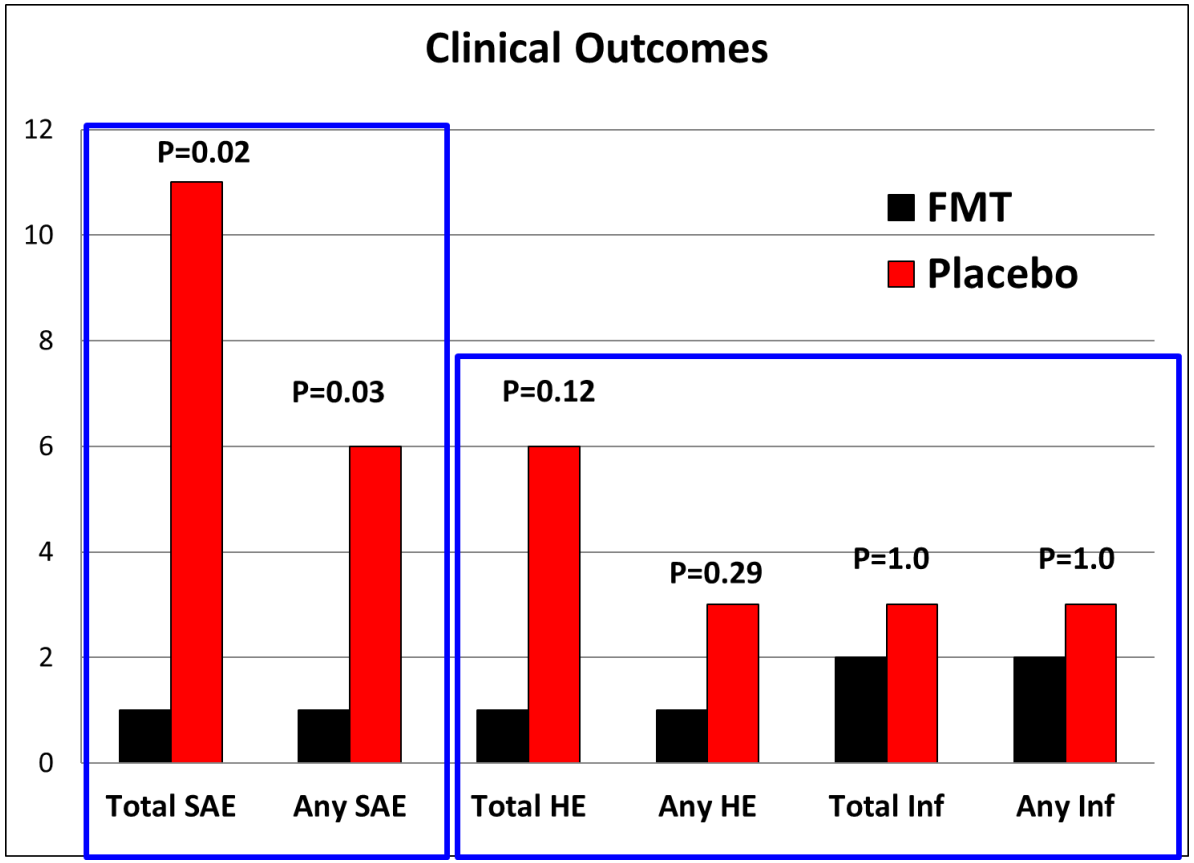




Bajaj JS et al Clin Gastro Hep 2022

Gut Microbiota modulation for HE prevention using FMT

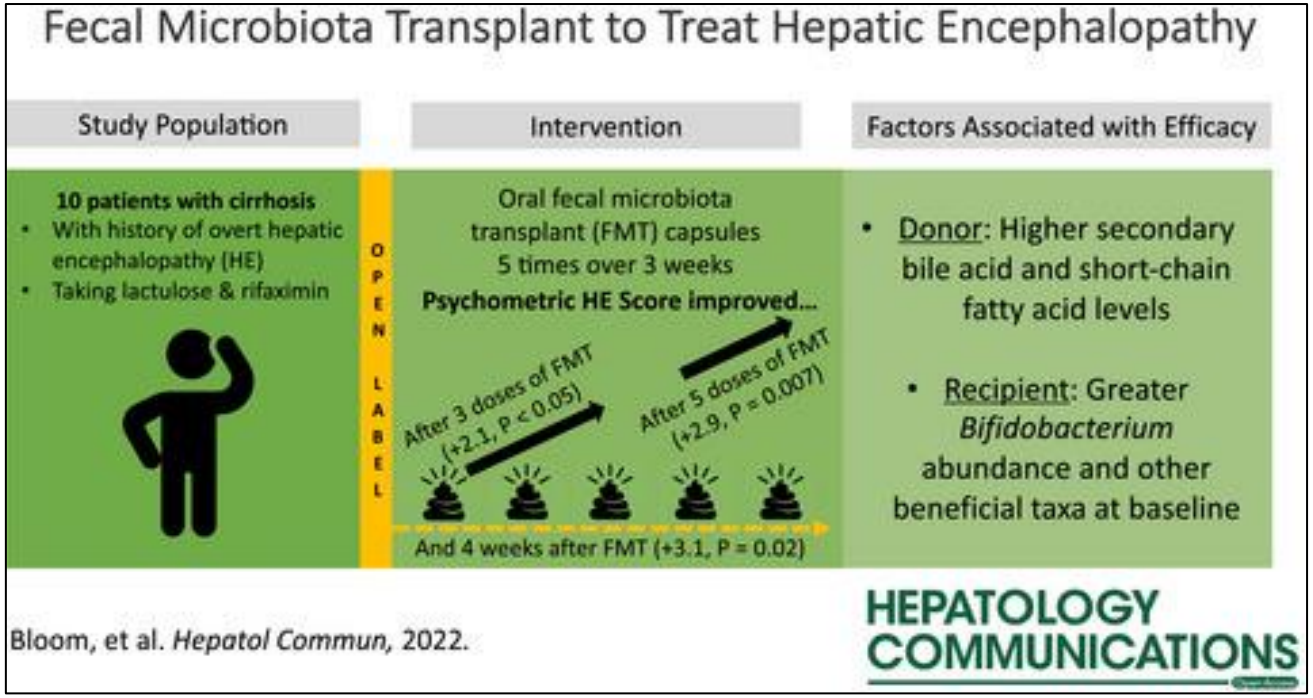




Enema and capsules are both safe with potential for improvement in 2 small RCTs
Large RCT in HE underway

Bajaj JS et al Hepatology 2017 and 2019

Further Studies on HE using FMT



Single session fecal microbiota transplantation in decompensated cirrhosis: an initial experience of clinical endpoints

Objectives

1⁰ Objective: To assess the difference in 180-day mortality between the FMT group and the SOC group

2⁰ Objectives

- To compare the changes in prognostic scores (CTP/MELD/MELD Na)
- To compare the complications in both groups
- Changes in ammonia levels and inflammatory markers (IL-1b, IL-6,) in both groups at 28 days

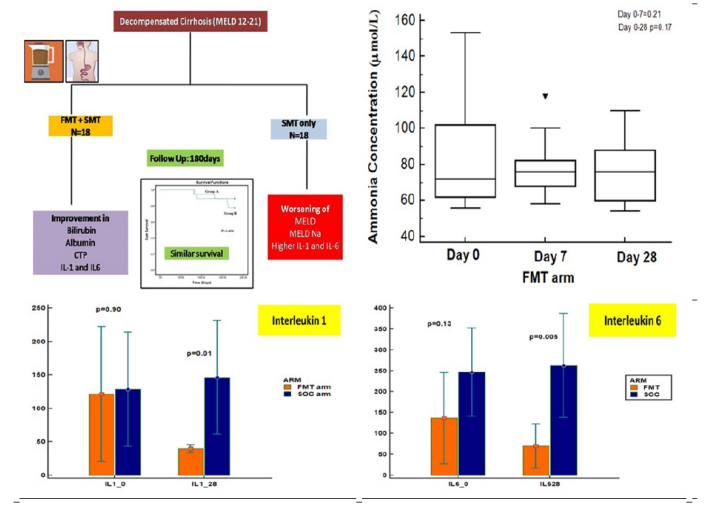
Methods

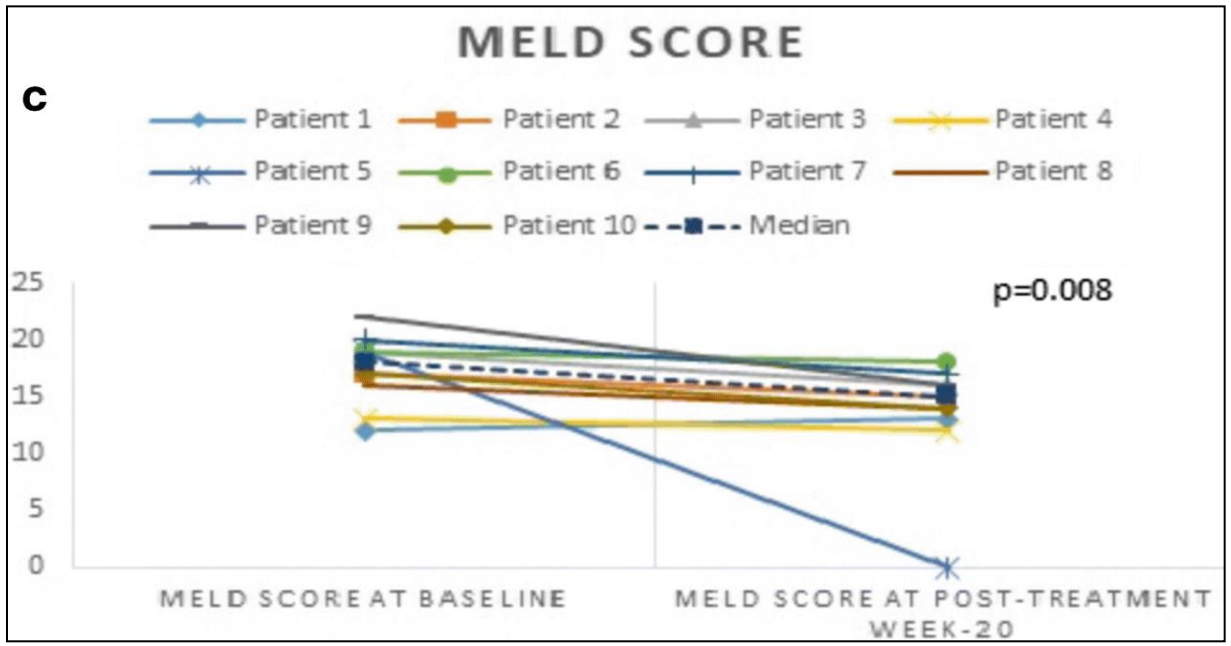
Open-label randomized control trial single session FMT (nasojejunal) using stool from family donors on patients with decompensated cirrhosis (DC) with MELD 12-21

Conclusions

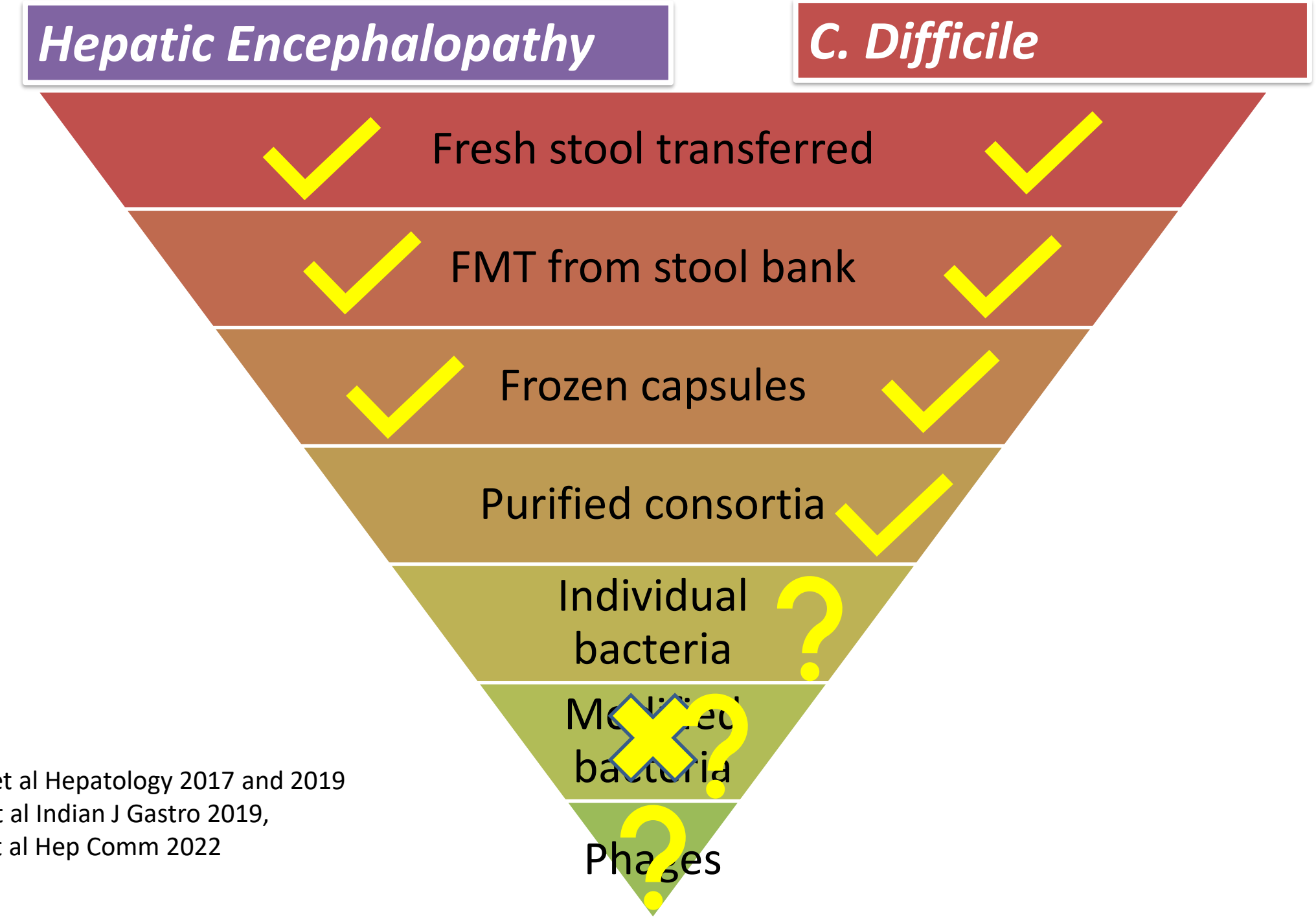
FMT in advanced but stable DC leads to selective improvement of prognostic scores, reduces inflammatory cytokines, and is associated with non-significant reduction in ammonia. However, there are no differences in complications (HE, SBP, VH) or 180-day mortality.

Roy A, et al., Abstract 176



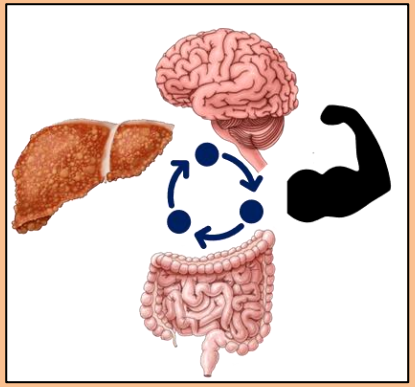


Mehta et al Indian J Gastro 2019, Bloom et al Hep Comm 2022



Bajaj JS et al Hepatology 2017 and 2019
Mehta et al Indian J Gastro 2019,
Bloom et al Hep Comm 2022

RIVET Trial: Impact of Rifamycin SV MMX on gut-brain and gut-muscle axis in patients with cirrhosis

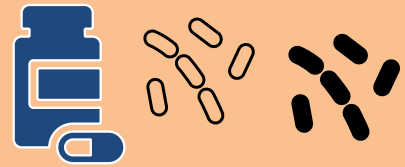


Cirrhosis and Minimal HE (N=30)

RANDOMIZATION

Placebo (n=15)

Rifamycin SV MMX (n=15)



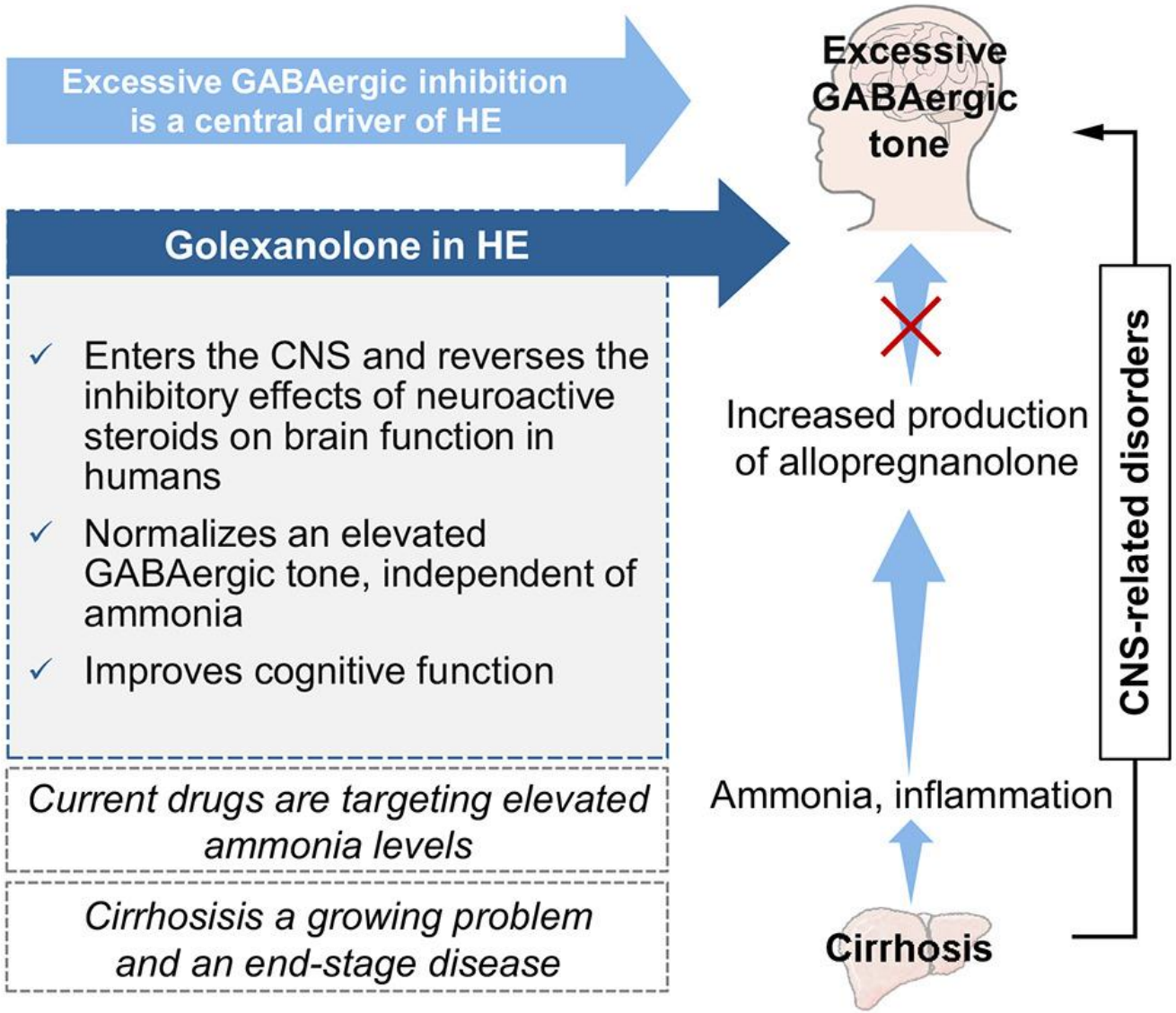
RIFAMYCIN SV MMX
Novel non-absorbable antibiotic with colonic site of action

Gut-Muscle & Gut-brain Axis Impact over 30 days with Rifamycin vs Placebo

Microbiota Composition and Function	Lower diversity but higher short-chain fatty acids and favorable bile acid profile in blood, urine and stool.
Ammonia & Cognitive Testing	Lower Ammonia but no improvement in cognitive testing
Sarcopenia & Physical Function	Higher handgrip, lean mass, & patient-reported physical function

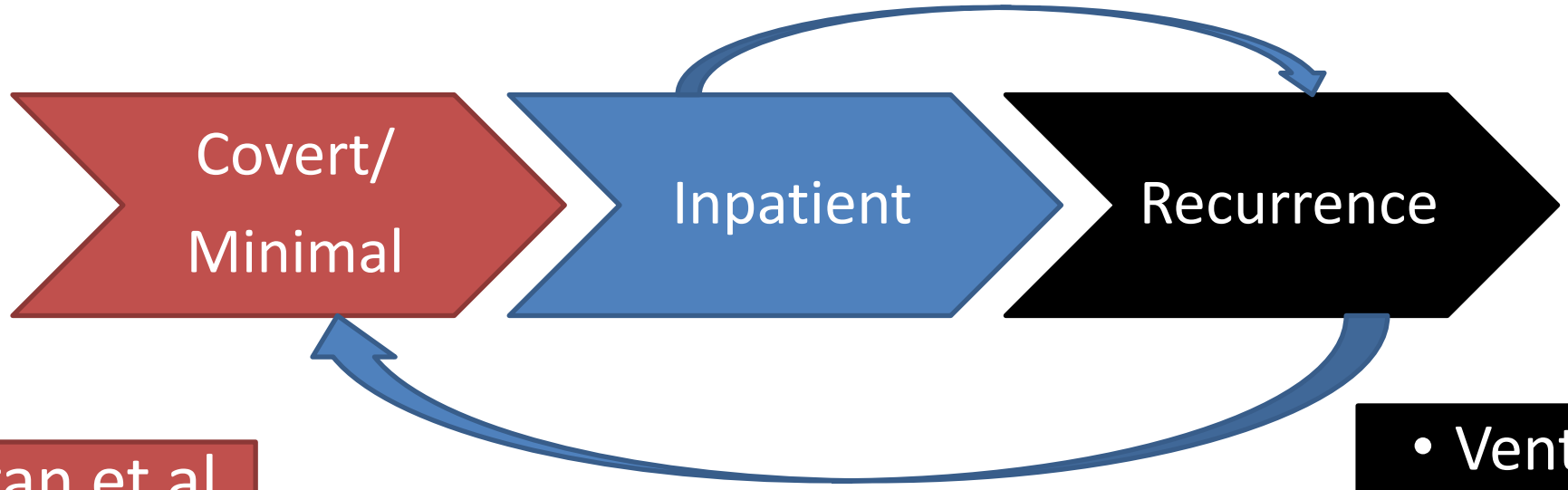
Bajaj JS et al Hepatology Communications 2024

Golexanolone: the only HE drug directly targeting CNS



Montagnese et al J Hepatol 2021

Stages of HE and where albumin has been used



- Fagan et al (HEAL study)

- Simon-Talero et al
- Sharma et al
- China et al*

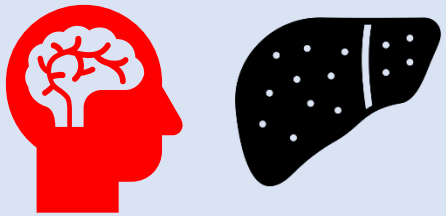
- Ventura-Cots et al (BETA trial)

- Caraceni et al (ANSWER trial)*

*HE was not the primary focus of inclusion

HEAL RCT: Albumin in Hepatic encephalopathy

Population

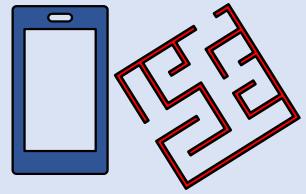


Created by Flowicon

Patients with cirrhosis and prior HE who have cognitive impairment or minimal HE despite standard of care

Outcomes

Primary: Cognitive Performance

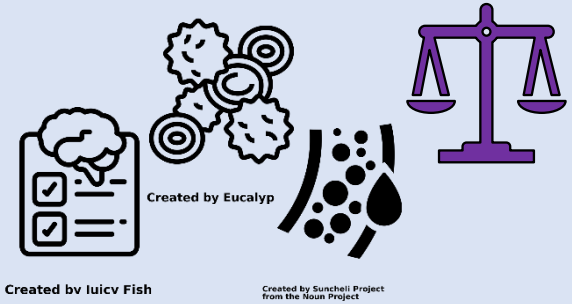


Secondary:

Quality of life

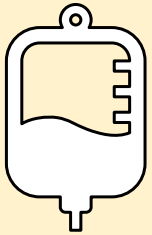
Inflammatory cytokines

Endothelial dysfunction



Intervention

25% IV albumin



Placebo (saline)

- 1:1 randomization
- 1.5g/kg weekly for 5 weeks using blinded infusions
- Follow-up 1 week after last infusion

Findings

In Albumin vs placebo

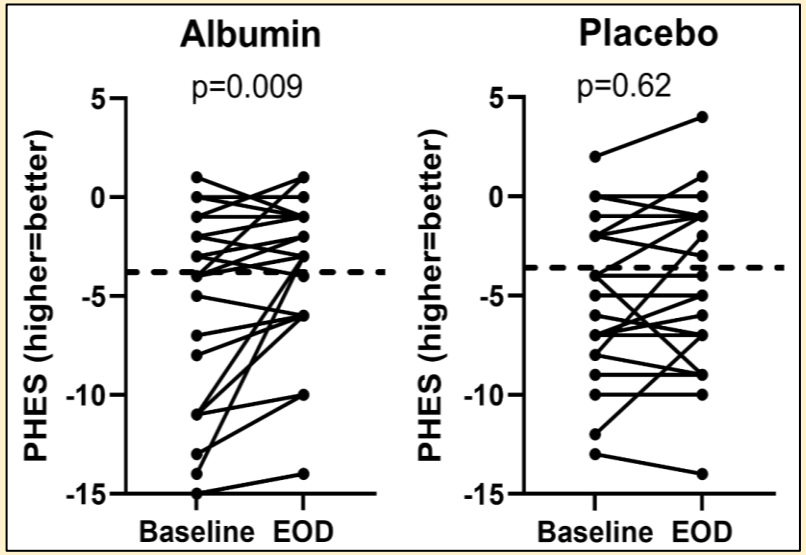
↑ Minimal HE Reversal

↑ Psycho-social quality of life

↓ endothelial dysfunction & inflammation

-Effect persisted even after albumin discontinuation

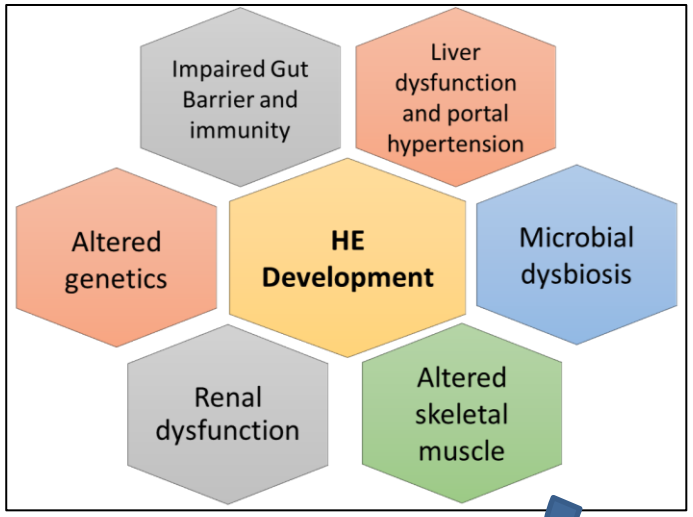
PHES: Primary Cognitive Outcome



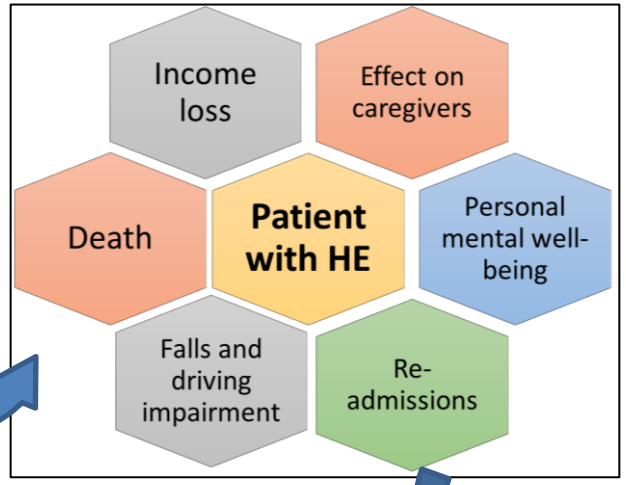
Fagan et al Journal of Hepatology 2022

The Three Villages of Hepatic Encephalopathy

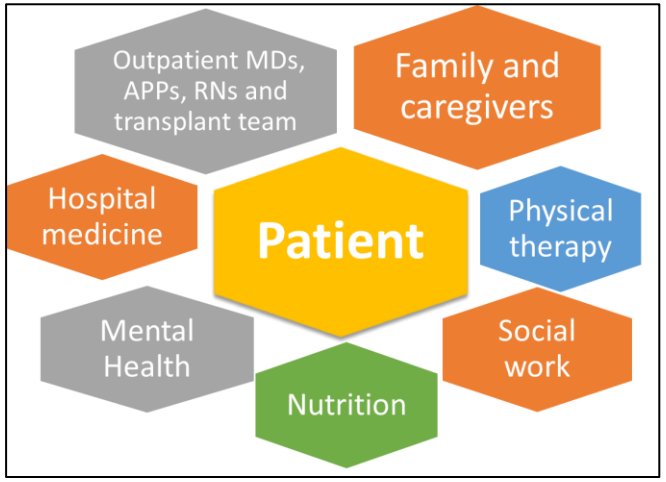
The Village Within for HE Development



The Village Affected by HE



The Village Required to Manage HE



Bajaj JS American Journal of Gastroenterology 2021
doi: 10.14309/ajg.0000000000001212

Take-home messages

- Hepatic Encephalopathy is a complex syndrome which requires several specialties in management
- Overt HE staging along 4 axes during inpatient settings to improve treatment and prevent readmissions is important
- Appropriate use of therapies to prevent recurrence with adequate patient contact, improving nutrition, optimizing medications and ensuring contact with caregivers are needed
- Checklists on discharge may be helpful, especially if included in the EMR
- Microbial alterations as prognosticators and FMT are potential emerging fields of management and quality vs quantity of stools may be important.

Collaborators and Team Members

VCU/VA Gastroenterology and Hepatology

- Arun J Sanyal, MD
- Richard K Sterling, MD
- Douglas M Heuman, MD
- William M Pandak, MD
- R Todd Stravitz, MD
- Velimir Luketic, MD
- Puneet Puri, MD
- Michael Fuchs, MD
- Mohammad S Siddiqui, MD
- Scott C Matherly, MD
- HoChong Gilles, NP
- Vaishali Patel, MD
- Obaidullah Aseem, MD
- Amon Asgharpour, MD
- Brian C Davis, MD
- Hannah Lee, MD
- Jennifer Miller, MD

VCU Microbiology/Immunology

- Phillip Hylemon, PhD
- Huiping Zhou, PhD
- DJ Kang, MS
- Genta Kakiyama, PhD

CARI Imaging

- F. Gerard Moeller, MD
- Joel Steinberg, MD
- Robert Cadrain, BS

Current /Past Fellows and trainees

- Jawaid Shaw, MD
- Chathur Acharya, MD
- Nikki Duong, MD
- Bryan Badal, MD
- Sarmed Al-Yassin, MD
- Rahul Chaudhari, mD

GMU Environmental Sciences

- Patrick M Gillevet, PhD
- Masoumeh Sikaroodi, PhD

University of Minnesota

- Alexander Khoruts, MD

VCU/VA coordination current

- Edith Gavis, RN
- Andrew Fagan, BS
- Mary Leslie Gallagher, NP
- Diandra Brown, BS
- Amy Bartels, RN
- Courtney Brown, BS
- Travis Mousel, RN

VCU/VA coordination past

- Melanie B White, RN
- Sara McGeorge, BS
- Nicole Noble, BS
- Ariel Unser, BS