Perinatal Hepatitis C Webinar

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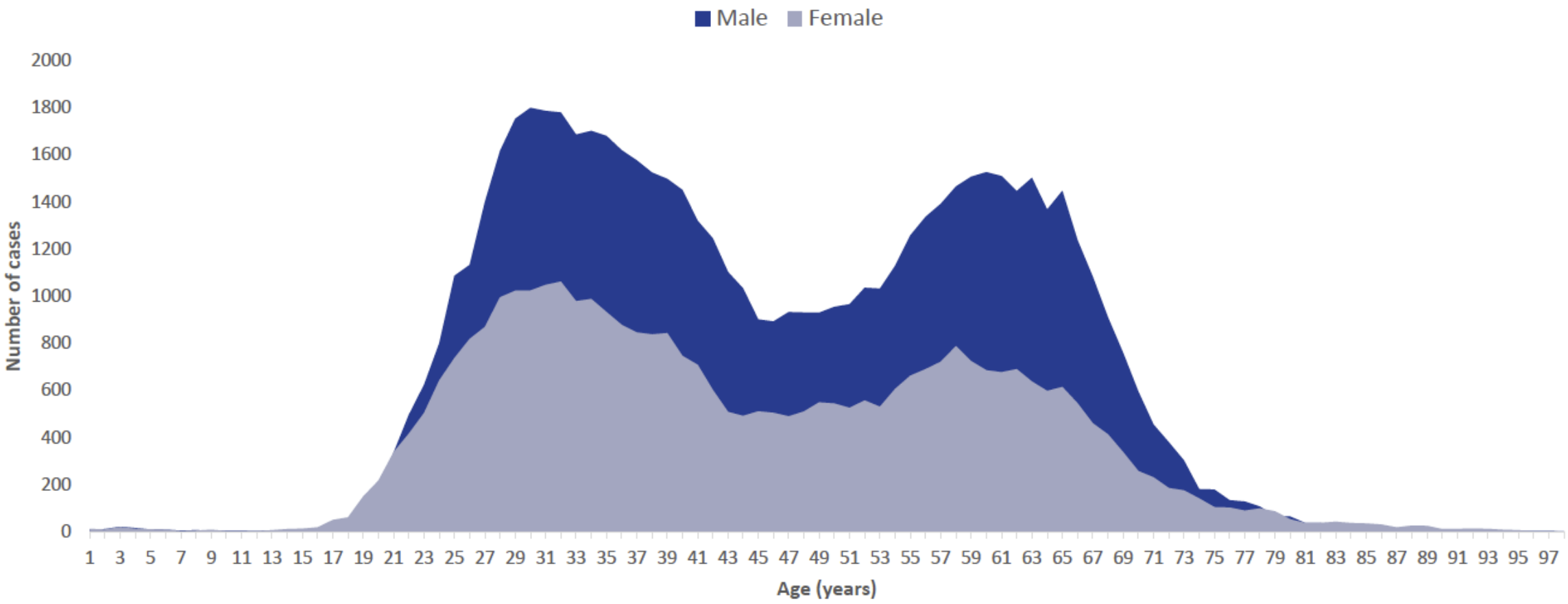
Disclosures

- Dr. Rick
  - Consultant for Pfizer, Inc
  - Medical Director for the Human Milk Science Institute and Biobank
- Dr. Chappell
  - Consultant and research funding from Gilead Sciences
  - Research funding from Merck and Organon

Newly reported Hepatitis C cases in 2020



2020 CDC Viral Hepatitis Report, CDC 2023

CLINICAL SCENARIO

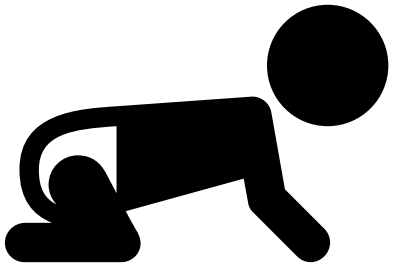
- TJ is a 33-year-old G2P1001 @ 14 weeks who presents for routine antenatal care. She has a history of opioid use disorder and has been in recovery for 2 years since the birth of her daughter. She was not screened in her previous pregnancy for HCV.
- Should she be screened for HCV?

Timeline of HCV screening recommendations in the United States, 2018–2023

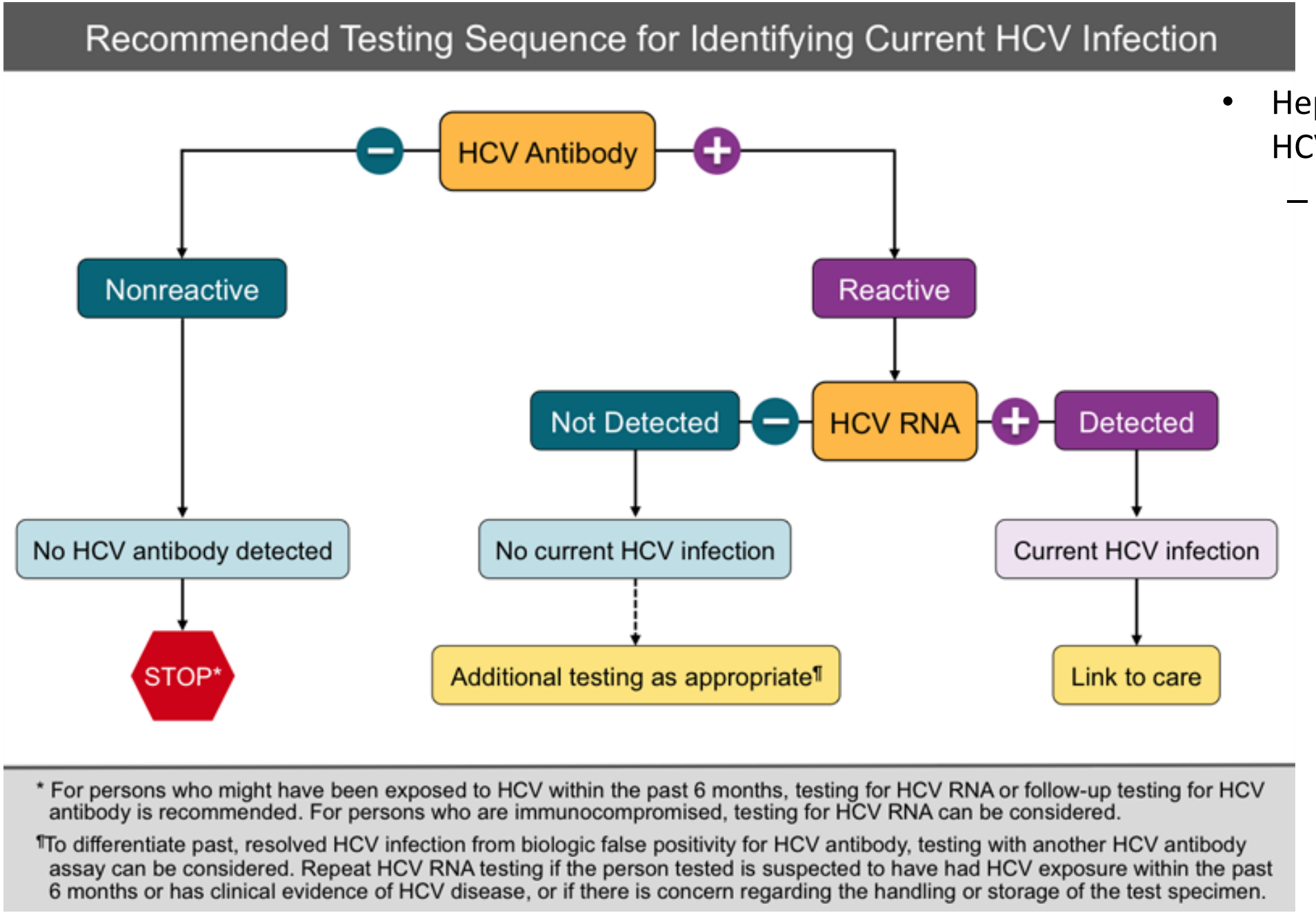
*except in settings where the prevalence of HCV infection is <0.1%

HCV Screening in Pregnancy: Two for the price of one

1. High engagement in healthcare
2. Unique motivation
3. Linkage to HCV care/treatment
4. Prevention of cirrhosis



1. Identification of all infants exposed
2. Early detection of perinatal HCV
3. Linkage to HCV care/treatment
4. Prevention of cirrhosis



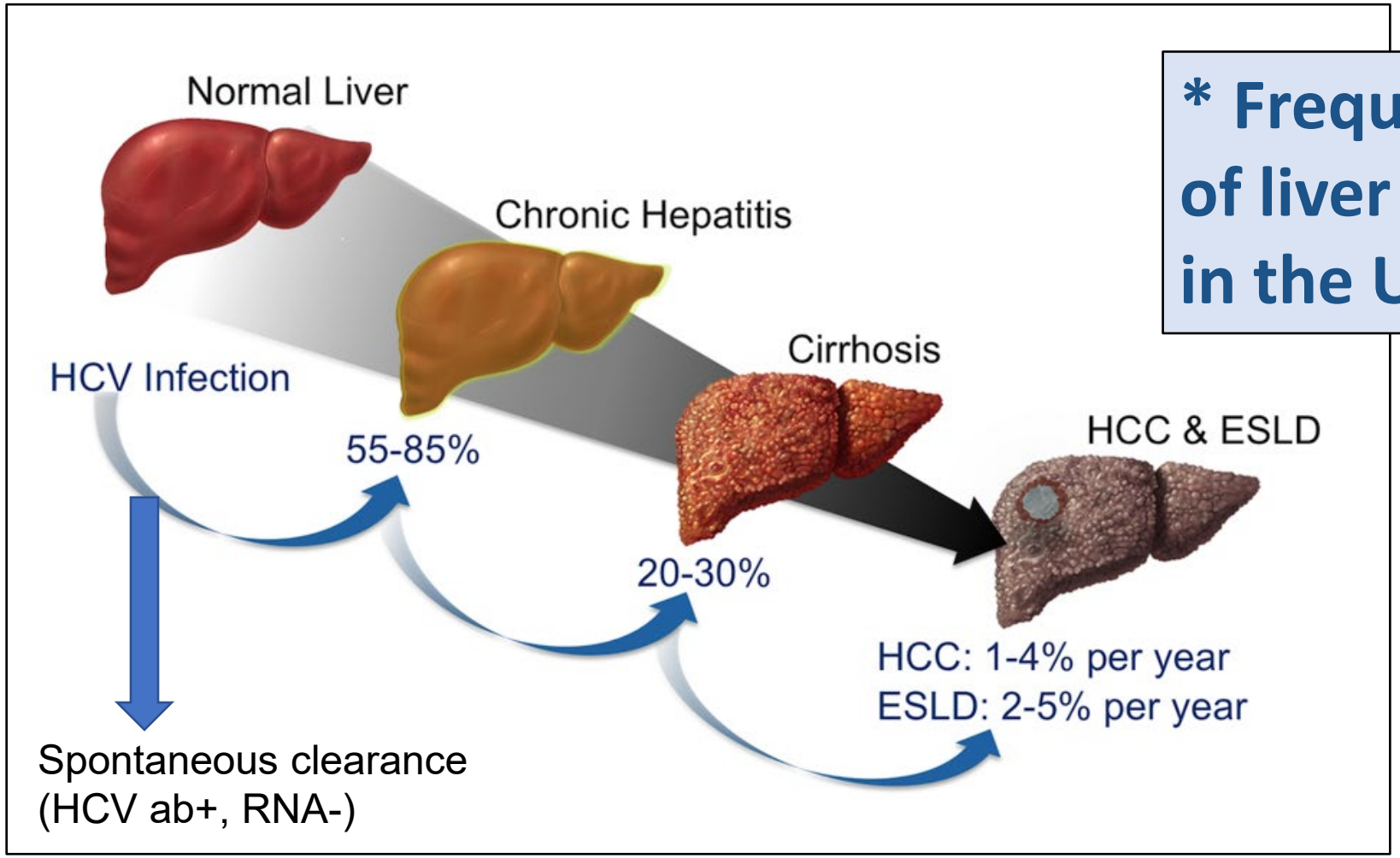
- Hepatitis C Ab with Reflex HCV RNA
  - If the HCV antibody test is positive, then an HCV RNA test will be automatically performed by the laboratory on the same blood sample.

CLINICAL SCENARIO

- TJ is a 33-year-old G2P1001 @ 14 weeks who presents for routine antenatal care. She has a history of opioid use disorder and has been in recovery for 2 years since the birth of her daughter. She was not screened in her previous pregnancy for hepatitis C, and her current testing shows is as follows:
  - HCV antibody positive
  - HCV RNA 560,000 IU/mL

- What are the implications of HCV in pregnancy?

Natural History of HCV*



*** Frequent cause of liver transplantation in the U.S.**

Image Source: **https://www.hepatitisc.uw.edu/go/evaluation-staging-monitoring/natural-history/core-concept/all**

Impact of HCV on Pregnancy: Maternal Health

Study	HCV+ Cases	Controls	Gestational Diabetes
Pergam 2008	506	**SUD, but** HCV negative	OR 2.5 (1.04-6.03) in women with excessive weight gain
Reddick 2011	555	HCV negative	OR 1.6 (1.0-2.6)
Connell 2011	999	HCV negative	40% increase
Kushner 2022	1636	HCV ab+/RNA-	40% decrease

- Intrahepatic cholestasis of pregnancy
  - Meta-analysis of 3 studies showed a 20-fold increased risk (Wijampreecha, et al. *Clin Res Gasrto Hepatol*. 2017)
  - 4% vs. <2% prevalence of ICP (Kushner, 2022)
  - Associated with 2.5x increase incidence of stillbirth (Ovadia C., et al. *Lancet*. 2019)
- Post-partum hemorrhage 9% vs. 5% (Kushner, 2022)

Impact of HCV on Neonatal Outcomes

- Neonatal Outcomes
  - Preterm birth*
  - Fetal growth restriction**
  - Low birth weight **
  - Admission to NICU
  - Mechanical ventilation
  - Congenital anomalies

***Caveat: It is difficult to know with certainty whether the increased risk of such adverse fetal outcomes is due to the viral effect of HCV or to potential confounders in the population being studied

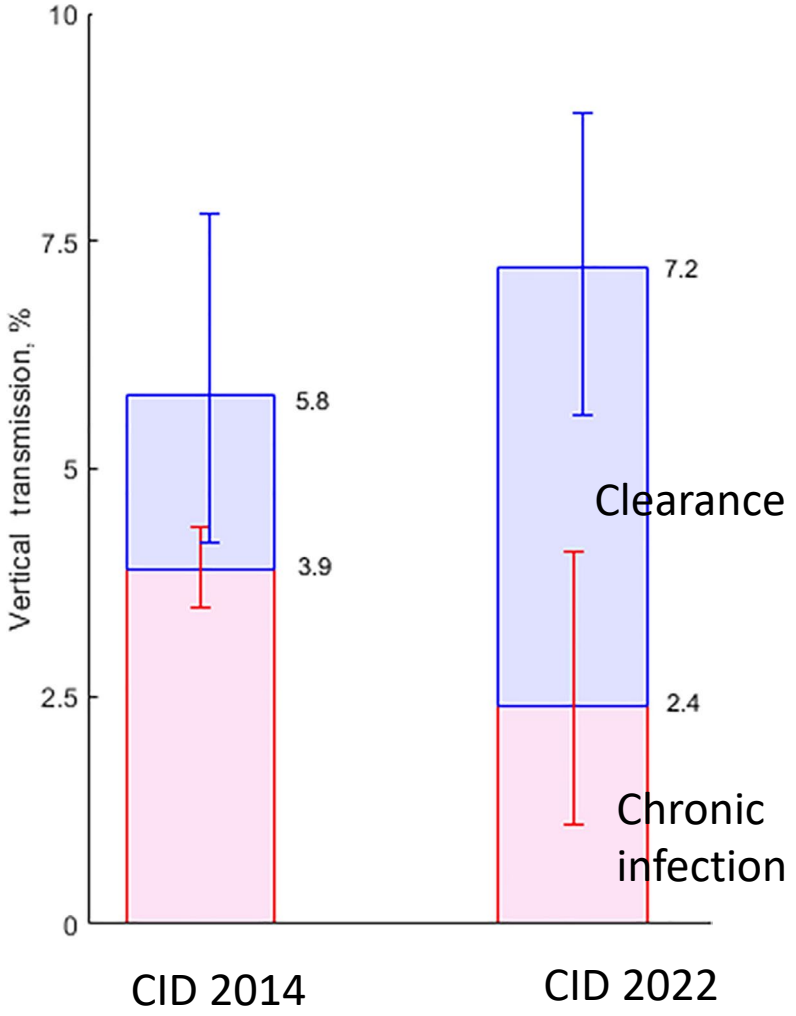
*HCV ab+ RNA- vs. HCV ab+ RNA+
**Supported by recent meta-analysis

Kushner T, et al. *J Hepatol*. 2022
Hughes B, et al. *Am J Obstet Gynecol*. 2021
Kushner T, et al. *J Hepatol*. 2020

Perinatal Hepatitis C Transmission: Frequency?

- What is the rate of perinatal Hepatitis C transmission?
  - **5.8%** (95% CI 4.2-7.80) (HIV negative)[1]
  - **10.8%** (95% CI 7.6-15.2) (HIV co-infected)[1]

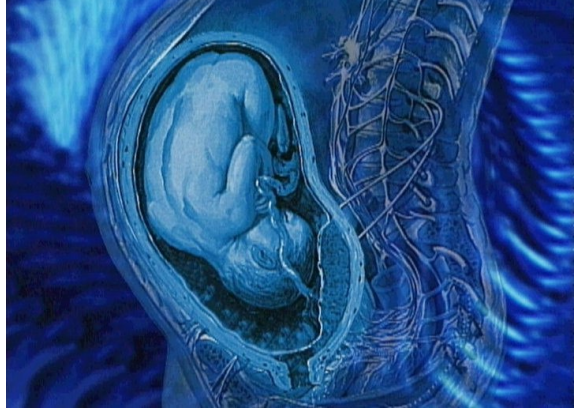
  - **7.2%** (95% CI 5.6-8.9) (HIV negative)[2]
  - **12.1%** (95% CI 8.6-16.8) (HIV co-infected)[2]



Overall, HCV perinatal transmission ~6-7%, but chronic infection 3-4%.

Benova L., et al. *CID.* 2014; Andes A, et al. CID 2022

Perinatal Hepatitis C Transmission: What do we know?



Risk factors for perinatal Hepatitis C transmission

- Prolonged rupture of membranes
- Obstetric procedures and intrapartum events that lead to infant exposure to Hepatitis C-infected maternal blood; eg, internal fetal monitoring, vaginal/perineal lacerations, operative delivery
- Maternal injection-drug use

When does transmission occur?

	Elective Cesarean Section	Non-elective cesarean section
Early in utero	27.5% (13.3–45.8)	24.8% (12.1–40.8)
Late in utero	72.5% (54.2–86.7)	66.0% (42.5–83.3
At delivery	N/A	9.3% (.5–30.6)

Ades, A, et al, CID 2022, Tonsone G, et al. World J. Hepatol. 2014; Resti M, et al J Infect Dis. 2001

CLINICAL SCENARIO

- TJ is a 33-year-old G2P1001 @ 14 weeks who presents for routine antenatal care. She has a history of opioid use disorder and has been in recovery for 2 years since the birth of her daughter. She was not screened in her previous pregnancy for hepatitis C, and her current testing shows is as follows:
  - HCV antibody positive
  - HCV RNA 560,000 IU/mL

- What are the implications of HCV in pregnancy?
- How do we manage HCV?

Management of HCV During Pregnancy

- Recommended lab tests only once:
  - LFTs, albumin, platelet count, HCV genotype*
  - STI screening
  - Hepatitis B surface IgG, Hepatitis A total Ig
- ***Vaccinate if Hepatitis A or B nonimmune***
- Avoid hepatotoxic substances (alcohol, Tylenol >2 grams per day)
- Transmission risk counseling (IVDU, sexual contacts, razors, etc.)
- Third trimester growth ultrasound due to increased risk of FGR

*HCV genotype recommended by SMFM, but not usually required for HCV treatment

SMFM. Sept 2021

Interventions to Decrease Perinatal Transmission: Lessons from HIV?

- Elective cesarean delivery?
  - No randomized controlled trials
  - Meta-analysis of 8 studies including 641 mother-infant pairs show no change in transmission rate (Gharmar ME, et al. *Arch Gynecol Obstet*. 2011)
- Avoidance of breast feeding?
  - No Hepatitis C RNA found in breastmilk (Polyweka S, et al. *Clin Infect Dis*. 1999)
  - No increased transmission with breast vs. bottle feeding (Kumar RM, et al. *J Hepatol*. 1998)
- Avoidance of procedures that might increase maternal to infant blood exchange
  - Avoid fetal scalp monitoring, amniocentesis, operative delivery, delayed cord clamping

The Revolution in HCV Treatment

- 2014: Harvoni (ledipasvir/sofosbuvir) licensed for treatment for genotype 1, 4, 5/6
- 2016: Epclusa (velpatavir/sofosbuvir) pan-genotypic coverage including genotype 2 & 3
- 2017: Mavyret (pibrentasvir/glecaprevir) pan-genotypic coverage, cheaper
- All >95% CURE with 8-12 weeks of treatment

If I were to choose any chronic viral infection it would be HCV.

Postpartum HCV Treatment Cascade for Women with Opioid Use Disorder 2016-2019: After DAAs

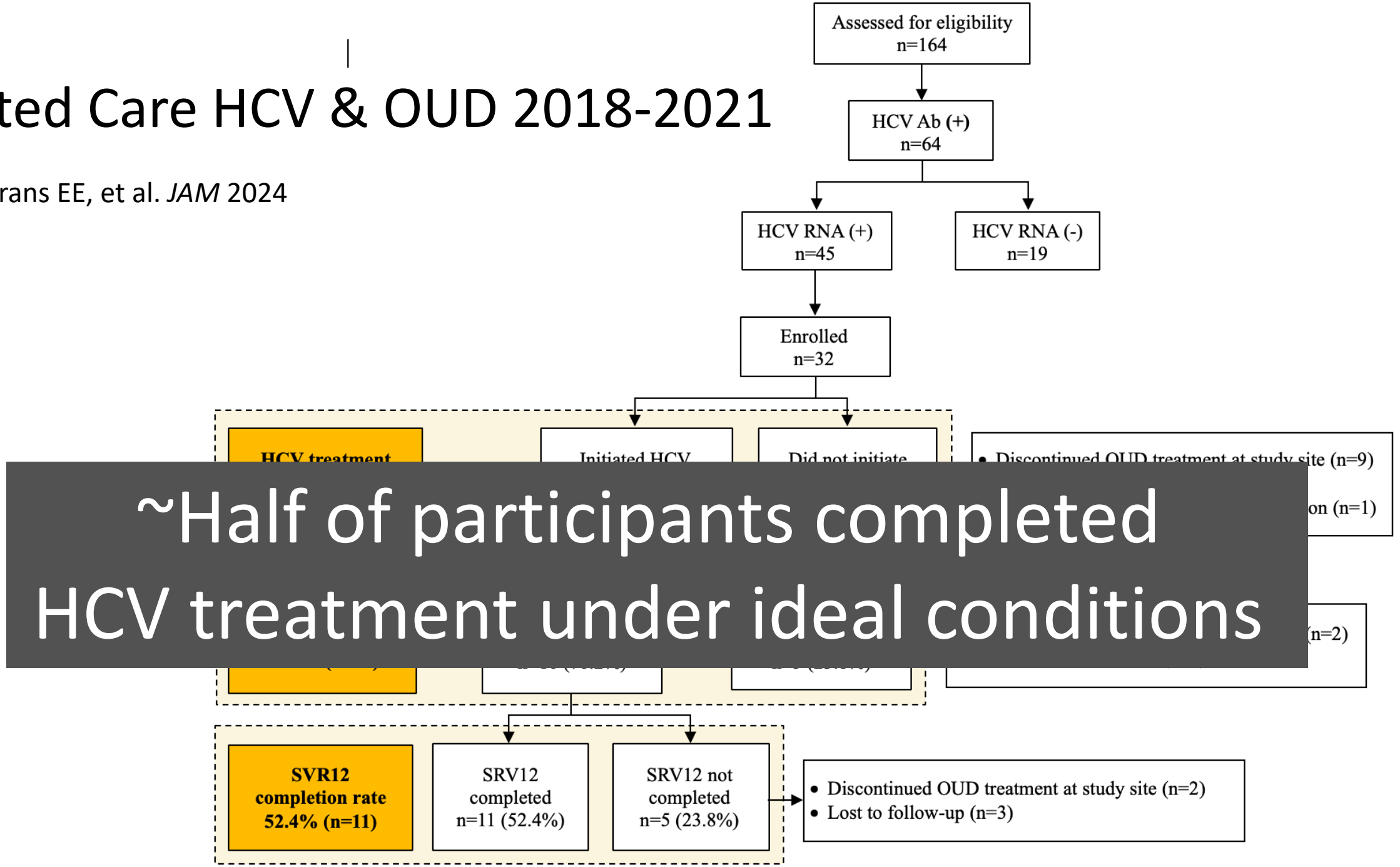
	Outcome	Probability	95% CI
60 days	HCV testing	70.3	61.5-79.1
	HCV diagnosis	30.9	16.2-45.7
	Linkage to treatment	3.2	2.1-4.3
6 months	HCV testing	70.0	60.4-79.5
	HCV diagnosis	30.9	23.6-38.2
	Linkage to treatment	5.9	4.9-6.9

*Pooled Medicaid Data from Delaware, Kentucky, Maine, North Carolina, Pennsylvania and West Virginia

Jarlenski M, Obstet Gynecol 2022

Integrated Care HCV & OUD 2018-2021

Chappell CA, Krans EE, et al. *JAM* 2024

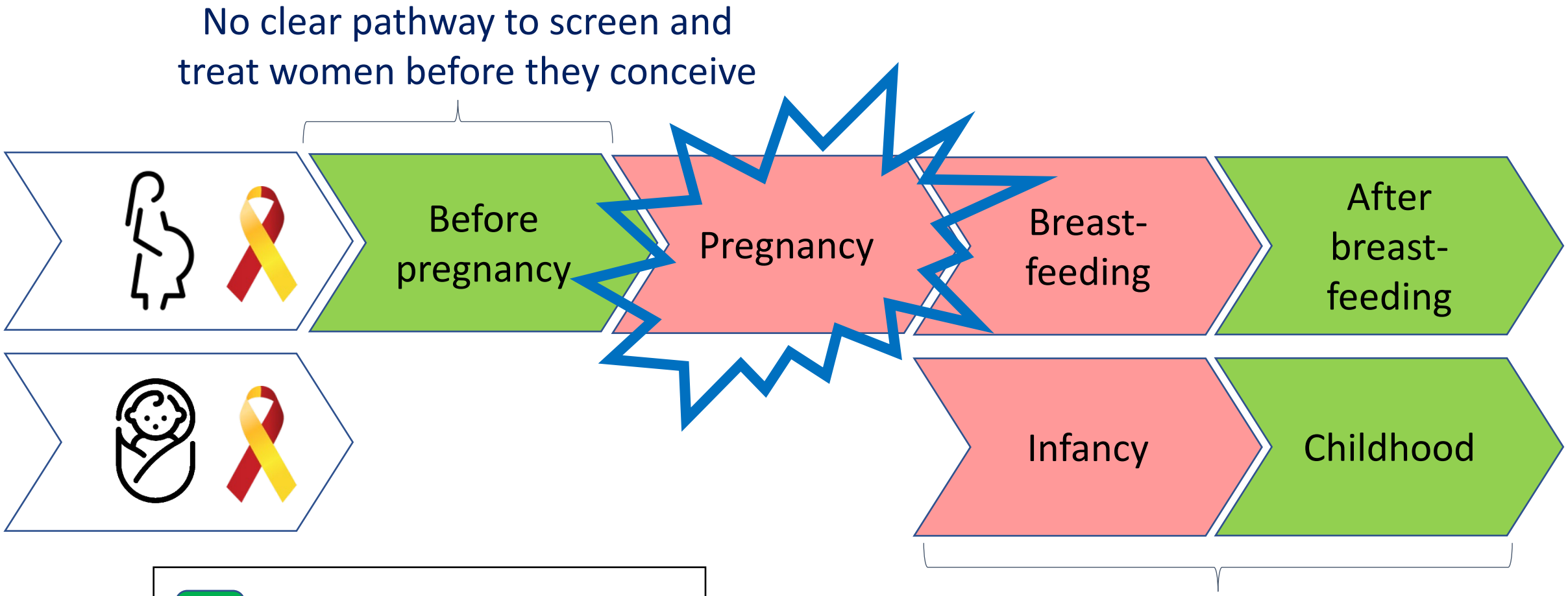


~Half of participants completed HCV treatment under ideal conditions

TIPS FOR POSTPARTUM LINKAGE

- Antenatal consult with HCV treatment provider
- Co-locate with care
  - Postpartum care
  - Pediatric care
  - Opioid use disorder care
- Provide HCV treatment via tele-medicine
- Postpartum period is a window of opportunity for treatment because of increased insurance coverage associated with pregnancy

HCV Treatment Availability for Women and Children



- Source: **Kushner T, et al. *Hepatology Communications*. 2018**

Harms of Evidence Gaps

- Historically, pregnant women were considered “vulnerable” because of the presence of a third party (the fetus) was unable to give consent.
- Pregnant women are often excluded from research participation, leading to harms:
  - Unknown adverse consequences
  - Limited access to studies with direct benefit
  - Incorrect dosing

Little MO, Wickremsinhe MN. *Reprod Health*. 2017.

HOW DO WE GET TO ROUTINE HCV TREATMENT IN PREGNANCY?

- We first need to make sure the dose for adults in appropriate for pregnancy.
- Small studies where we evaluate the concentrations of the drugs in pregnant people vs. those in non-pregnant people.
- Bear with me, while I present to pharmacology data.

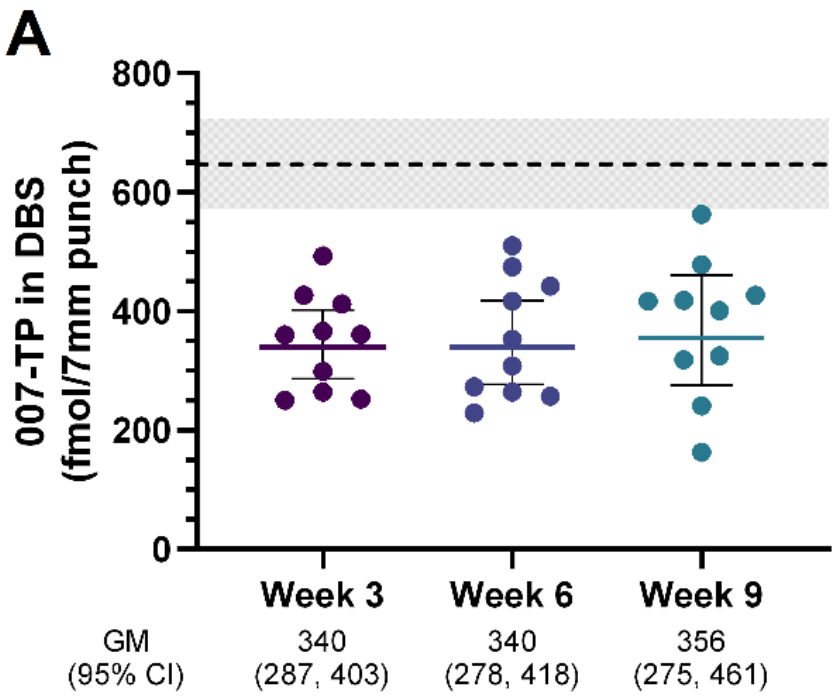
Pharmacokinetic Data for LDV/SOF and SOF/VEL in Pregnancy

Study	AUC* Mean (%CV)	Pregnant Women with HCV	Non-Pregnant Women with HCV	%GMR (90%CI)
HIP-1	SOF	1840 (15.2)	2210 (49.9)	92 (79, 107) -
	GS-331007**	8930 (12.0)	14800 (29.6)	62 (56, 69)↓
	LDV	10500 (34.4)	12100 (46.0)	90 (70, 117) -
HIP-2	SOF	2039.62 (29.75)	1483.83 (66.43)	138 (106, 178) ↑
	GS-331007**	9588.94 (18.75)	15361.31 (22.35)	62 (55, 71) ↓
	VEL	3244.45 (39.89)	3570.65 (72.04)	91 (67, 123) -

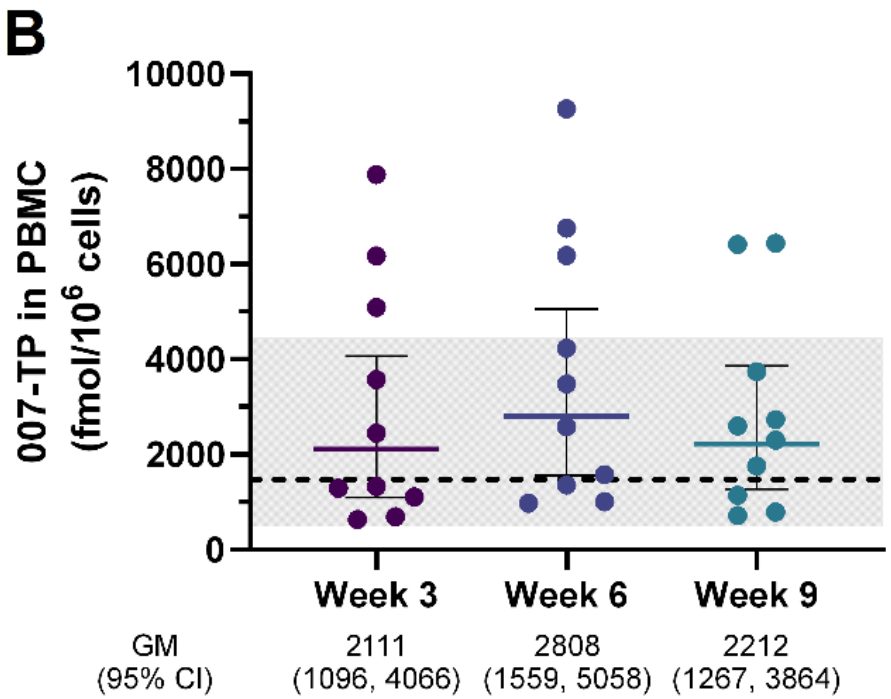
*AUC = Area under the curve; **GS-33007 = inactive, renally excreted SOF metabolite

Chappell et al, *Lancet Microbe*, 2020; Chappell et al, CROI 2023

Intracellular Sofosbuvir Concentrations



Dried Blood Spots

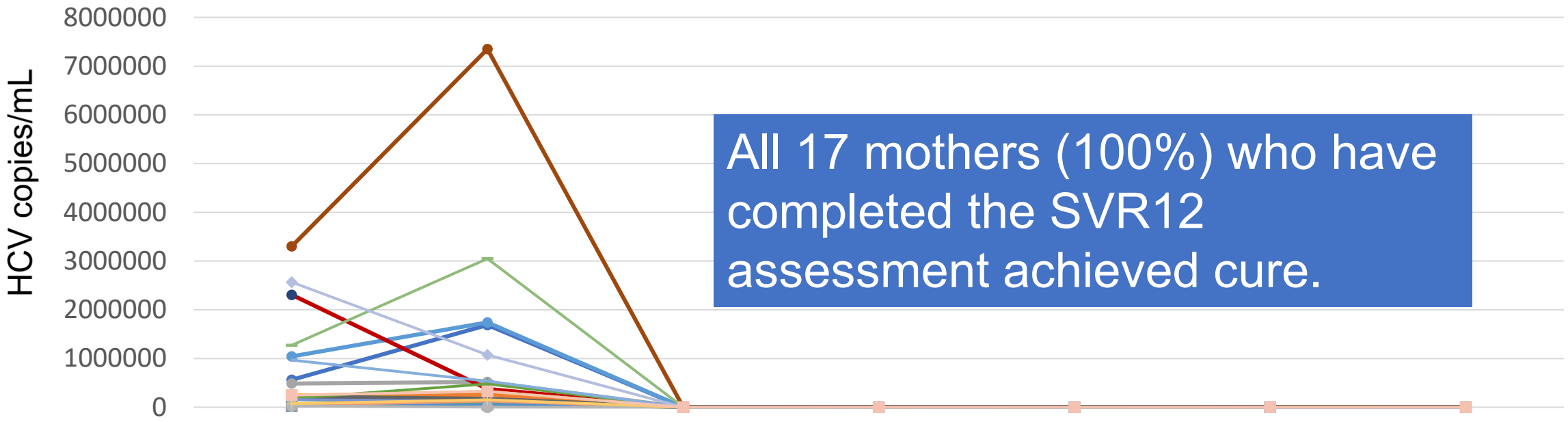


Peripheral Blood Mononuclear Cells

Dried Blood Spots impacted by hemodilution of pregnancy.
Active Sofosbuvir Metabolite concentrations in PBMCs is reassuring.

Chappell CA. CROI 2024

HCV Viral Response during Pregnancy to LDV/SOF and SOF/VEL



Visit	Screening	Enrollment	PK-1	PK-2	PK-3	Delivery	SVR12
HCV	2.4 (0.3, 33.0)x10^5	3.2 (0.04, 73.5)x10^5	12 (0, 49)	0 (0, 12)	0 (0, 0)	0 (0, 12)	0 (0,0)

12 weeks of treatment

12 weeks after finishing course
Undetectable = cure

Delivery and Neonatal Outomes (N=20)

Outcome	N (%) or Median (High, Low)
Maternal Related Adverse Events	11 (55%)
Maternal Related Adverse Events >Grade 2	1 (5%)
Vaginal Delivery	12 (60%)
Gestational age at delivery (weeks + days)	39+0 (35+4, 41+0)
Preterm birth	3 (15%)
Birth weight (g)	3,290 (2,580, 4,160)
Infant Length of Hospital Stay (days)	3 (2, 12)
Infant Related Adverse Events	0 (0%)
Infant HCV RNA at Any Visit (copies/mL) (n=17)	0 (0, 0)

Hepatitis C treatment in pregnancy: increased self-esteem and sense of well-being, which was sometimes protective against relapse

I'm down to like barely detectable... I think it's definitely gonna help me not wanna keep relapsing or using because this has been such a process trying to cure it... that's not the life I wanna live anymore, I don't wanna use

"...Life-saving..."

I think I'm.. a bright thing and it's a clean start...

I mean ecstatic, grateful. I don't know, kind of proud that I went through with something and accomplished it.

Kislovsky Y, et al. *Substance Abuse,* In Press

CONCLUSIONS FROM EARLY PK STUDIES OF HCV TREATMENT DURING PREGNANCY

- No clinically significant PK changes in SOF, VEL, or LDV in identified attributable to pregnancy.
  - GS-331007 (inactive SOF metabolite) was reduced, likely due to increased GFR during pregnancy and is unlikely to be clinically significant.
- Reassuring preliminary safety and efficacy outcomes for LDV/SOF and SOF/VEL
- Larger study must be conducted to support safety and efficacy of antenatal HCV treatment

Safety, Tolerability, and Outcomes of VelpatasviR/SofosbuviR in Treatment of Chronic Hepatitis C Virus during Pregnancy (STORC)

- Primary Objectives:
  - To evaluate the sustained virologic response 12 weeks after completion of SOF/VEL treatment (SVR12) in women treated during pregnancy.
  - To evaluate impact of antenatal treatment with SOF/VEL on the gestational age at delivery for women who received SOF/VEL for HCV treatment during pregnancy.
- Secondary Objectives:
  - To evaluate the maternal and neonatal safety of HCV treatment during pregnancy with SOF/VEL
  - To determine the rate of HCV perinatal transmission among women treated with SOF/VEL during pregnancy according to HIV co-infection status

STORC Study Design

12-week treatment course

Enrollment 20-30 weeks' gestation

V3: 4 weeks; safety labs

V4: 8 weeks, safety labs

V5: End of treatment

Delivery: in person or chart review

Sustained viral response (SVR)12 visit (post-partum)

HCV viral load and adverse events

Delivery

Visit 1 (8w)

Visit 2 (6m)

Visit 3 (12m)

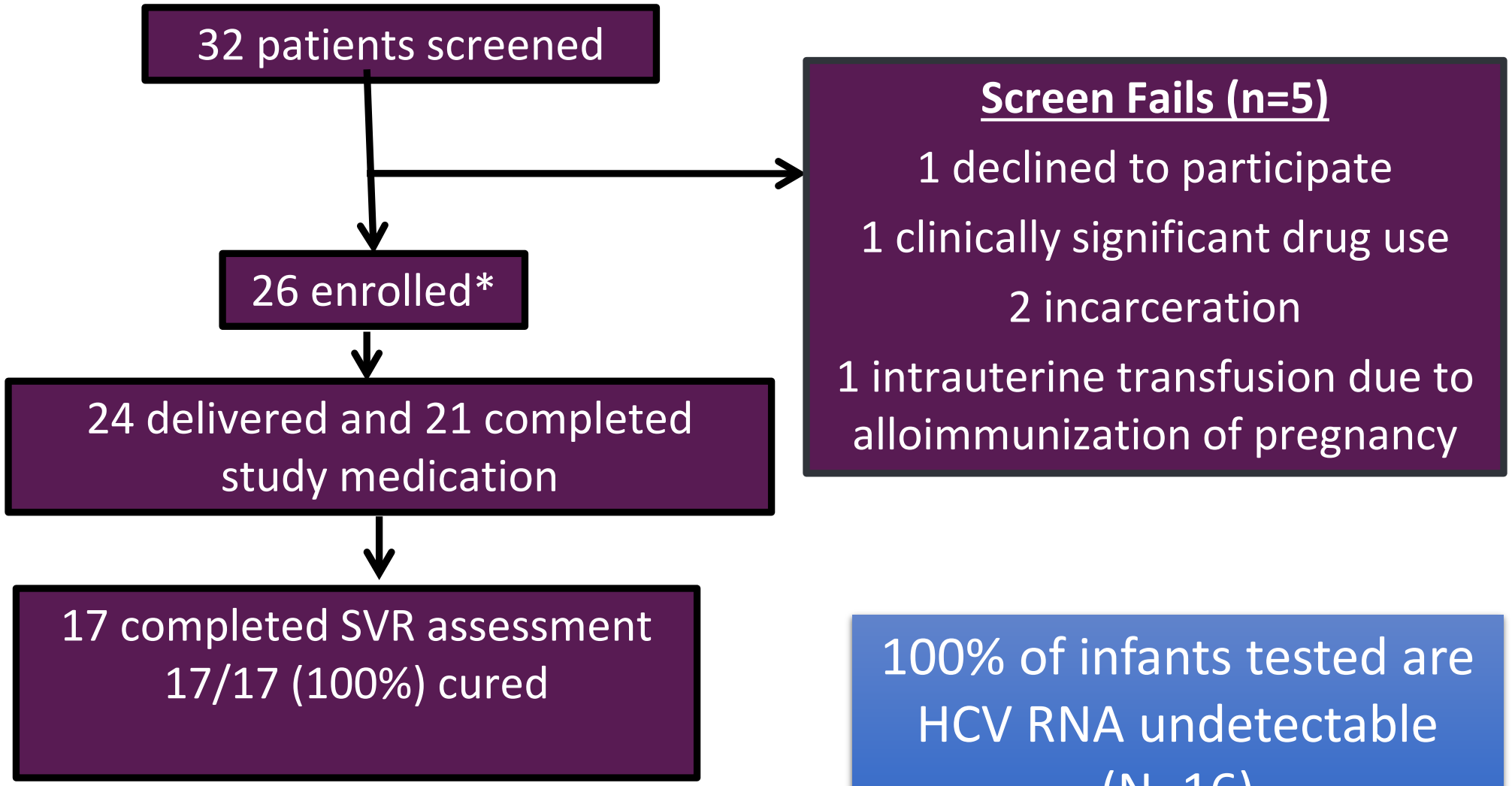
HCV viral load, adverse events, physical exam, growth and neurodevelopmental assessment

STORC Study Sites

- Pitt/MWRI
- Ohio State
- The Christ Hospital
- University of Utah
- University Health Network
  - Saint Michael's Toronto
  - London HSC
- Marshall University*
- Vanderbilt*

N = 100 participants
-SVR <92%
-PTB rate > 13% difference

STORC Interim Results



100% of infants tested are HCV RNA undetectable (N=16)

1 infant did not get blood sampling, 1 had an insufficient sample

Chappell CA, et al. AASLD. 2023

CLINICAL SCENARIO REVISITED WITH KEY TAKE-AWAYS

- TJ is a 33-year-old G2P1001 @ 14 weeks with active HCV.
  - Labs only once (LFTs, hepatitis A/B serologies, HCV genotype - maybe, platelet count and albumin)
  - Third trimester growth ultrasound
  - Watch out for gestational diabetes and cholestasis of pregnancy
  - **Vaginal delivery and breastfeeding are OK!** Try to avoid FSE, early amniotomy
  - Direct-acting antivirals could eliminate HCV
  - Facilitate linkage to care for HCV treatment
  - Someday soon, testing and treatment of HCV during pregnancy will be a reality – which would cure maternal HCV and could prevent perinatal transmission

CLINICAL SCENARIO

- TJ is worried about her child's risk of contracting Hepatitis C from her. She wants to do know what she should do and whether or not she can breastfeed.

- What is the risk that TJ's child will get HCV from their mother?
- What do you recommend to TJ in terms of HCV screening for her child and other precautions?
- Are there any other recommendations?

Increasing Prevalence of Pediatric HCV

- 3.5 to 5 million children worldwide with chronic HCV
- 0.2%–0.4% of 6- to 19-year-olds in U.S. are HCV Ab+
- Perinatal mother-to-child transmission most common cause
  - 5% of infants exposed *in utero* become infected
  - Higher if mother HIV-infected or high viral load

Increased infections in pregnant women = increased infections in infants

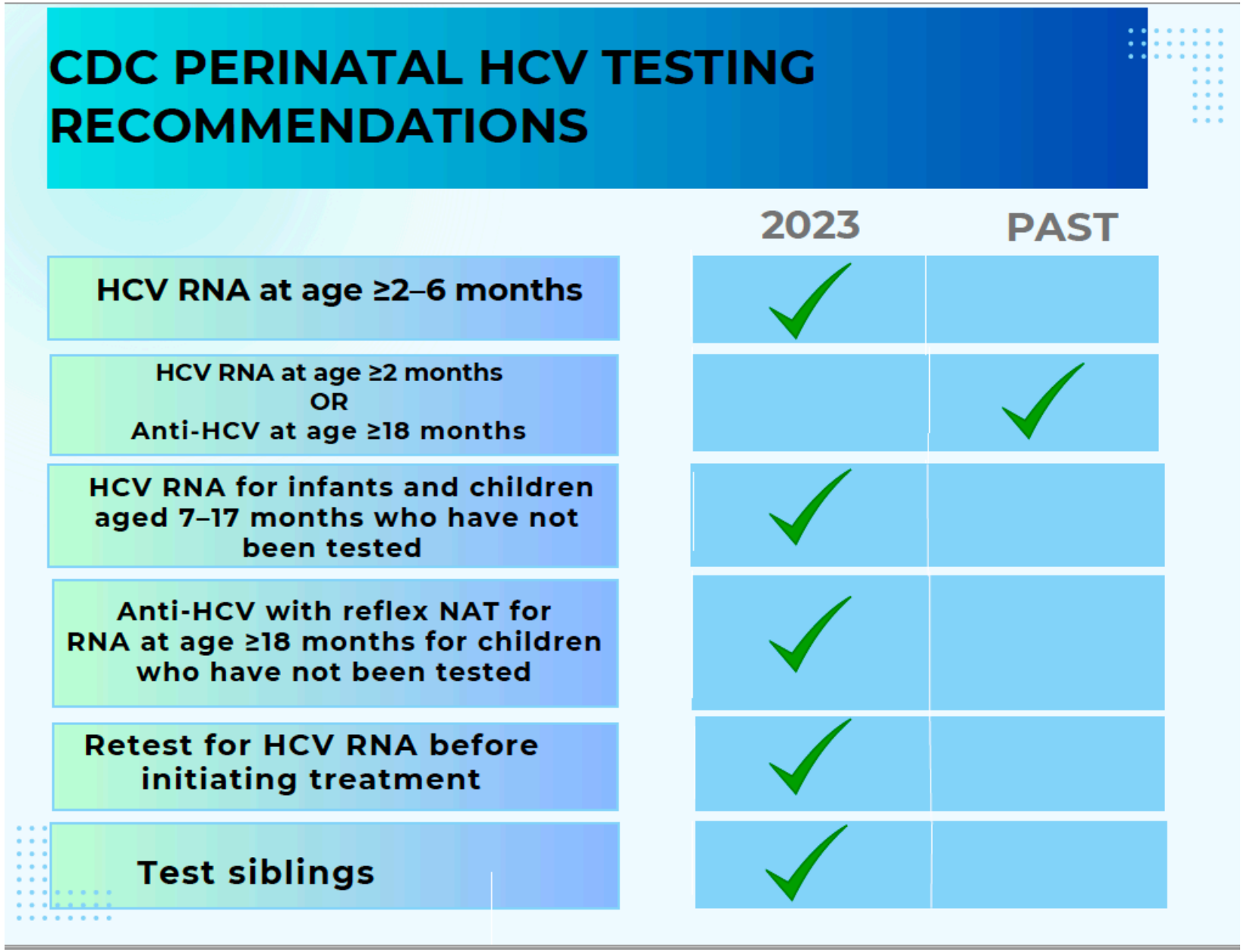
ONE TEST TWO LIVES
Prevent HIV Indiana

Source: (Indolphi, 2019); (Gower, 2014) Alter, 1999).

Benova L., et al. *CID.* 2014;

AASLD-IDSA Heptatis C Guidance Panel Hepatology 2020

CDC PERINATAL HCV TESTING RECOMMENDATIONS



Slide credit: Rachael Bieltz, MPH

PERINATAL HCV TESTING RECOMMENDATIONS

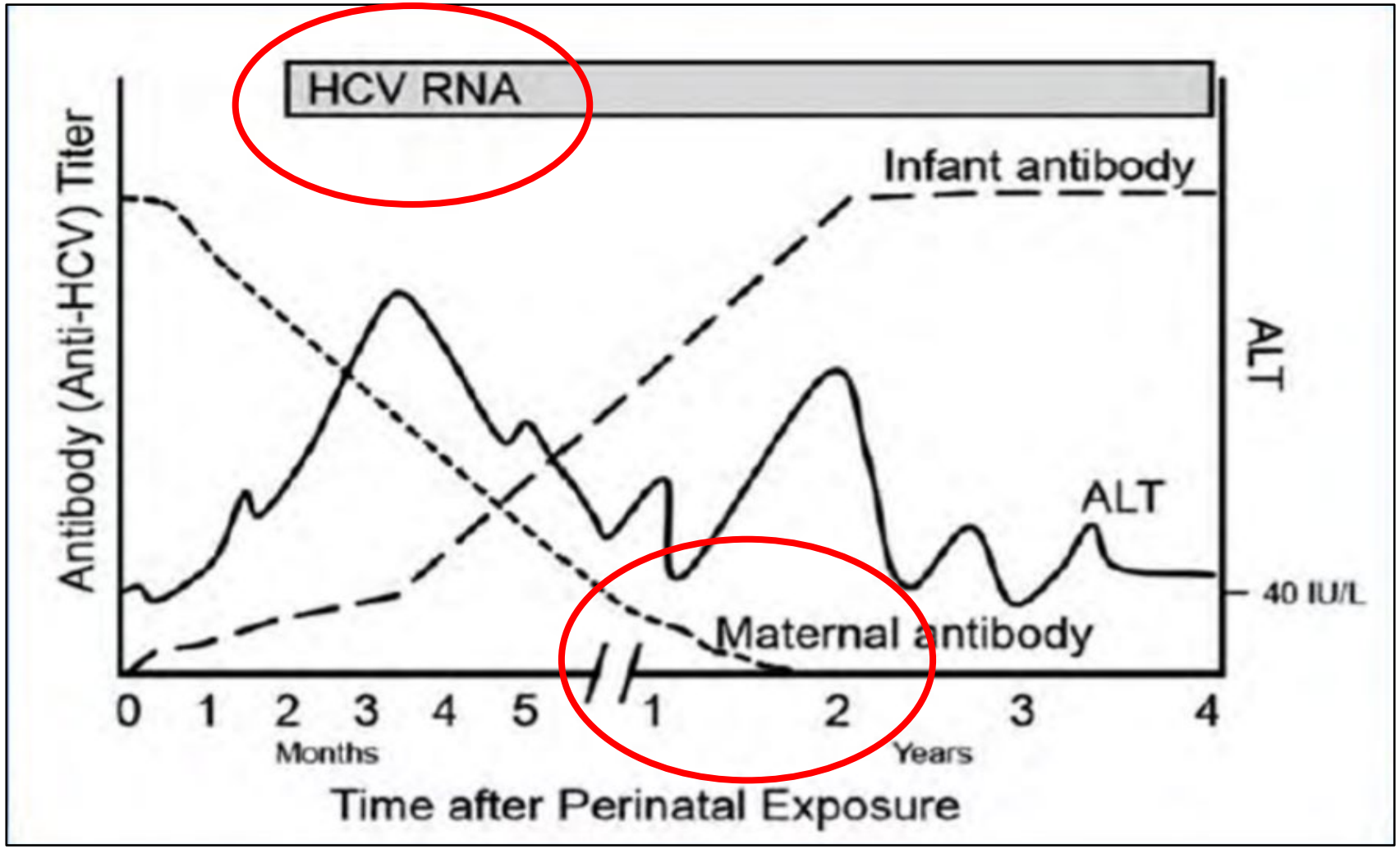
ORGANIZATION	HCV RNA at age ≥2–6 mths	Anti-HCV with reflex NAT for RNA at age ≥18 mths	Confirm Anti-HCV at age ≥18 mths	Test Siblings	Retest for HCV RNA before initiating treatment
CDC (Current)[1]	✓	If not previously tested *	No	✓	✓
CDC (Prior to November 2023)	Consider (≥2 mths)	If not previously tested	NA	NA	NA
AAP (2021)[2]	Consider	✓	✓	NA	NA
AASLD-IDSA (2020)[3]	Consider (≥2-12 mths)	✓	✓	✓	✓

1 Panagiotako poulos L, Sandul AL, et al. CDC Recommendations for Hepatitis C Testing Among Perinatally Exposed Infants and Children —

*RNA for infants and children aged 7–17 months

Slide credit: Rachael Bieltz, MPH

Why screen at 2-6 months rather than 18 months?



Source: **Squires JE and Balistreri WF. *Hepatology Commun.* 2017; 1(2):87-98.**

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Barriers to hepatitis C Screening for Infants/Toddlers

- Loss to follow-up
- In care of guardian / DHS
- Unaware of maternal hepatitis C status
- Inconsistent documentation in the EHR
- Infrequently see 'at-risk' infants
- Lack of awareness of screening guidelines
- Wrong test ordered
- In-office vs lab-based phlebotomy
- Child does not obtain test

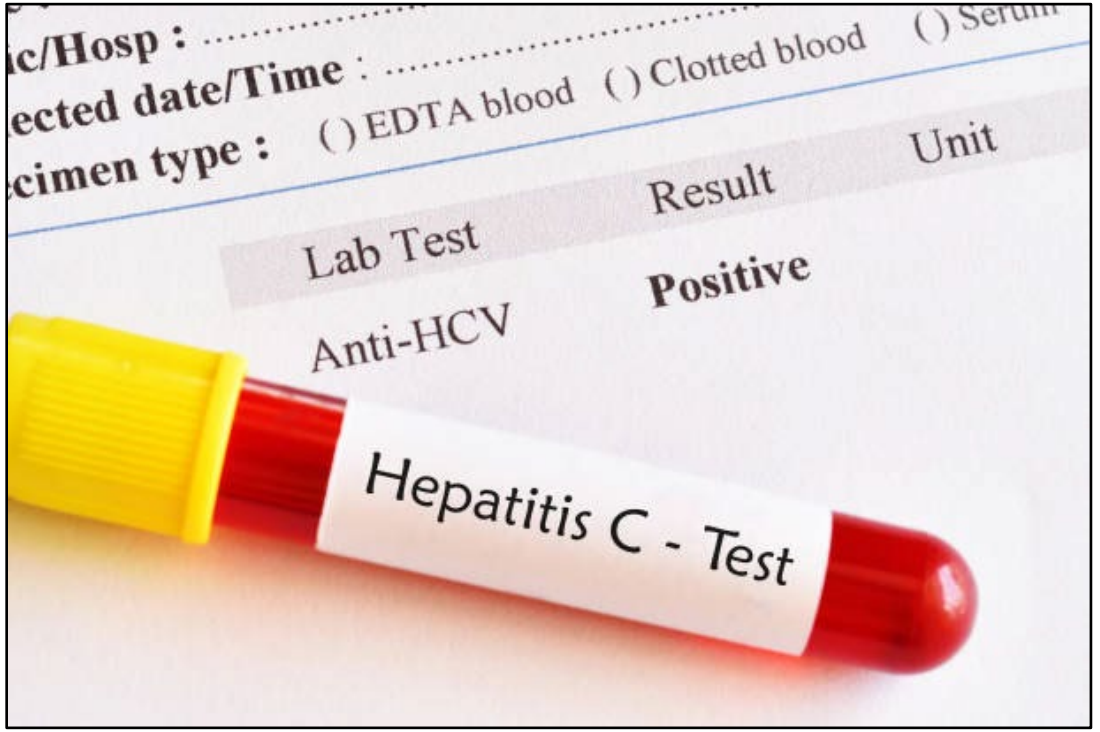
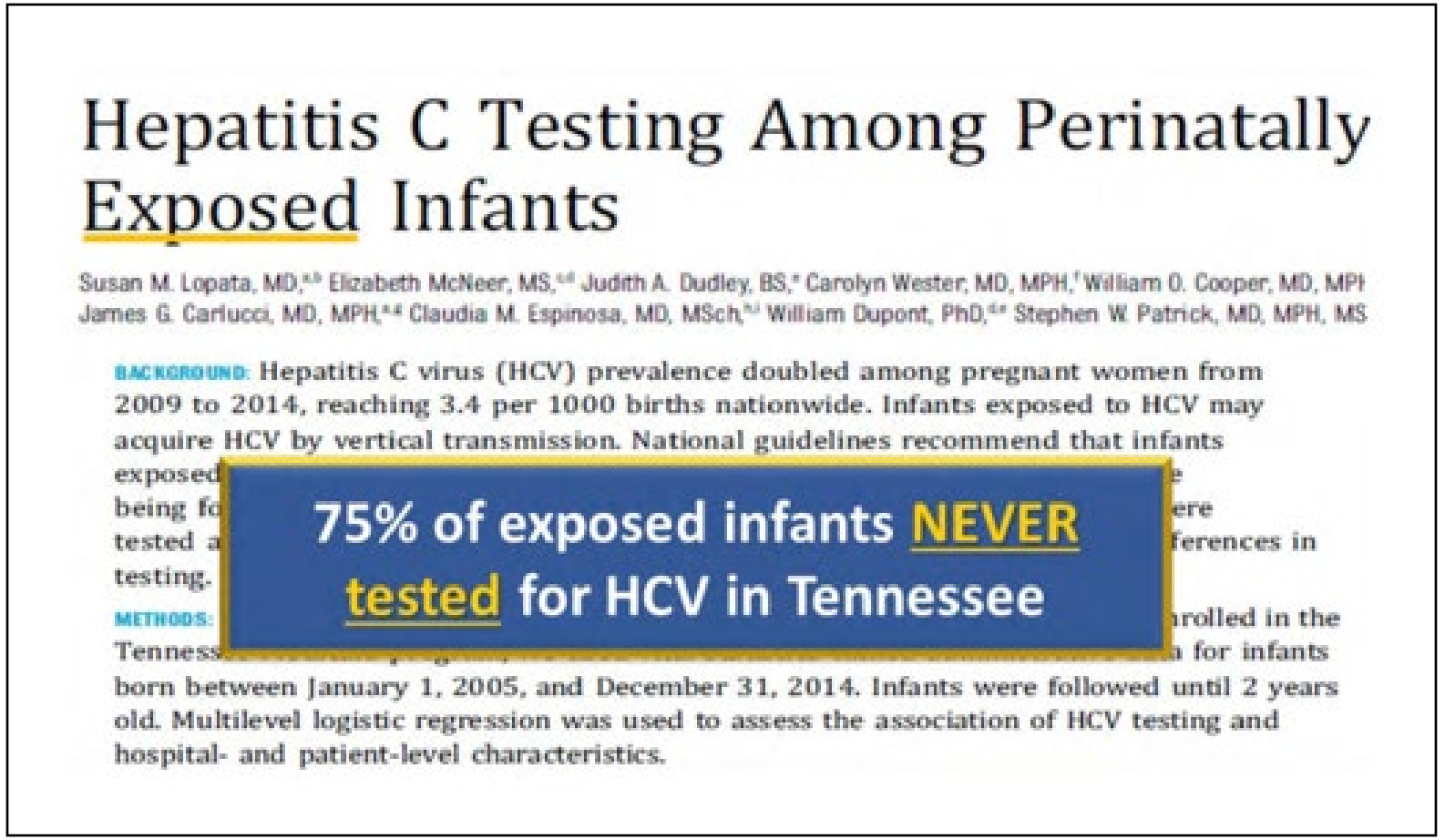


Image Source: **iStock**

Lopata Study

- **75% of exposed infants never tested for HCV in Tennessee**



Hepatitis C Testing Among Perinatally Exposed Infants

Susan M. Lopata, MD,[a,b] Elizabeth McNeer, MS,[c,d] Judith A. Dudley, BS,[e] Carolyn Wester, MD, MPH,[f] William O. Cooper, MD, MPH,[g] James G. Carlucci, MD, MPH,[a,d] Claudia M. Espinosa, MD, MSch,[h,i] William Dupont, PhD,[d,e] Stephen W. Patrick, MD, MPH, MS

BACKGROUND: Hepatitis C virus (HCV) prevalence doubled among pregnant women from 2009 to 2014, reaching 3.4 per 1000 births nationwide. Infants exposed to HCV may acquire HCV by vertical transmission. National guidelines recommend that infants exposed
being fo
tested a
testing.

METHODS:
Tenness
rolled in the
a for infants
born between January 1, 2005, and December 31, 2014. Infants were followed until 2 years old. Multilevel logistic regression was used to assess the association of HCV testing and hospital- and patient-level characteristics.

75% of exposed infants NEVER tested for HCV in Tennessee

Source: **Lopata SM, *et al. Pediatrics.* 2020; 145(3):e20192482.**

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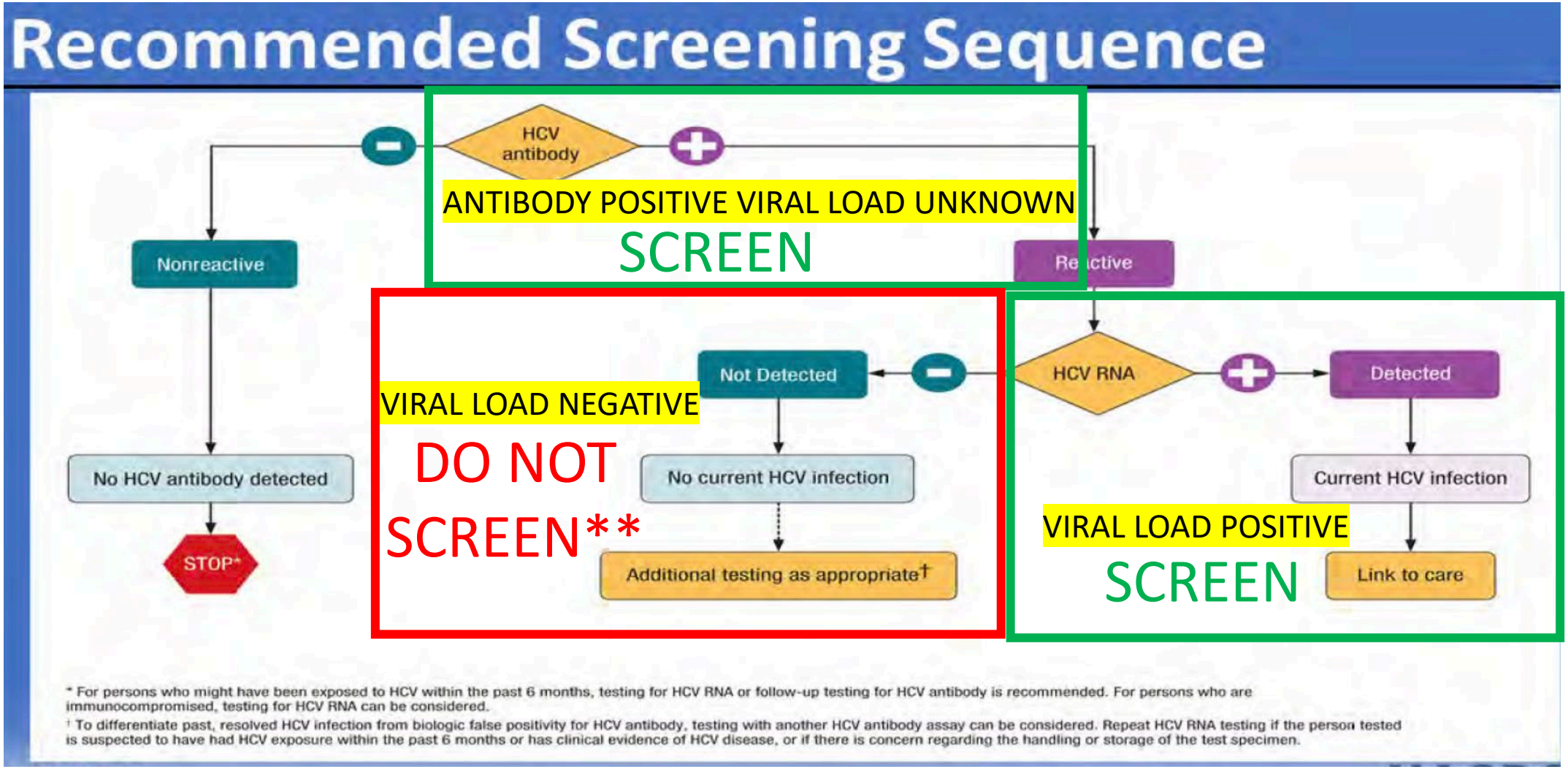
WHICH INFANTS NEED SCREENING UNDER 2023 CDC GUIDELINES?



https://www.cdc.gov/hepatitis/hcv/pdfs/hcv_flow.pdf

Pediatric HCV Antiviral Therapy

Indications: ≥ 3 years; HCV viremia

Advantages: Safe, single pill, minimal side effects >95% cure

Genotype	DAA	Age
2 and 3	Sofosbuvir with ribavirin x 12 weeks	≥ 3 year; approved 2017/2019
1, 4, 5, 6	DAA: Ledipasvir/Sofosbuvir x 12 weeks	≥ 3 years; approved 2017/2019
All	Glecaprevir/Pibrentasivr x 8–12 weeks	≥ 12 years; approved 2019
All	Sofosbuvir/velpatasvir x 12 weeks	≥ 6 years; approved 2020

Barriers to Cure with DAA's in Children with HCV

- Cost
- Palatability
- Medical Restrictions
- Paperwork/Appeals
- Adherence

The Initial Sticker Shock of Treatment

- Can cost between $26,000–75000 cash for a 12-week treatment
- In some cases, nearly $1000 per pill
- Actual cost paid for the medications may be significantly lower. Patient assistance and support programs available can be as low as $5 per co-pay with commercial insurance.

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Perinatal HCV Quality Improvement Collaborative

Global Aim: Improve HCV screening of at-risk children to enhance diagnosis, linkage to care and ultimately cure of chronic HCV in children.

- By 6 months: 90% identified, 90% test ordered, 80% tested, 100% of positives referred
- Refine algorithm for dissemination/scaling

Gen Peds:
- Anne-Marie Rick, MD, PhD
- Deborah Moss, MD
- Jennifer Zarit, MD
- Robert Cicco, MD

GI/Hepatology
- James Squires, MD
- Mary Ayers, MD

Peds ID
- Divna Djokic, MD

Biostatistics
- Hui Liu, MS

OB
- Catherine Chappell, MD
- Yasaswi Kislovskiy, MD

QI specialist
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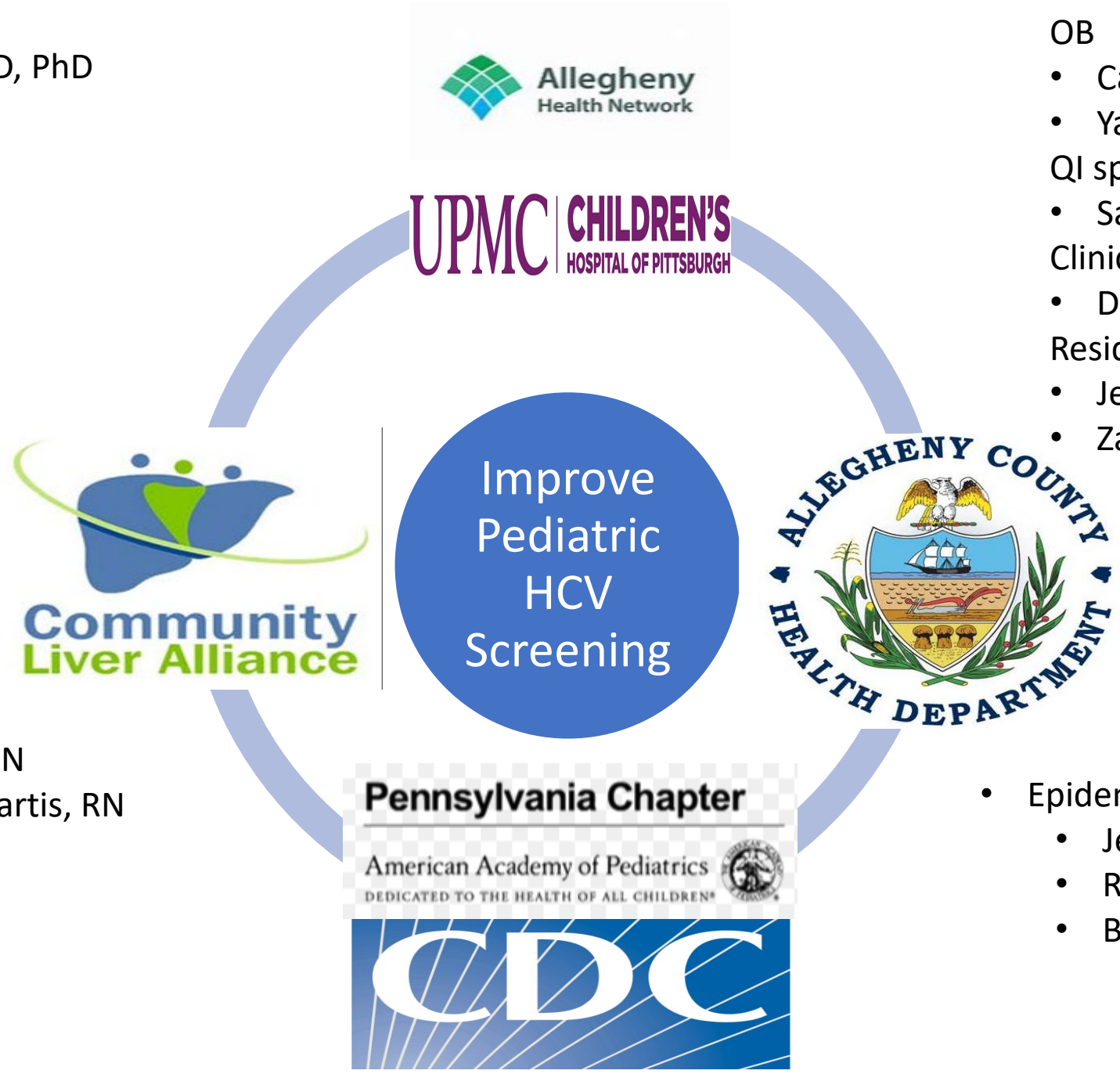
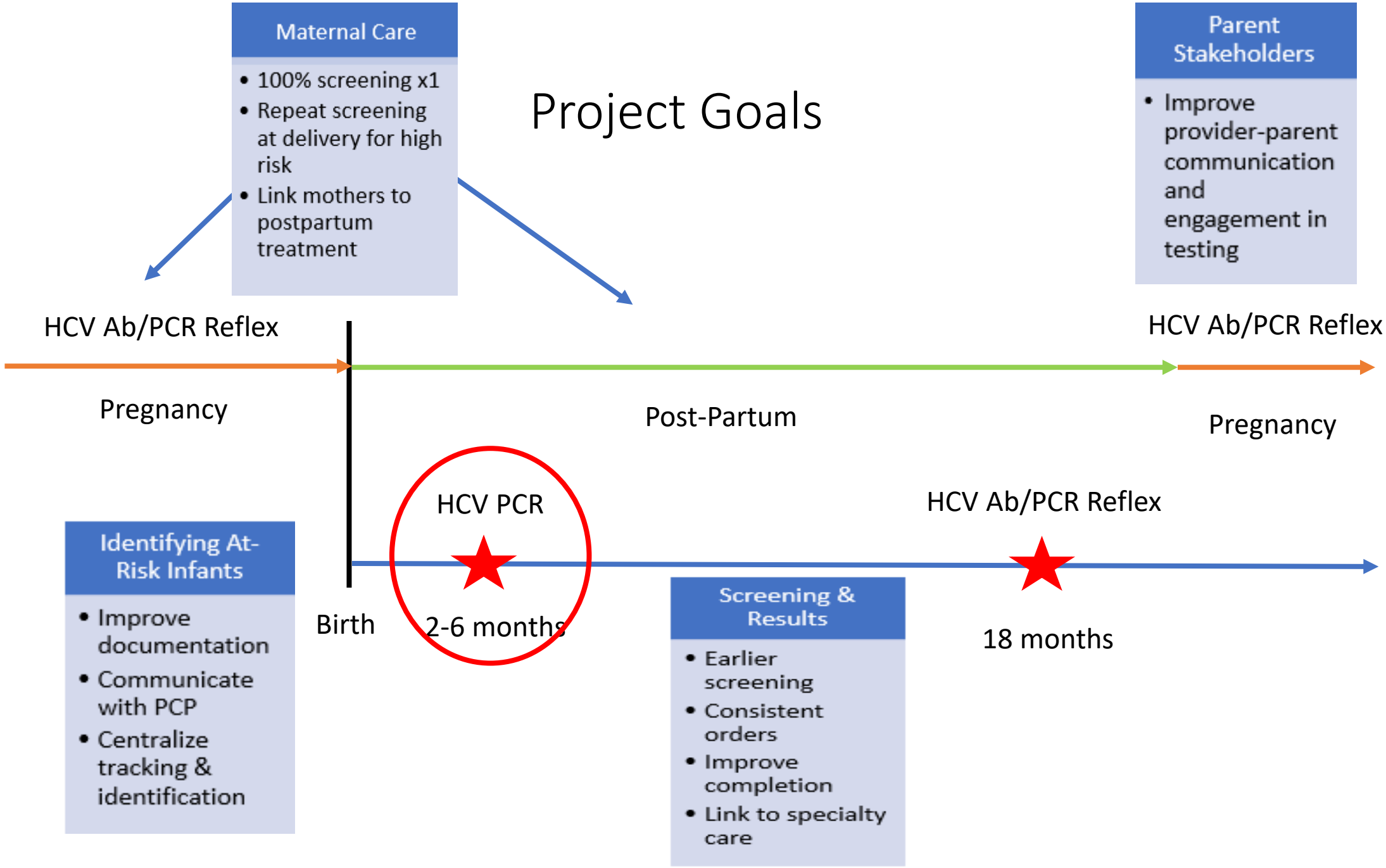
- Jennifer Deng, MD
- Zachariah Shalginewicz, MD



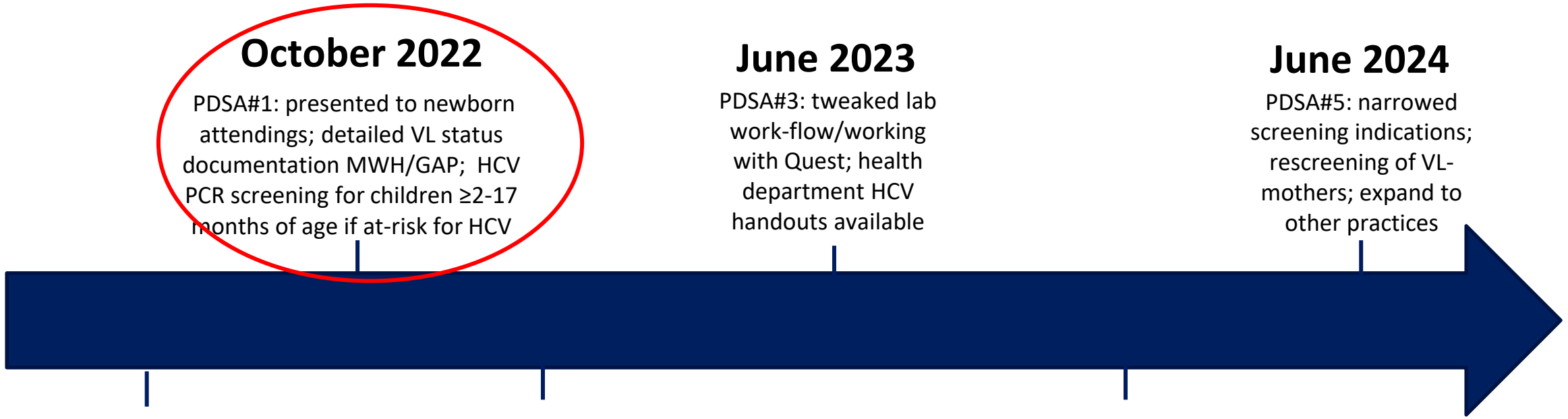
- Alison Kost, RN
- Suzanna Masartis, RN

- Epidemiologists
  - Jennifer Fiddner, MPH, CIC
  - Rachel Bieltz, MPH, CHES
  - Bethany Reynolds

Project Goals



Timeline of Perinatal HCV QI Collaborative



July 2022

SIDM DxQI Funding and QI approval obtained

October 2022

PDSA#1: presented to newborn attendings; detailed VL status documentation MWH/GAP; HCV PCR screening for children ≥2-17 months of age if at-risk for HCV

January 2023

PDSA#2: Presented at faculty and staff meeting; introduced smartphrase; collected baseline data

June 2023

PDSA#3: tweaked lab work-flow/working with Quest; health department HCV handouts available

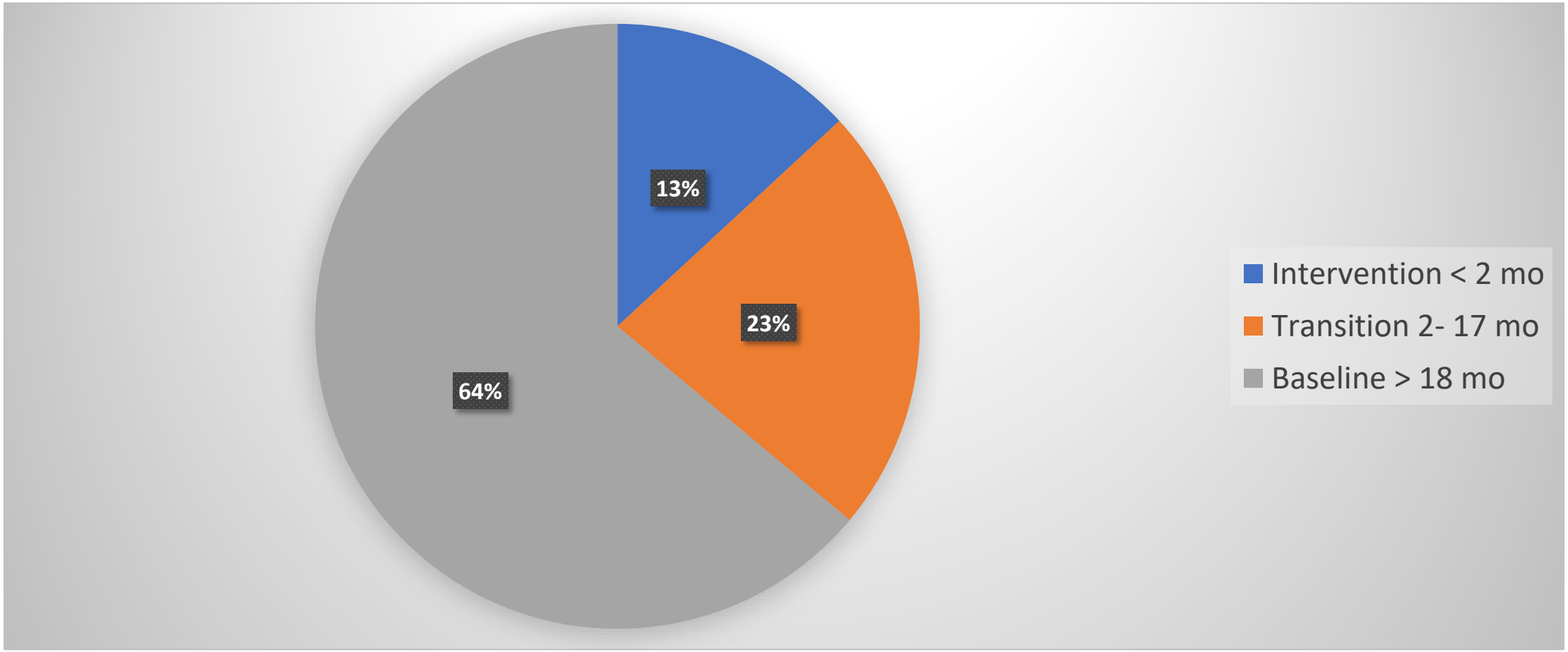
October 2023

PDSA#4: Made repeat 18 month HCV Ab screen optional; engaging care coordinators

June 2024

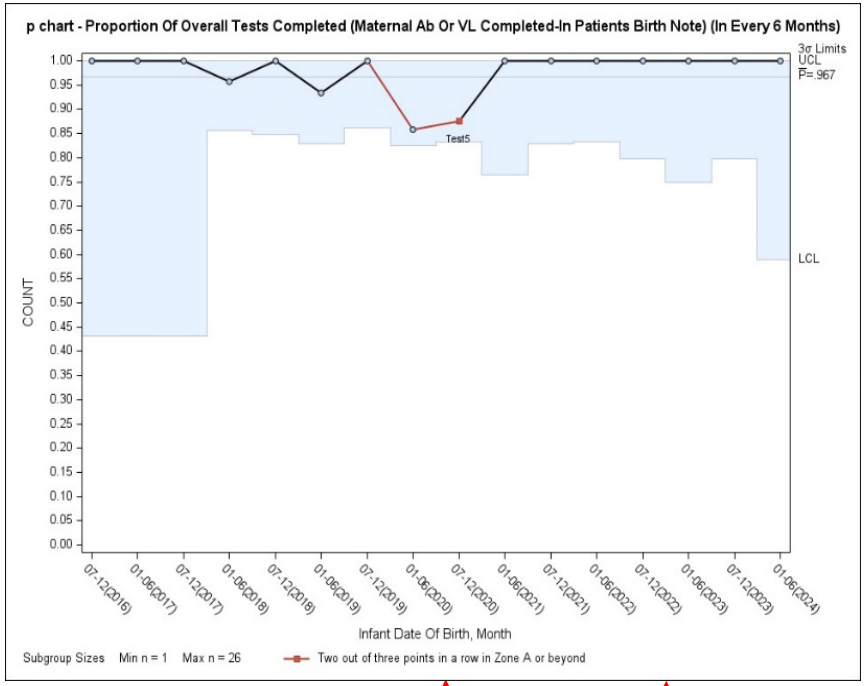
PDSA#5: narrowed screening indications; rescreening of VL-mothers; expand to other practices

183 Perinatally HCV-Exposed Children



Pediatric Birth Note Documentation

Identified as HCV Positive

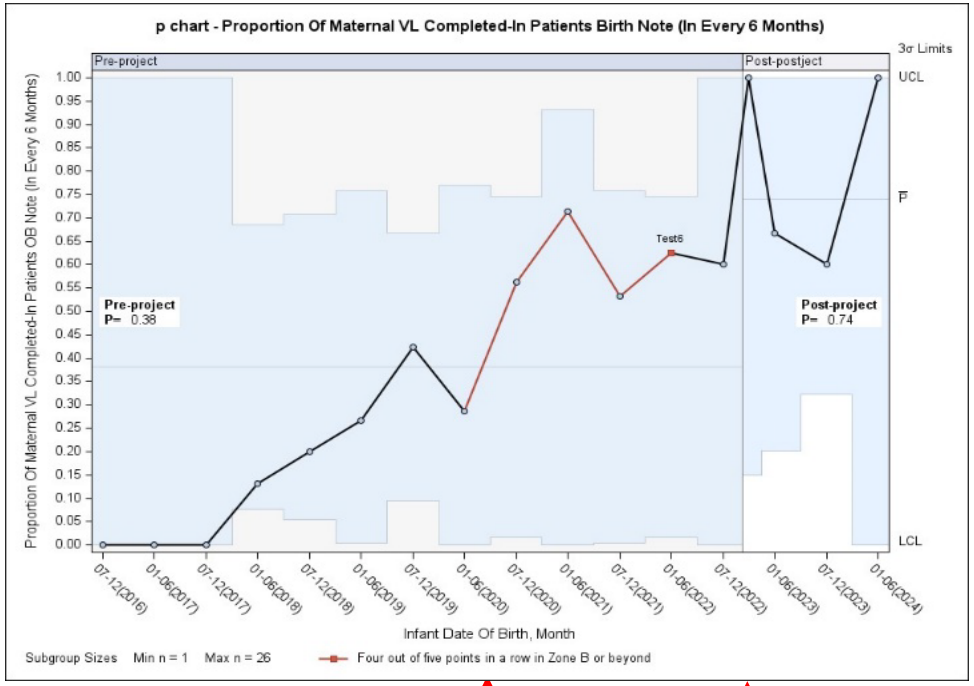


2016 2024

April 2020 October 2022

CDC Universal HCV screen QI Project Started

HCV Viral Load Documented

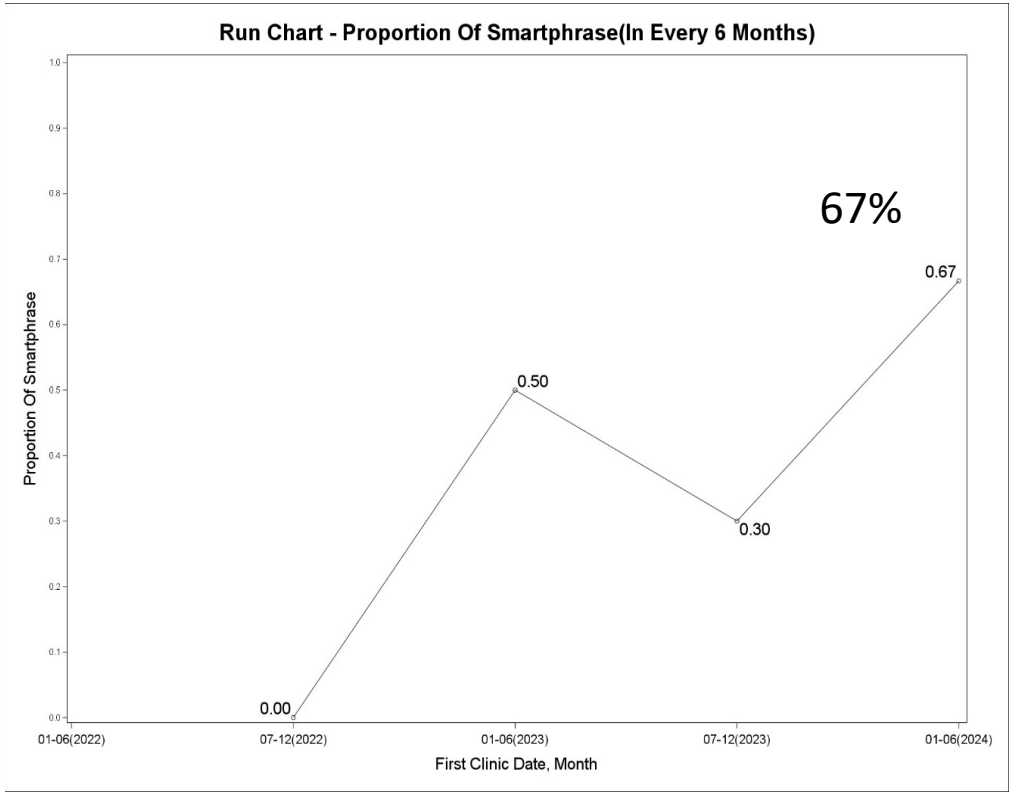


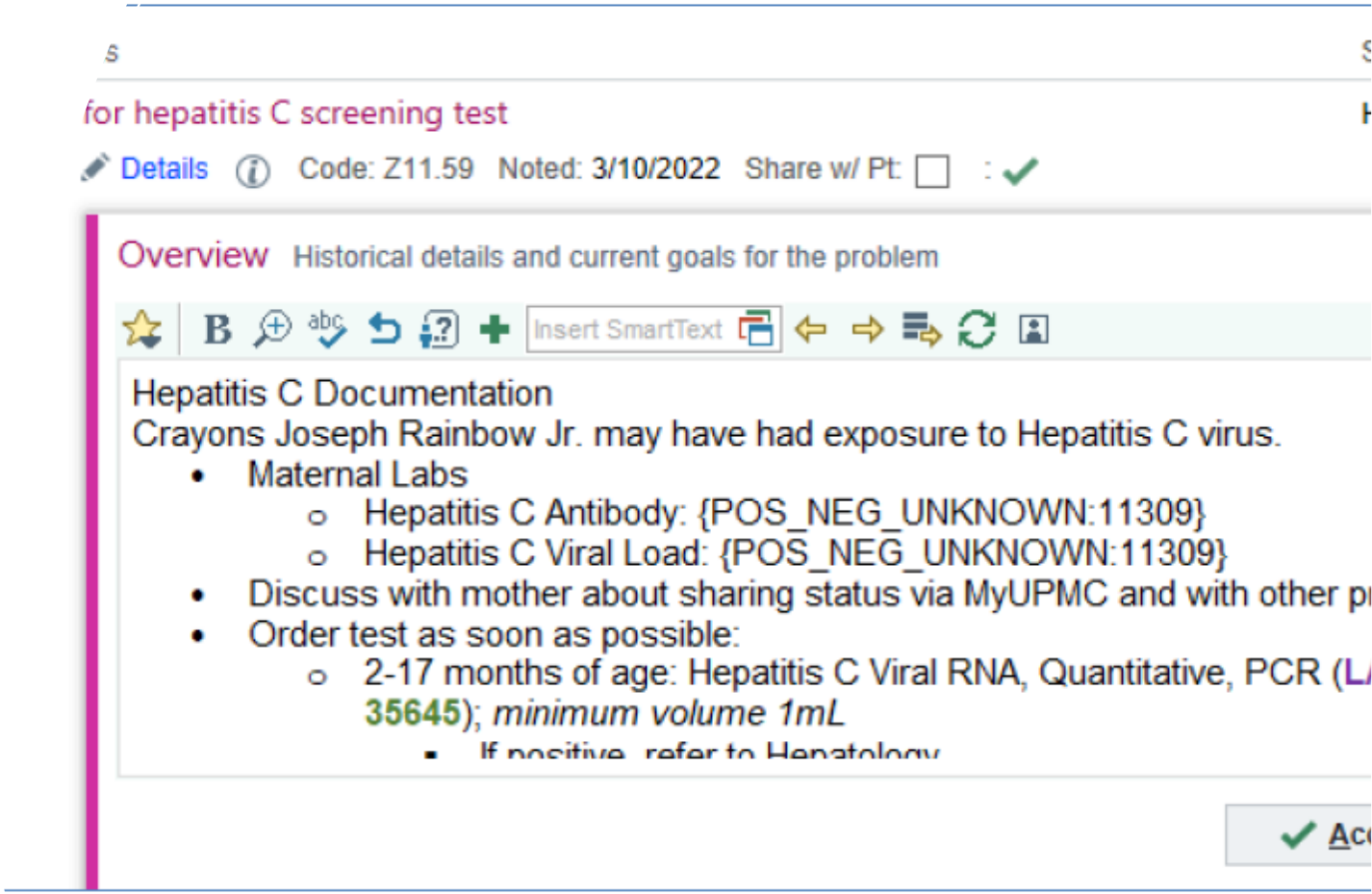
2016 2024

April 2020 October 2022

CDC Universal HCV screen QI Project Started

Increasing use of SMARTPHRASE



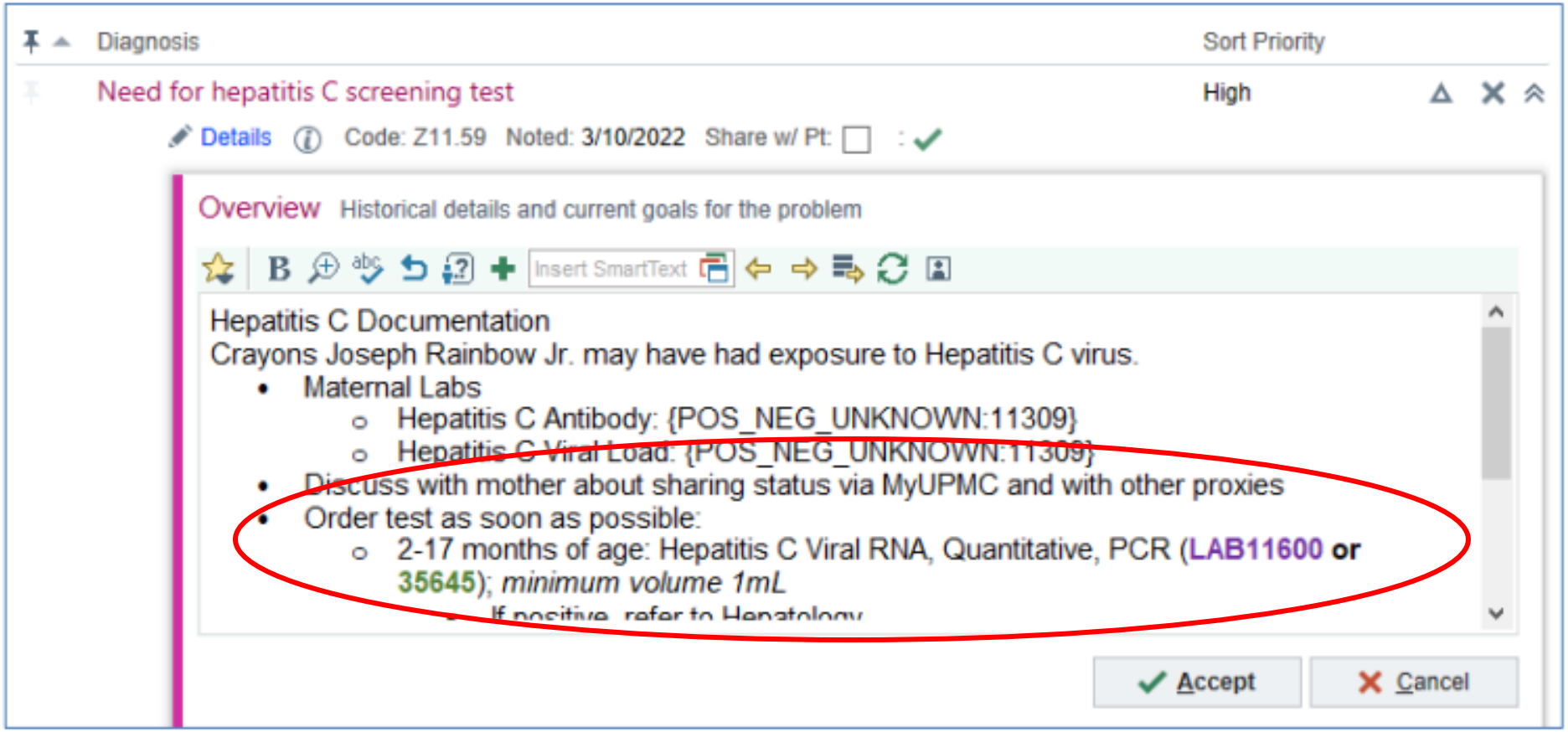


".GAPPEDHCV" in the overview section and complete 'Maternal Labs'

iscuss screening plans with family and place future order if patient is < 2 months

mpt collection via heel stick, in-clinic venipuncture (if > 20 lbs) or CHP lab refe

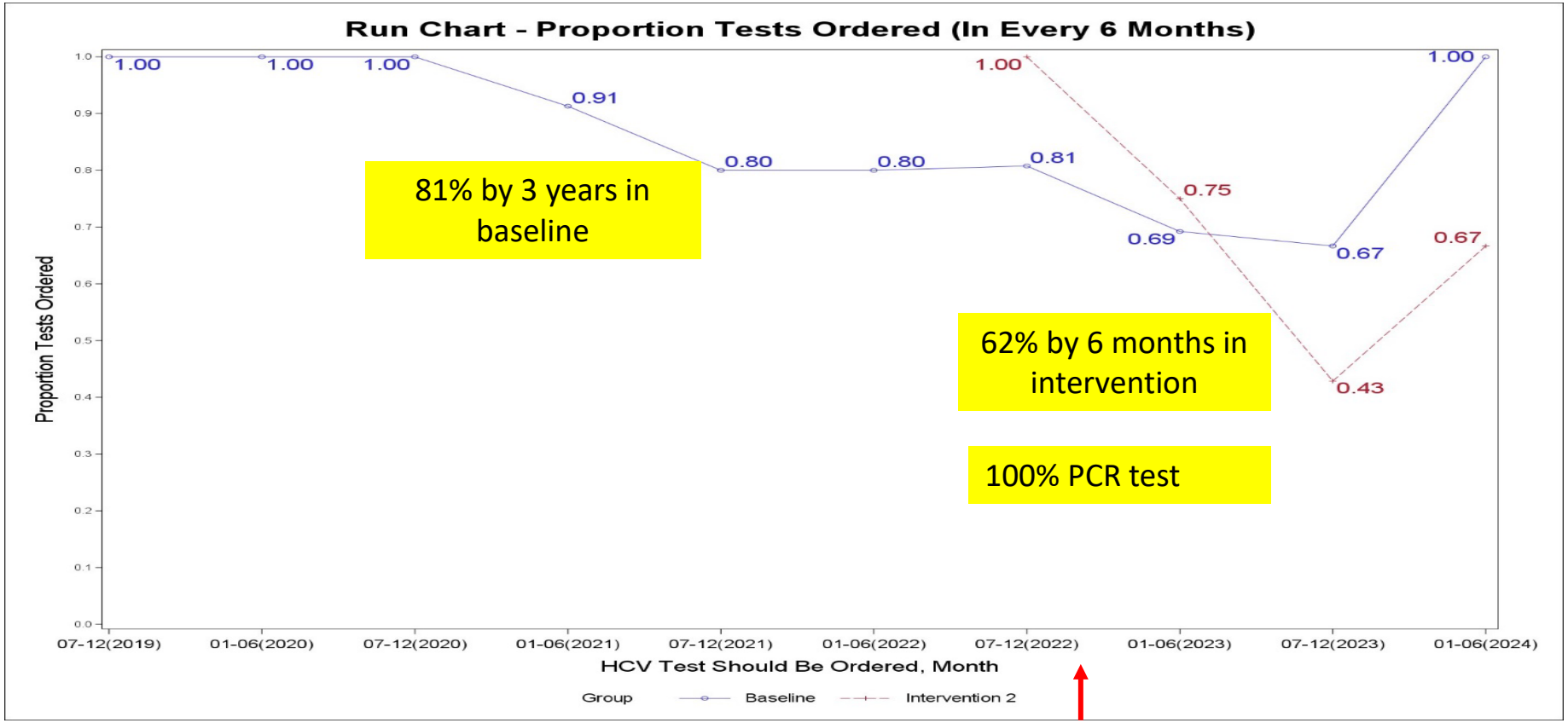
le family pediatric Hepatitis C and Children Fact Sheet



2. Discuss screening plans with family and place future order if patient is < 2 months of age **OR** order and attempt collection via heel stick, in-clinic venipuncture (if > 20 lbs) or CHP lab referral.

3. Provide family pediatric Hepatitis C and Children Fact Sheet

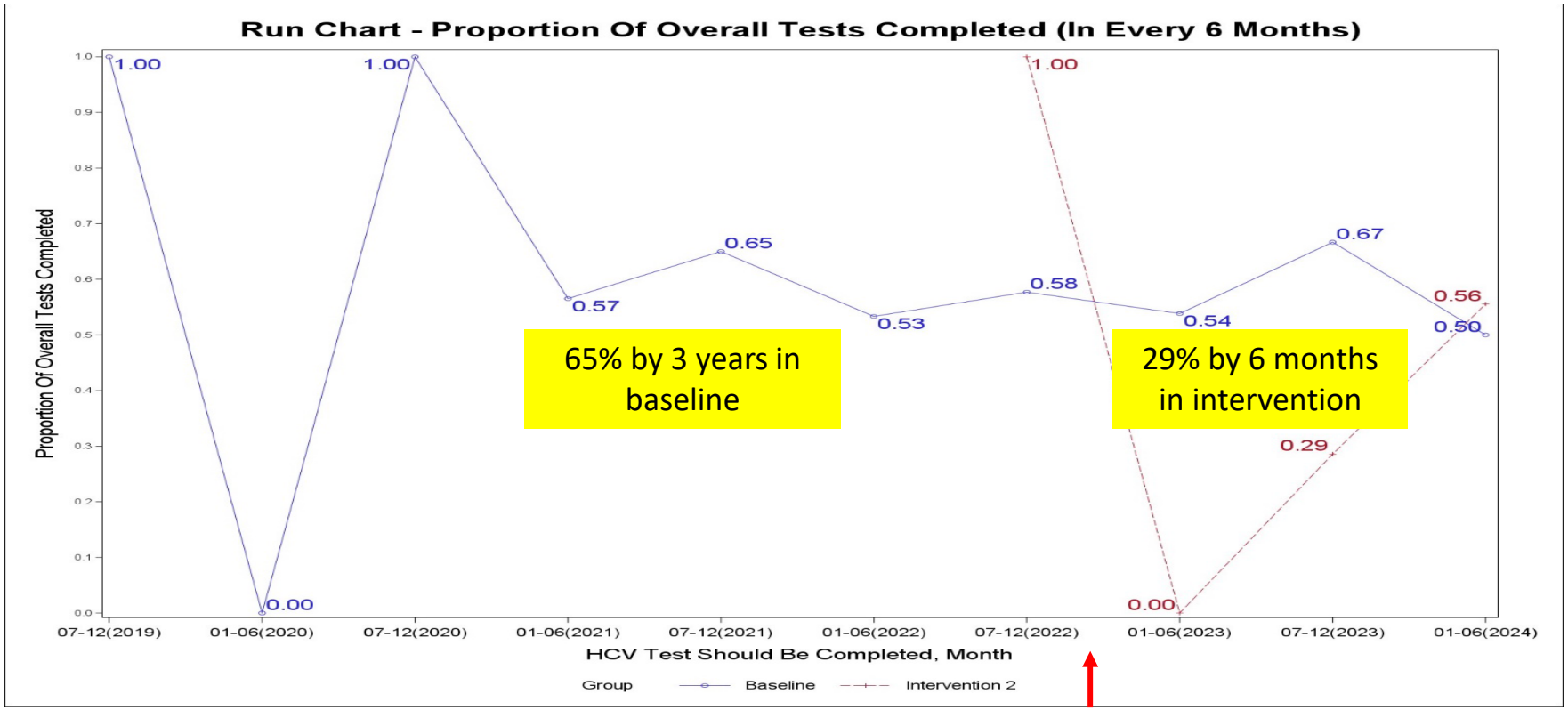
HCV Screening Tests Ordered



October 2022

QI Project Started

HCV Screening Tests Completed



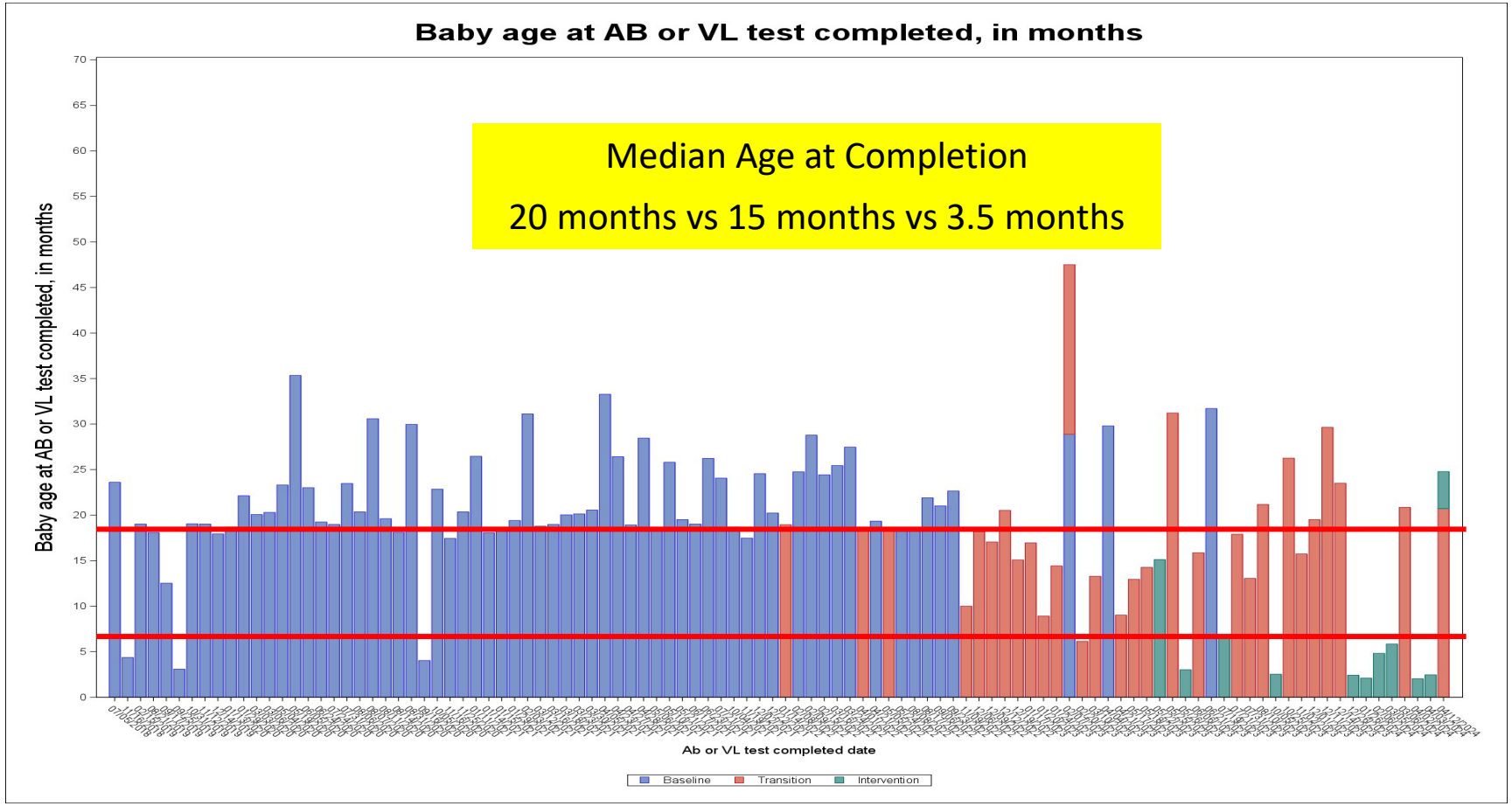
October 2022

QI Project Started

Deep Dive on Screening

- No Order
  - 5 transferred clinics between 1-4 months
- No Result
  - 3 transferred clinic before 6 months
  - 2 had outside lab script sent, parent has not gone
  - 1 parent refusal – mother viral load negative
- Results of those screened
  - 1 positive at limit of detection; subsequent neg
  - 3 negative

Time to Test Completion



18 months

6 months

Future Directions

- Sibling screening
- Improving maternal HCV screening
- Obtain HCV viral load on all HCV Ab+ pregnant women
- Repeat viral load at delivery if IVDU
- Linking mothers to treatment/care

CLINICAL SCENARIO REVISITED WITH KEY TAKE-AWAYS

- TJ is a 33-year-old G2P1001 @ 14 weeks with active HCV. Her child is at risk of contracting HCV.
  - ~5% of children exposed to a HCV (i.e. positive viral load) in utero will contract HCV (1:20)
  - Breastfeeding is OK! Avoid temporarily if cracked/bleeding nipples.
  - Infants should be screened with PCR (viral testing) between 2-6 months of age
    - If negative, no other screening needed
    - If positive, refer to pediatric hepatology and rescreen at 3 years
  - Siblings should be screened if not previously screened
  - Avoid sharing of toothbrushes, razors, nail clippers – ok to share cups, utensils; kisses OK!
  - No need to disclose on daycare forms

Questions?

Resources

- Panagiotakopoulos L, Sandul AL; DHSc; Conners EE, Foster MA, Nelson NP, Wester C; Collaborators. CDC Recommendations for Hepatitis C Testing Among Perinatally Exposed Infants and Children - United States, 2023. MMWR Recomm Rep. 2023 Nov 3;72(4):1-21.
- Kimberlin DW, Barnett ED, Lynfield R, Sawyer MH, editors. Red Book 2021–2024: report of the Committee on Infectious Diseases, 32nd edition. Itasca, IL: American Academy of Pediatrics; 2021.
- Infectious Diseases Society of America. HCV in children. Arlington, VA: Infectious Diseases Society of America; 2022. https://www.hcvguidelines.org/unique-populations/children