

Neonatal Abstinence Syndrome

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Dr. Bada has no conflicts of interest and no disclosures to make. October 30, 2025



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Objectives

-  Review historical events leading to the current status of neonatal abstinence syndrome
-  Be familiar with current epidemiologic data related to NAS
-  Understand the associated maternal risks and maternal postpartum issues in NAS
-  List neonatal, post-discharge and long-term outcomes for mothers and children
-  Understand the role of psychosocial risks and mitigating factors in affecting NAS outcomes
-  Understand the framework for management of the mother-infant dyad affected by drug use

**“The one who does not remember history is
bound to live through it again.”**

Georges Santayana, Spain (1863-1952)



Historical Background

- ~ 4000 BC Sumerians migrated from Persia and settled between the Tigris and Euphrates Rivers. Discovered a plant that will eventually bring more pleasure and more suffering than any plant in history – the “plant of joy” or opium.
- Opium: described as accommodating, growing in different types of climates and soil, and resistant to insects and fungi.
- Gum from opium seedpod contains morphine, codeine, alpha narcotic and papaverine, and thebaine



Historical Background

- 🛡️ Early 16th century. Paracelsus created the concoction (**laudanum**, from Latin *laudare* – to be praised), opium mixed with brandy, liquid opium used through Europe; physicians used for coughs, diarrhea, dysentery, and gout
- 🛡️ 1692: Thomas Sydenham said “Among the remedies which it has pleased the almighty God to give man to relieve his sufferings, none is so universal and efficacious as opium.
- 🛡️ 1800s – Louisa May Alcott and George Washington used liquid opium; Mary Todd Lincoln was addicted to it.
 - Women were considered gentle and harmless addicts

Historical Background

- 🛡️ 1803: isolation of morphine and expansion to medical use → public health problem
- 🛡️ 1827: marketed by Merck & Co., Inc for pain relief and alcohol treatment
- 🛡️ 1853: Alexander Wood. Morphine as intravenous drug.
- 🛡️ 1839-1860. Two opium wars between Britain and China. China lost both times resulting in China opening ports for imports, payment of tariffs, and ceded Hongkong to the British.
- 🛡️ 1850—First mention of drugs as a “problem” for babies.



Historical Background

- 🛡️ 1870: Introduction of opium to US with the arrival of Chinese citizens during **California Gold Rush**, and use rapidly extending to other US cities
- 🛡️ 1875: First attempt to regulate opiates in US (Opium Den Ordinance in San Francisco)
- 🛡️ 1875: 1st reported case of a newborn with signs of opioid withdrawal at birth; diagnosis: **congenital morphism**. No treatment; infant died.
- 🛡️ 1898: Heinrich Dreser developed **heroin** (diacetylmorphine) since morphine was as addictive as opium. High drug potency, less dose needed, and less risk for addiction

Historical Background

- 🛡️ 1898 to 1910: Bayer distributed heroin as OTC medication for colds, sore throat, pneumonia, and tuberculosis. Since believed to be not addictive, proposed Rx for morphine addiction and published in JAMA; 1906
- 🛡️ 1900 – 1924: Heroin marketed as safe for pregnant women
- 🛡️ By 1900: China was importing 8,600,000 pounds of opium and had more than 13 million opium addicts.
- 🛡️ Early 1900s: Sir William Osler called opium as “God’s own medicine.”
- 🛡️ Since 1900, opium became the basis of a drug killing Americans about 20,000 a year.

Historical Background

- 🛡️ 1901-- recognized clinical signs were the result of the infant withdrawing from the cessation of the passive transfer of maternal morphine and providing the infant with medication would ease his/her signs.
- 🛡️ 1903 - report described survival of a neonate after morphine treatment
 - Treatment of affected infants through breast feeding
- 🛡️ 1914: Harrison Narcotic Act. Federal gov required registration and keep records of importing, producing, selling, or dispensing “narcotics” and then replaced in 1970 by the Controlled Substance Act enforced by DEA

Historical Background

- 🛡️ 1947--Successful treatment of seizures reported in an infant with congenital morphism; methadone approved for use in US
- 🛡️ Congenital Morphism remained a medical curiosity and was subsequently renamed Neonatal Abstinence Syndrome (NAS)
- 🛡️ 1953-55--Report of 18 infants with abstinence, 5 died-- prematurity, respiratory failure, Rx-methadone, phenobarbital, paregoric
- 🛡️ 1966: Buprenorphine discovered and FDA-approved in 1985
- 🛡️ 1960s: Multiple reports of infants with NAS during the heroin epidemic

Historical Background

- 🛡️ 1986: Portenoy published based on 38 patients that “ opioid maintenance therapy can be safe, salutary, and more humane alternative for patients with intractable non-malignant pain and no history of drug abuse.” Believed that compassion for patients with terminal cancer be extended to all patients
- 🛡️ Birth of pain as “fifth vital sign.”
- 🛡️ Used term opioid to refer to synthetic forms of opium versus opiates (morphine and codeine) purified directly from opium.
- 🛡️ Drugs like oxycodone had finally solved the problem of pain relief without addiction
- 🛡️ Nixon had the “war on drugs” while Portenoy’s war was “war on the war on drugs.”

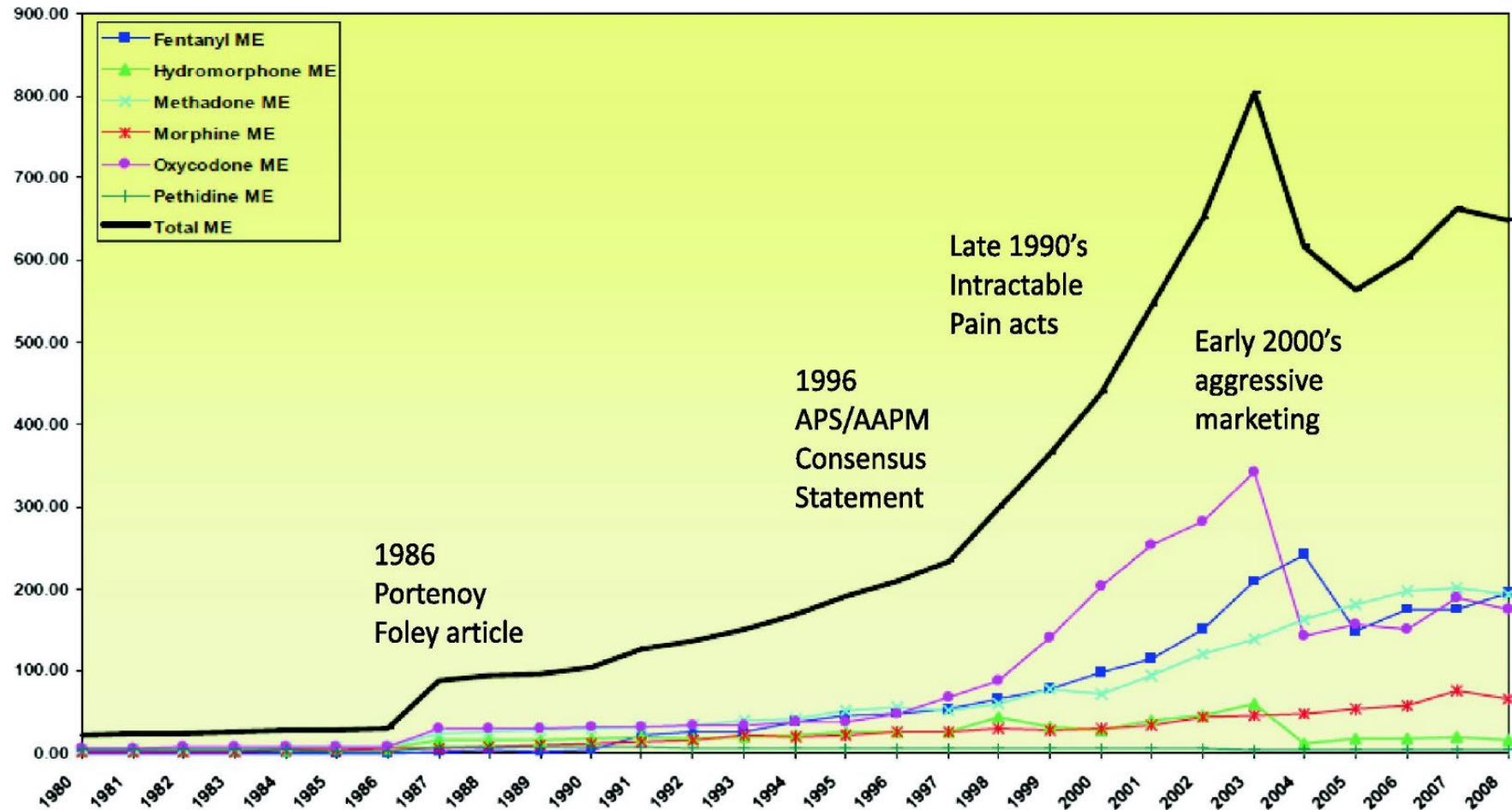
Historical Background

- 🛡️ 1997--First reported case of buprenorphine withdrawal in newborns.
- 🛡️ 2002--First reported case of oxycontin withdrawal in newborns.
- 🛡️ 2012--Opioid prescriptions shifted to the treatment of chronic pain → steep increase in abuse
- 🛡️ 2015--An estimated 2 million people living in the United States with a SUD related to prescribed opioids



United States of America

Opioid Consumption in Morphine Equivalence (ME), Mg/person

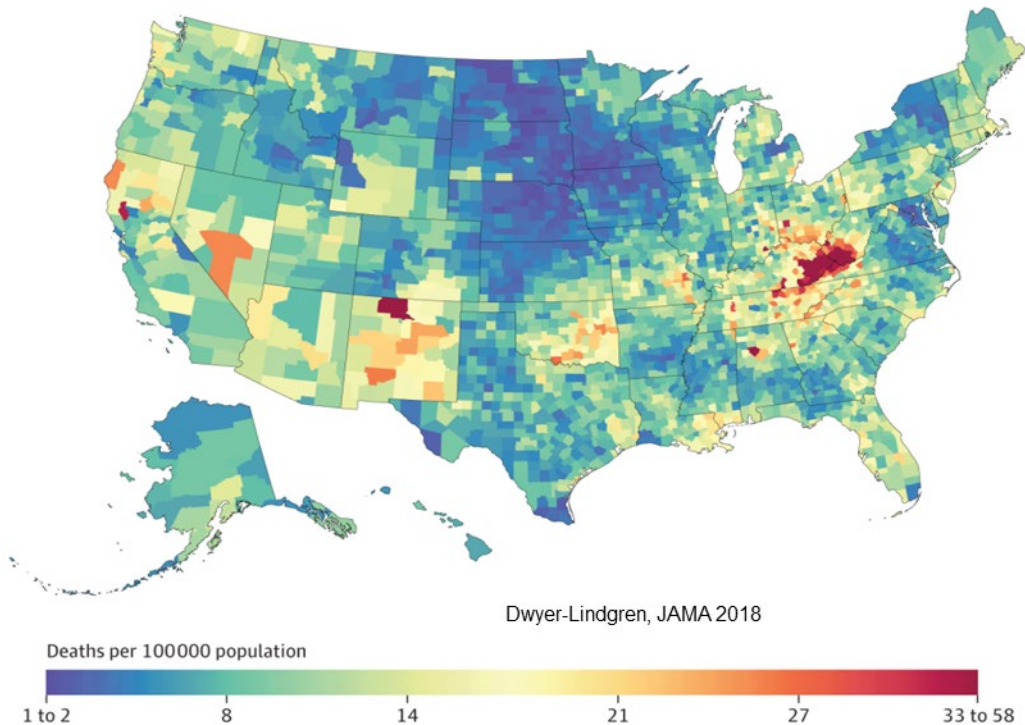


Data sources:
Consumption data - International Narcotics Control Board;
Population - United Nations;
ME conversion factors - WHOCC Centre for Drug Statistics Methodology

Pain & Policy Studies Group
University of Wisconsin
Carbone Cancer Center
WHO Collaborating Center

Big concern...

A Age-standardized mortality rate from drug use disorders, both sexes, 2014



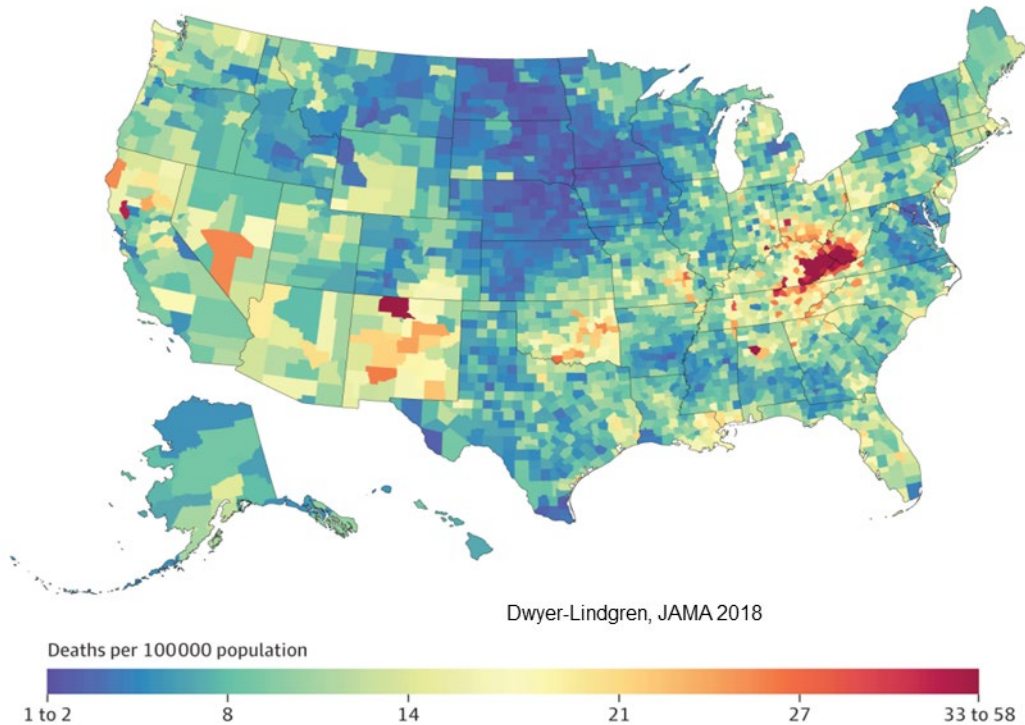
2023: 301 Americans died each day from drug-related overdose

2024: 220 Americans died each day from drug-related overdose

Drug causes: opioids, psychostimulants, cocaine

Centers for Disease Control and Prevention
<https://www.cdc.gov/nchs/pressroom/releases/20250514.html>

A Age-standardized mortality rate from drug use disorders, both sexes, 2014



- 🏥 Opioid epidemic/crisis
- 🏥 Deaths from overdose
- 🏥 Increase in NAS cases
- 🏥 Increase in hospital costs
- 🏥 ??? Consequences post-discharge

**Opioids easily pass from mother to fetus...
(low molecular weight, lipid solubility). Clamping the
umbilical cord interrupts the drug supply, creating a 60-
80% chance for Neonatal Abstinence Syndrome**



Are babies addicted?

- No. Babies don't have compulsive drug seeking behavior in spite of adverse consequences.
- Neonatal Abstinence Syndrome (NAS) is a transient but potentially serious physiologic disturbance from abrupt discontinuation of prenatal opioid exposure when the umbilical cord is cut.



Frequency of Substances

Frequency of Opioids in the Public Health NAS	
<i>Any opioids</i>	87.37%
Buprenorphine	59.47%
Fentanyl	25.76%
Heroin	17.30%
Methadone	10.48%
Oxycodone	8.21%
Hydrocodone	3.54%
Kratom	0.63%
Tramadol	0.13%
Unspecified Opioids	28.28%

Frequency of Other Substances in the Public Health NAS Reporting Registry	
Methamphetamines	41.92%
Cannabinoid	36.24%
Benzodiazepines	12.88%
Gabapentin	9.60%
Cocaine	9.47%
SSRIs	2.90%
Barbiturates	2.27%
Tricyclics	0.51%
Ondansetron	0.51%
Xylazine	0.38%
SARIs	0.25%

Kentucky Cabinet for Health and Family Services (CHFS). (2024). Neonatal Abstinence Syndrome in Kentucky: Annual Report on 2023 Public Health Neonatal Abstinence Syndrome (NAS) Reporting Registry.

Characteristics of NAS Cases

	NAS cases n (%)	No NAS n (%)
Maternal age 25-29 y	937 (37.5)	31842 (30.6)
Race: white	2402 (95.9)	89049 (83.2)
Less than HS	729 (29.3)	14748 (13.9)
Urban	1125 (45.1)	65149 (60.8)
Medicaid	2093 (84.0)	48139 (45.3)
Late preterm	311 (12.4)	8556 (8.0)
NICU	696 (28.0)	8948 (8.8)
Smoking	1951 (78.2)	18947 (17.7)
Hepatitis C	680 (27.7)	1421 (1.4)

Maternal Factors Contributing to Neonatal Risks

- Maternal medical complications:
- Cardio-vascular disorders, hypertension, preeclampsia, placental disorders
- Infectious diseases, including those related to drug use: Sepsis, sexually transmitted diseases, Group B strep; MRSA, UTI
- Psychosocial issues: depression, domestic violence, drug use
- Social determinants of health: Environment, education, social/community context, neighborhood, health care, economic stability.

Social Determinants of Health (SoDH)



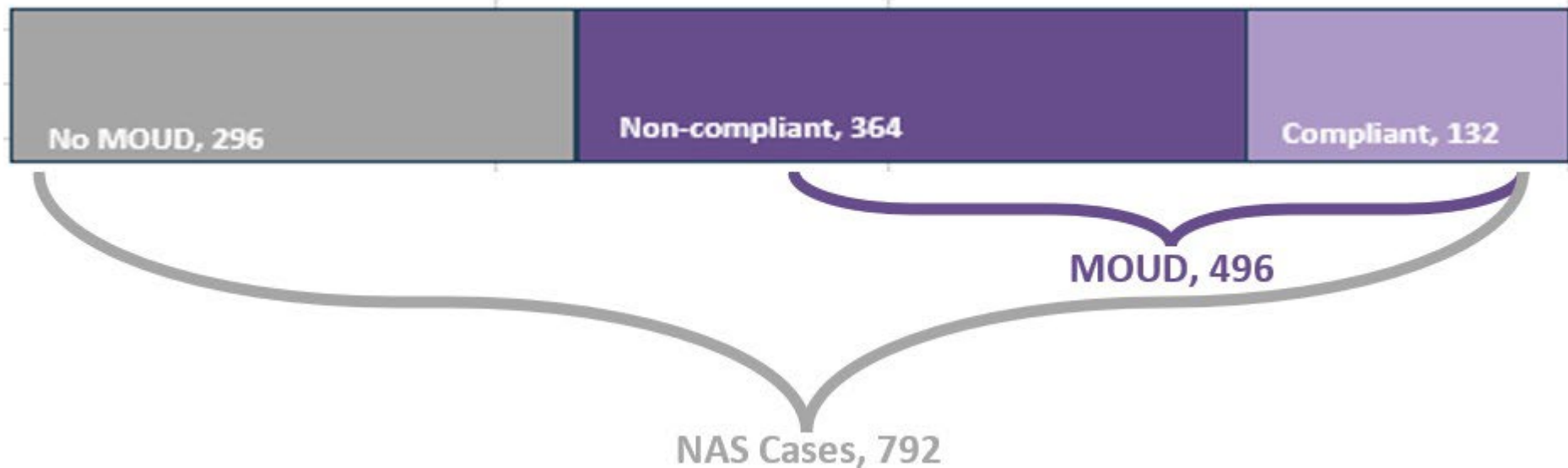
Maternal Treatment Programs

Maternal Characteristics	NAS
Mother in treatment during pregnancy	39.1%
Of those in treatment:	
Continuing treatment at discharge	57%
Program includes drug testing	25%
Counseling	22%
Parenting classes	5%

KPA: KPQC 2014-2016, unpublished

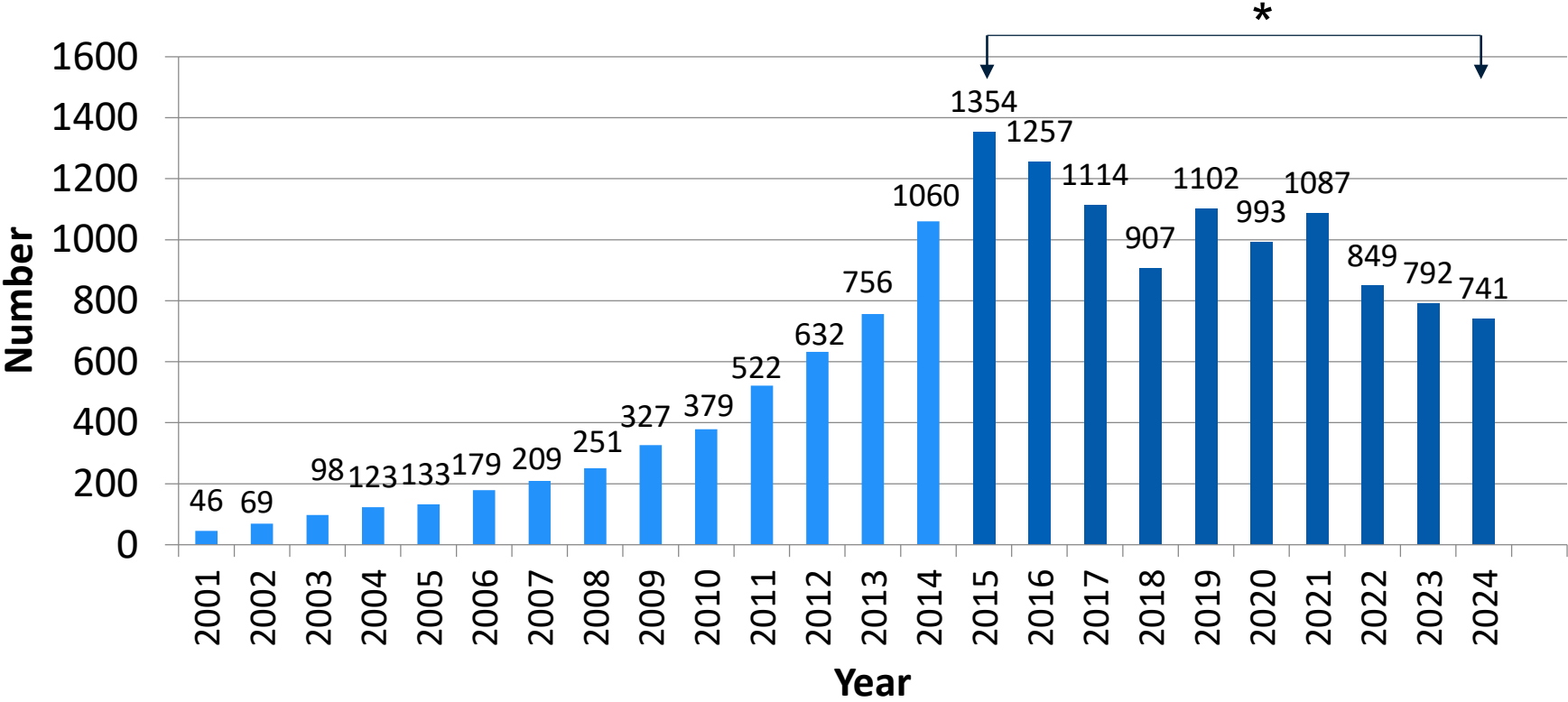
MOUD Participation

Number of Cases in NAS Registry, by MOUD Participation and Compliance, 2023



Kentucky Cabinet for Health and Family Services (CHFS). (2024). Neonatal Abstinence Syndrome in Kentucky: Annual Report on 2023 Public Health Neonatal Abstinence Syndrome (NAS) Reporting Registry.

NAS Hospitalizations of Kentucky Resident Newborns, 2001 - 2024



* Data from NAS Surveillance Registry

NAS is defined by any mention of the ICD-9-CM codes 779.5 and V3x, or of the ICD-10-CM codes P96.1 and Z38. The U.S. transition to ICD-10-CM occurred on October 1, 2015. The transition to ICD-10-CM should be considered as a possible contributor to any changes in trend observed between 2014 and 2016.

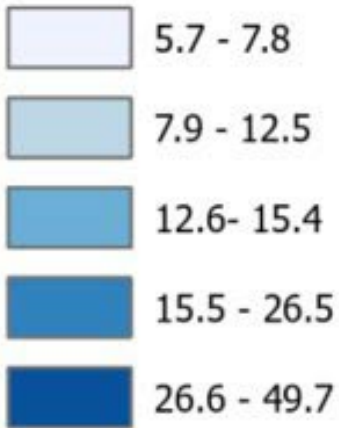
Years on the time axis represent the admission date (not the discharge date).

*2015 data from NAS State reporting started

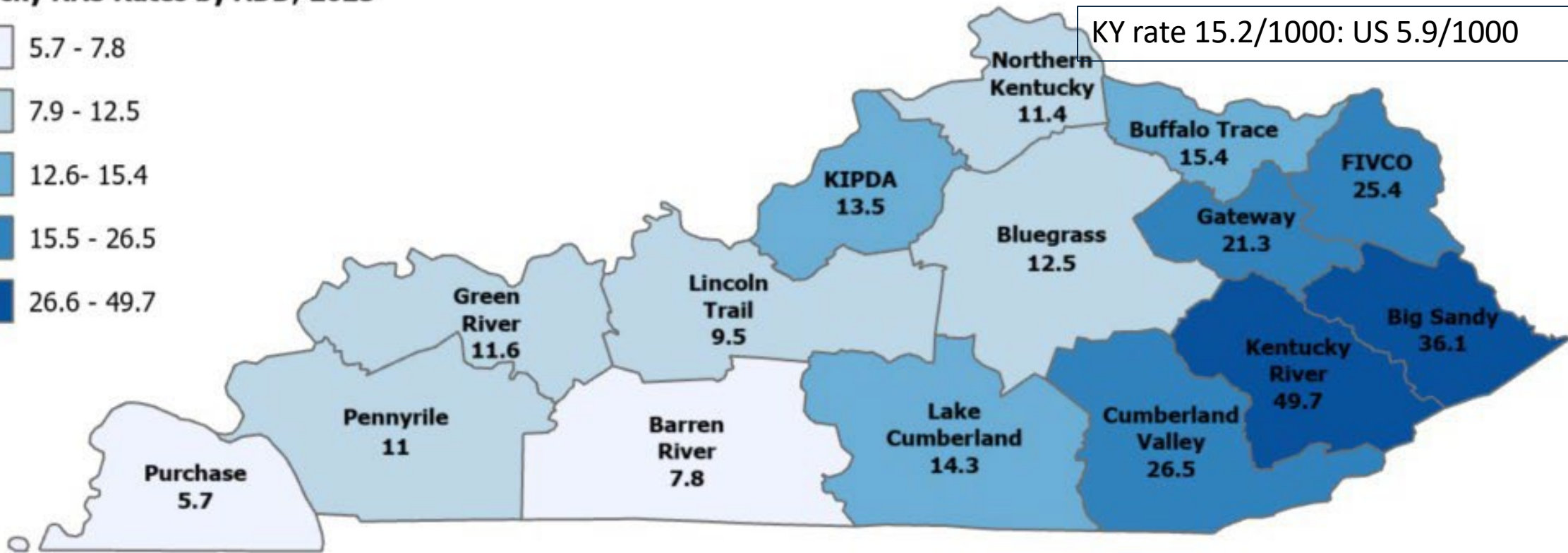
Produced by Kentucky Injury Prevention Research Center, August, 2016 (Include data prior to 2015)

Data are provisional and subject to change.

Kentucky NAS Rates by ADD; 2023



KY rate 15.2/1000: US 5.9/1000



Kentucky Cabinet for Health and Family Services (CHFS). (2024). Neonatal Abstinence Syndrome in Kentucky: Annual Report on 2023 Public Health Neonatal Abstinence Syndrome (NAS) Reporting Registry.

Detection of Drug Exposure



Maternal Screening

- Admits to drug use
- Urine screening during pregnancy
- Maternal hair analysis



Neonatal Screening

- Baby urine drug screen
- Meconium drug screen
- Baby hair analysis
- Umbilical cord analysis

Detection of Drug Exposure



Maternal Characteristics to initiate baby screen

- History
- Suspicion based on risk factors
 - » Gravida (number times pregnant) ≥ 3
 - » No or late prenatal care
 - » Child or children not living with mother
 - » Other CPS involvement
 - » Abruptio placentae/ Placenta previa
 - » Physical injuries (ER visits)
 - » History of pain, headaches, migraine, etc
 - » STD's, Risky lifestyles
 - » Disorientation, expression during interviews

Detection of Drug Exposure

-  **Unreliability of history**
-  **Urine and or meconium screening may be negative in the presence of in-utero exposure**

Drug Exposure Screening at UK: By history and infant testing

Drug	History	History + Urine/Meconium	Increase in Identification
Opiate	166	183	10%
Cocaine	115	128	11.3%
Benzodiazepine	87	87	No change
PCP	3	4	33%
Amp/Meth	25	28	12%
Marijuana	292	309	5.8%

Opiate Exposure Effects NAS Versus NOWS

Neonatal Abstinence Syndrome



Onset of manifestations:

- Usually within 72 hours of birth
- Birth to two weeks
- Late presentation: 2-4 weeks

Neonatal Abstinence Syndrome



Variable onset of manifestations and depends upon:

- Drug used during pregnancy
- Single drug versus polydrug use
- Dosage
- Timing of use before delivery
- Anesthesia/analgesia (labor and delivery)
- Fetal accumulation
- Delayed excretion due to tissue binding

Neonatal Abstinence Syndrome: Preterm versus Term Infant

- 🛡️ **Preterm infants may exhibit later and less severe symptoms**
 - Less immature CNS
 - Shorter duration of exposure
- 🛡️ **Scores of withdrawal may be related to prematurity (e.g. respiratory signs, poor feeding, etc)**

Withdrawal Versus Drug Effects

-  **CNS manifestations such as hypertonia, irritability, shrill cry, myoclonic jerks, seizures, especially in opiate exposure**
-  **These manifestations are noted with other withdrawal signs and with other drugs**
-  **Opiates, cocaine, and other drugs have also been demonstrated to affect brain development (prominent feature small head circumference).**

Signs of Neonatal Abstinence or Withdrawal

Central Nervous System Signs

- High-pitched cry to continuous crying
- Decreased sleeping time
- Hyperactivity
- Hyper-reflexia
- Tremors
- Hypertonia
- Myoclonic jerks
- Convulsions
- Irritability



Signs of Neonatal Abstinence



Gastrointestinal disturbances

- Excessive sucking
- Poor feeding
- Regurgitation
- Projectile vomiting
- Loose to watery stools



Metabolic/vaso-motor disturbances

- Sweating
- Fever
- Yawning
- Mottling

Signs of Neonatal Abstinence



Respiratory disturbances

- Nasal stuffiness
- Sneezing
- Nasal flaring
- Tachypnea
- Retractions



Other manifestations

- Abrasions or excoriations (knees, elbows, chin)
- Fever

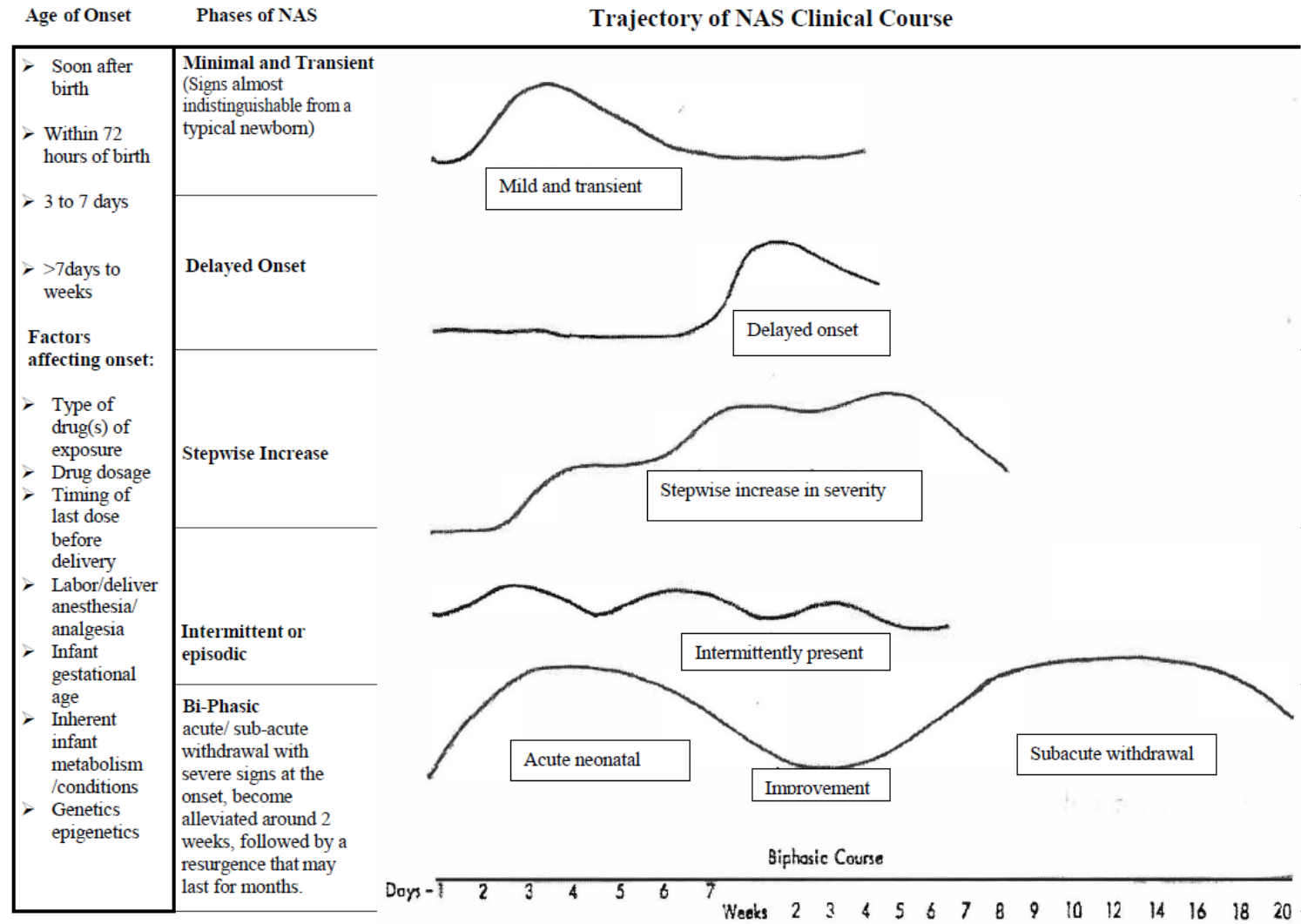
Abrasions or excoriations (knees, elbows, chin)
Fever

Other manifestations

Neonatal Abstinence Syndrome

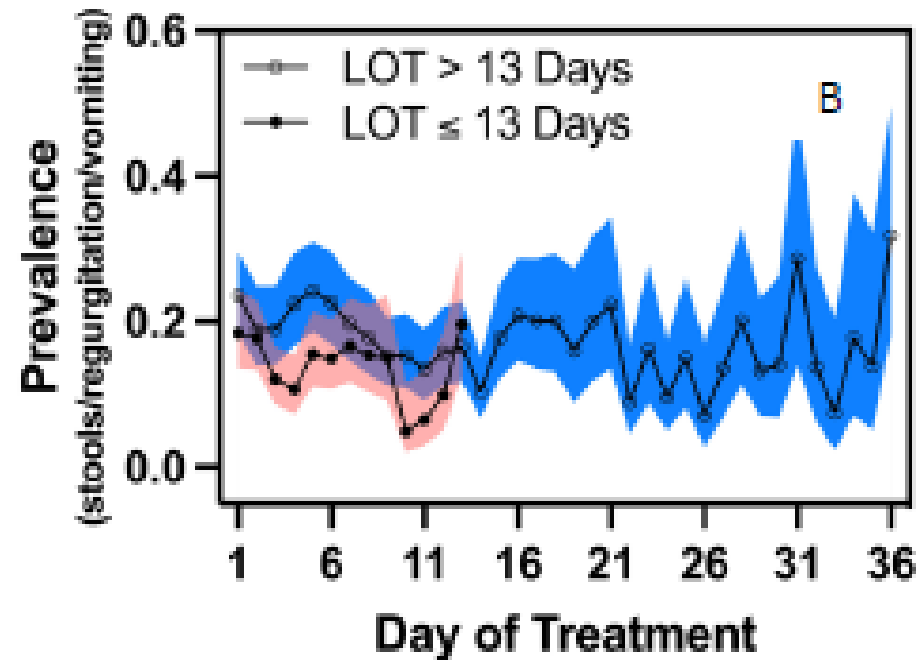
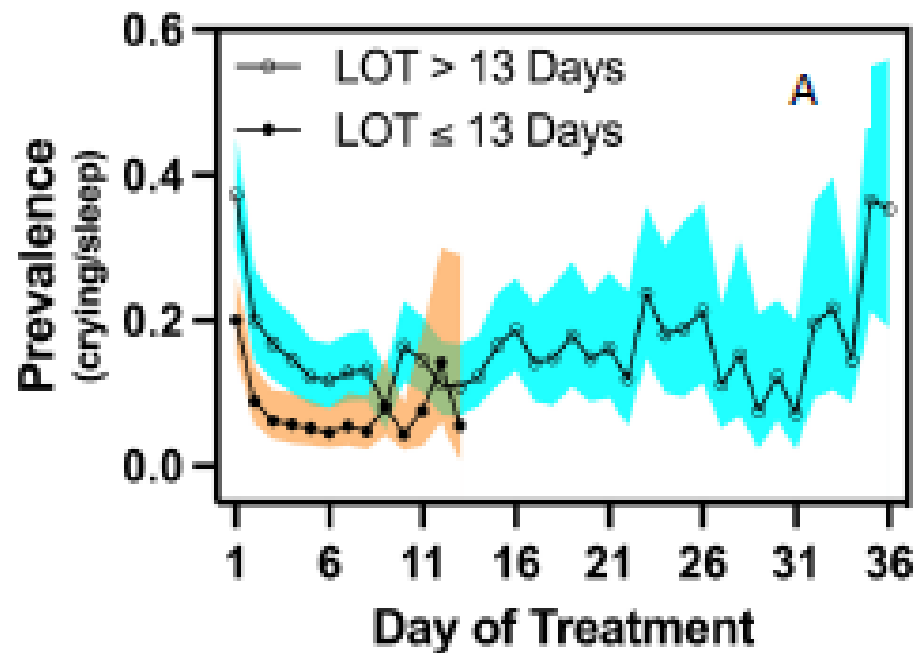
- 🛡️ **Duration of withdrawal manifestations:**
 - 6-8 days (if not requiring treatment)
 - Longer in some infants (3 – 6 months)

Trajectory of NAS manifestations



Revised from Desmond MM, Wilson GS. Neonatal abstinence syndrome: Recognition and diagnosis. Addict Dis. 1975;2(1-2):113-21.

Resurgence of Signs (CNS and GI)



Miller JS, Bada HS, Westgate PM, Sithisarn T, Leggas M. Neonatal Abstinence Signs during Treatment: Trajectory, Resurgence and Heterogeneity. Children (Basel). 2024;11(2).

Neonatal Abstinence Syndrome



Evaluation of abstinence/drug effects

- Finnegan's Abstinence Scoring System
- Lipsitz modification of Finnegan
- Brazelton's Neurobehavioral Assessment Scales (NBAS)
- NICU Network Neurobehavioral Scale (NNNS)
- Eat, Sleep, Console(ESC)

Limitations of Finnegan Scoring System

- High inter-rater variability due to the subjective nature of the items
- Overlap with normal infant behavior: sneezing or yawning
- The need to disturb the baby for accurate assessment
- Less encourage parent/caregiver involvement
- It's usage in withdrawal from drugs other than opioids is not clear
- Several studies have noted a longer length of hospital stay and pharmacological treatment
- The score itself does not promote the use of non pharmacologic measures
- Limited scientific rationale to begin treatment at scores of 8 and 12

ESC

Can the baby Eat at least 1 oz per feed?

Can the baby Sleep uninterrupted for 1 hour?

Can the baby be Consoled within 10 minutes?

Eat, Sleep, Console (ESC) Tool

- A newer method of NOWS management developed in 2014 (Grossman et al), which focuses on basic functioning of infants- ability to eat, sleep and be consoled
- Quality improvement project: ≥ 35 wks GA- mothers took methadone daily for at least 1 month before delivery
- **Family's involvement in the infant's care- emphasizing that** infants stay with parents/ caregiver for entire hospitalization
- **Maximizing non-pharmacological treatments before starting medications**
- ESC model approach for management of NAS aims to
 - 🛡️ -Significantly reduce length of stay
 - 🛡️ -Reduced need for pharmacological treatment in infants
 - 🛡️ -Reduce hospital costs

Ref: (M.R. Grossman et al., 2017; Matthew R Grossman, Lipshaw, Osborn, & Berkwitt, 2018; E. M. Wachman et al., 2018; E. Wachman, Whalen, Minear, & Macmillan, 2017)

ORIGINAL ARTICLE

Eat, Sleep, Console Approach or Usual Care for Neonatal Opioid Withdrawal

L.W. Young, S.T. Ounpraseuth, S.L. Merhar, Z. Hu, A.E. Simon, A.A. Bremer, J.Y. Lee, A. Das, M.M. Crawford, R.G. Greenberg, P.B. Smith, B.B. Poindexter, R.D. Higgins, M.C. Walsh, W. Rice, D.A. Paul, J.R. Maxwell, S. Telang, C.M. Fung, T. Wright, A.M. Reynolds, D.W. Hahn, J. Ross, J.M. McAllister, M. Crowley, S.K. Shaikh, K.M. Puopolo, L. Christ, J. Brown, J. Riccio, K. Wong Ramsey, Akshatha, E.F. Braswell, L. Tucker, K.R. McAlmon, K. Dummula, J. Weiner, J.R. White, M.P. Howell, S. Newman, J.N. Snowden, and L.A. Devlin, for the ACT NOW Collaborative*

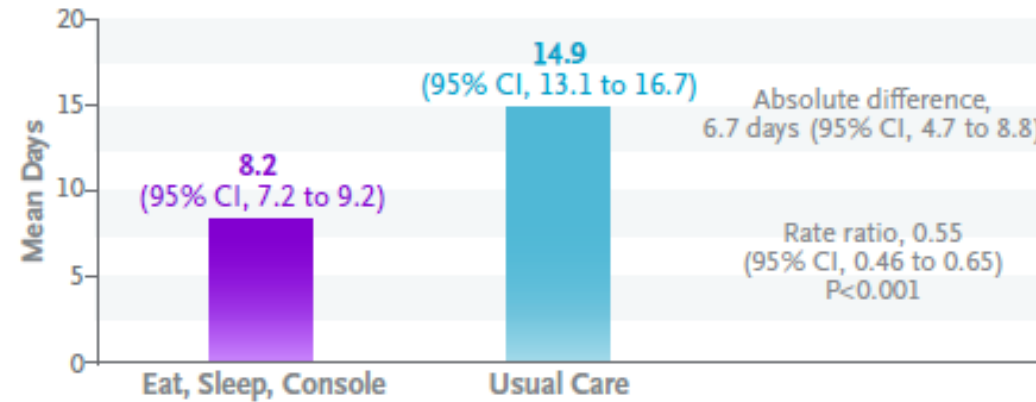
Table 1. Maternal and Neonatal Characteristics at Baseline.*

Characteristic	Usual Care (N=702)	Eat, Sleep, Console Care Approach (N=603)
Maternal		
Median gravidity (IQR) — no.	3 (2–5)	4 (2–5)
Median parity (IQR) — no.	3 (2–4)	3 (2–4)
Race or ethnic group — no. (%)†		
Non-Hispanic White	462 (66)	447 (74)
Non-Hispanic Black	98 (14)	71 (12)
Hispanic	107 (15)	33 (5)
Other	25 (4)	37 (6)
Missing data	10 (1)	15 (2)
Adequate prenatal care — no. (%)‡		
Yes	432 (62)	381 (63)
Missing data	21 (3)	9 (1)
Medication for opioid use disorder — no./total no. (%)		
Any	512/702 (73)	451/603 (75)
Buprenorphine	316/512 (62)	288/451 (64)
Methadone	191/512 (37)	154/451 (34)
Other	0	2/451 (<1)
Unknown	5/512 (1)	7/451 (2)
Missing data	15/702 (2)	20/603 (3)
Metropolitan residence — no. (%)§	586 (83)	547 (91)
Neonatal		
Female sex — no. (%)	336 (48)	314 (52)
Birth weight — g	3026.4±455.4	3012.8±490.4
Gestational age — wk	38.6±1.3	38.6±1.3
Polysubstance exposure — no. (%)¶	420 (60)	343 (57)

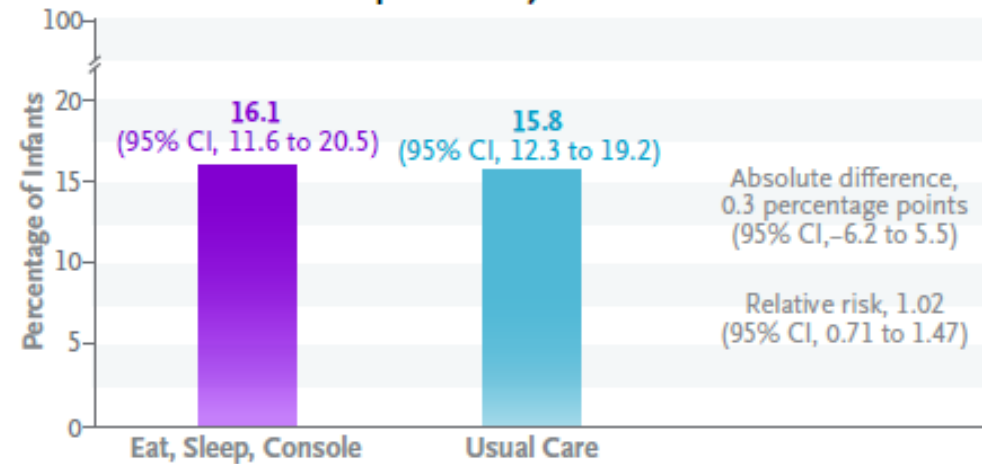
Eat, Sleep, Console Approach or Usual Care for Neonatal Opioid Withdrawal

- **Design:** A multicenter, stepped-wedge, cluster-randomized, controlled trial evaluated the safety, efficacy, and generalizability of the Eat, Sleep, Console approach as compared with usual care with the Finnegan tool.
- **Intervention:** At randomly assigned times, 26 U.S. hospitals transitioned from usual care to the Eat, Sleep, Console approach (with a 3-month training period for staff members)
- Primary outcome was the time from birth until the infant was medically ready for discharge.
- Composite safety outcome at 3-month follow-up included in-hospital safety, unscheduled health care visits, and nonaccidental trauma or death.

Time from Birth to Medical Readiness for Discharge



Composite Safety Outcome



Young, LW et al, NEJM 2023

RCT: Influence of Eat, Sleep, and Console on Infants Pharmacologically Treated for Opioid Withdrawal

POPULATION

243 Males, 220 Females



Infants born at 36 weeks' gestation or later who received pharmacologic treatment for opioid withdrawal

Mean gestation, 38 wk

SETTINGS / LOCATIONS



26 Hospitals across the US

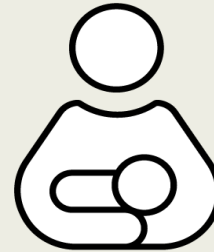
INTERVENTION

463 Infants analyzed



320 Usual care

Site usual care practices including use of the Finnegan Neonatal Abstinence Scoring Tool



143 Eat, sleep, console (ESC) care approach

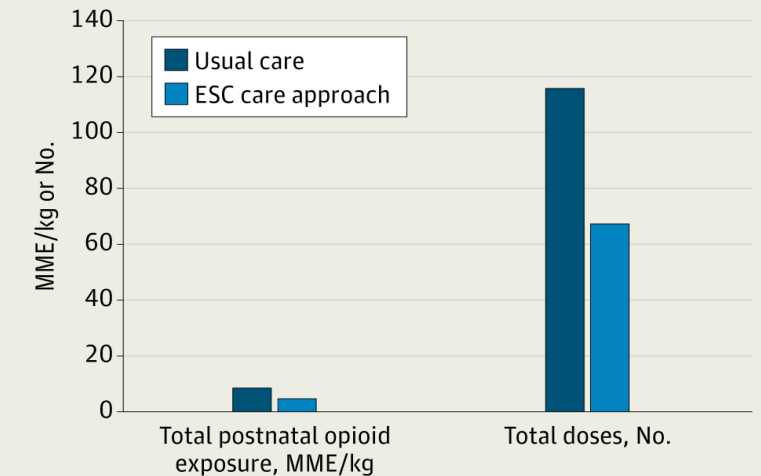
Function-based care approach emphasizing nonpharmacologic care and caregiver involvement

PRIMARY OUTCOME

Total postnatal opioid exposure (morphine milligram equivalents [MME] per kg and number of opioid doses) in infants pharmacologically treated for neonatal opioid withdrawal syndrome

FINDINGS

Total adjusted mean postnatal opioid exposure was significantly less for infants pharmacologically treated in the ESC care approach group when compared with usual care



Adjusted mean difference (95% CI)

Exposure: 4.1 MME/kg (1.3-7.0); $P = .001$

Doses, No.: 48.7 (19.9-77.4); $P < .001$

Devlin LA, Hu Z, Merhar SL, et al; Eunice Kennedy Shriver NICHD Neonatal Research Network and NIH Environmental Influences on Child Health Outcomes (ECHO) Program Institutional Development Award States Pediatric Clinical Trials Network. Influence of eat, sleep, and console on infants pharmacologically treated for opioid withdrawal: a post hoc subgroup analysis of the ESC-NOW randomized clinical trial. *JAMA Pediatr*. Published online April 15, 2024. doi:10.1001/jamapediatrics.2024.0544

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TABLE 1 Comparison of studies on the “Eat, Sleep, and Console” approach in the management and assessment of infants with NAS.

	Grossman et al. (8)	Blount et al. (19)	Dodds et al. (14)	Miller and Willier (11)	Ryan et al. (6)	Amin et al. (17)	Young et al. (18)
Number of patients	287	76	82	135	158	71	837
Setting	Urban	Not specified	Urban	Urban	Rural/urban	Rural	Urban
MOUD	100%	~85%	Not specified	~94%	Not specified	Not specified	~73%
Eat	1 oz	>1 oz	Breastfed well or took the prescribed amount of formula	0.5–1 oz	Breastfeed well or took >1 oz	0.5–1 oz	Ability to coordinate feeding (breast or bottle) within 10 min, breastfeeding $\geq$ 10 min and taking $\geq$ 10 ml
Sleep	>1 h	>1 h	>1 h	>1 h	>1 h	>1 h	>1 h
Console	Within 10 min	Within 10 min	Within 10 min	Within 10 min	Within 10 min	Within 10 min	Within 10 min
Pharmacological intervention	Morphine 0.05 mg/kg/dose	Morphine 0.03 mg/kg/dose	Morphine 0.1 mg/kg/dose	Methadone	Morphine 0.04 mg/kg/dose	Methadone	Per institution
Short-term outcomes	30-day readmissions	Percent weight change 30-day readmission	Readmission rate	30-day readmission	30-day readmission	30-day readmission	3-months composite safety measure

TABLE 1 Reduction in Pharmacotherapy Rates for NAS by Described Alterations in Treatment

Author, Year	Method Applied	Premethod Incidence, % ^a	Postmethod Incidence, %
Grossman et al, ⁶ 2017	ESC plus other interventions	98	14
Wachman et al, ⁷ 2018	ESC plus other interventions	87	40
Welle-Strand et al, ²⁰ 2013	Breastfeeding	80	54
McKnight et al, ²¹ 2016	Rooming-in	83	15
McCarthy et al, ²² 2015	Maternal methadone split dosing	(60–80; undefined)	29
Wiegand et al, ²³ 2015	Maternal medication (methadone versus buprenorphine-naloxone)	52	25
Kelty and Hulse, ²⁴ 2017	Maternal medication (methadone versus naltrexone)	42	8

^a Of infants prenatally exposed to opioids requiring pharmacotherapy for NAS.

Key factors for successful management of NAS

Maternal

- 🛡️ Access to prenatal care
- 🛡️ Access to treatment programs
mitigation of polysubstance use
- 🛡️ Identification and intervention of
adverse Social Determinants of Health
and other comorbidities

Neonatal

- 🛡️ An established protocol to define,
promptly initiate and reinforce non-
pharmacological interventions
- 🛡️ If needed, continuous cardiorespiratory
monitoring of infants that require
pharmacotherapy
- 🛡️ Facilitating rooming-in
- 🛡️ Breastfeeding when appropriate
- 🛡️ Prompt follow-up

Neonatal Abstinence Syndrome



Supportive Treatment (Non-Pharmacologic Intervention)

- Swaddling
- Small frequent feedings
- High nutrient density formula
- IV fluids
- Decrease sensory stimulation
- Monitor closely for other disease status
- Monitor weight gain



Pharmacologic treatment

Initiation of Pharmacologic Treatment



Variation in threshold scores:

- A score greater than 7
- Three scores more than 8
- A score above 9
- A score above 10
- A score greater than 12



Pharmacologic Treatment

- Must be individualized
- Based on severity
- Agents: morphine, clonidine, phenobarbital, chlorpromazine, diazepam, methadone, buprenorphine

Morphine: most common

Table 3. Comparing body weight based dosing and symptom-based dosing using severity of NAS as determined from the Finnegan scores.

Weight-based dosing Finnegan & Kaltenbach (1995)			Symptom based dosing Jansson et al. (2009)			
Scores	Initial dose of morphine equivalent*	Escalation needed	Scores by category	Initial dose of morphine solution	Escalation as needed	Re-escalation if needed (2 scores within each category)
0-7	No treatment	---	Category 0: 0-8	No treatment	---	
8-10	0.053 mg/kg/dose q 4 h	Increase dose by 0.02 mg (0.05mL) with each subsequent dose	Category 1: 9- 12	0.04 mg/dose	0.02 mg	0.01 mg
11-13	0.080 mg/kg/dose q 4 h		Category II: 13- 16	0.08 mg/dose	0.04 mg	0.02 mg
14-16	0.107 mg/kg/dose q 4 h		Category III: 17 - 20	0.12 mg/dose	0.06 mg	0.03 mg
=>17	0.133 mg/kg/dose q 4 h		Category IV: 21 - 24	0.16 mg/dose	0.08 mg	0.04 mg
If re-escalation needed: resume previous dose that effected control of symptoms			Category V >25	0.20 mg/dose	0.20 mg	0.05 mg
Upon stabilization: Maintain dose for 3 days			Upon stabilization: Maintain dose for 3 days			
Decrease by 10% of total daily dose every 24 hours			Decrease dose by 0.02 mg every 24 hours			
Observe at least 48 hours after drug discontinuation			Observe at least 48 hours after drug discontinuation			

*Paregoric (0.4mg/ml morphine equivalent)

** Morphine solution (0.4 mg/ml)

Clonidine

- 🛡️ Centrally acting alpha 2 adrenergic receptor agonist
- 🛡️ Suppresses opiate withdrawal symptoms
- 🛡️ Activation of alpha 2 adrenergic receptors result in activating an inhibitory neuron, resulting in reduced sympathetic outflow, producing a decrease in vasomotor tone and heart rate
- 🛡️ Gradual taper to prevent increase in BP and sympathetic over activity

Clonidine

- 🛡️ Few studies
- 🛡️ Case series in post-op cases in pediatric patients (some neonates); no complications and facilitated weaning of opiates for analgesia.
- 🛡️ Agthe et al: clonidine as adjunctive therapy to morphine. Dose 6 -12 mcg/kg/day
- 🛡️ Shorter duration of treatment with clonidine added (11 versus 15 days);
- 🛡️ similar conclusion when clonidine used with choral hydrate
- 🛡️ As monotherapy: 1 to 3 mcg/kg/dose q 3 hr

Infants With NAS: Common Measures of Outcomes

- Preterm birth
- Intrauterine growth restriction
- Congenital malformations
- Medical complications
- Pharmacotherapy: (no/yes, duration of therapy)
- NICU care
- Length of stay

Discharge Planning

- DCBS reporting
- Maternal characteristics (drug dependence, treatment or none, comorbidities- medical and mental health)
- Discharge teaching (safe sleep, shaken baby, routine well-baby care, coping with a difficult child)
- Discharge disposition (mother, kinship care, foster care, adoption, institution)
- Follow-up care (medical home) and developmental monitoring
- Plan of safe care

OUTCOMES BEYOND LENGTH OF STAY

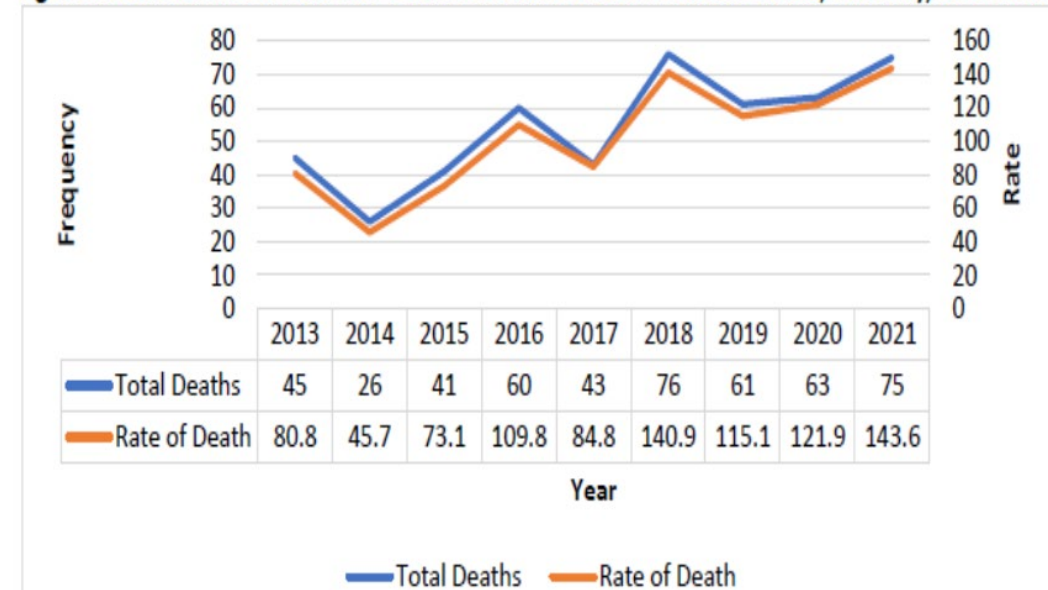
How are the mothers doing?

Maternal Issues

- 🛡️ Continuation of maternal medical problems
- 🛡️ Co-morbidities
- 🛡️ Anxiety and depression (pregnancy to post-partum)
- 🛡️ Psychosis
- 🛡️ Continued influence of SDoH
 - Homelessness
 - Food insecurity
 - Access to resources and health care
 - Parenting issues
 - Lack of support

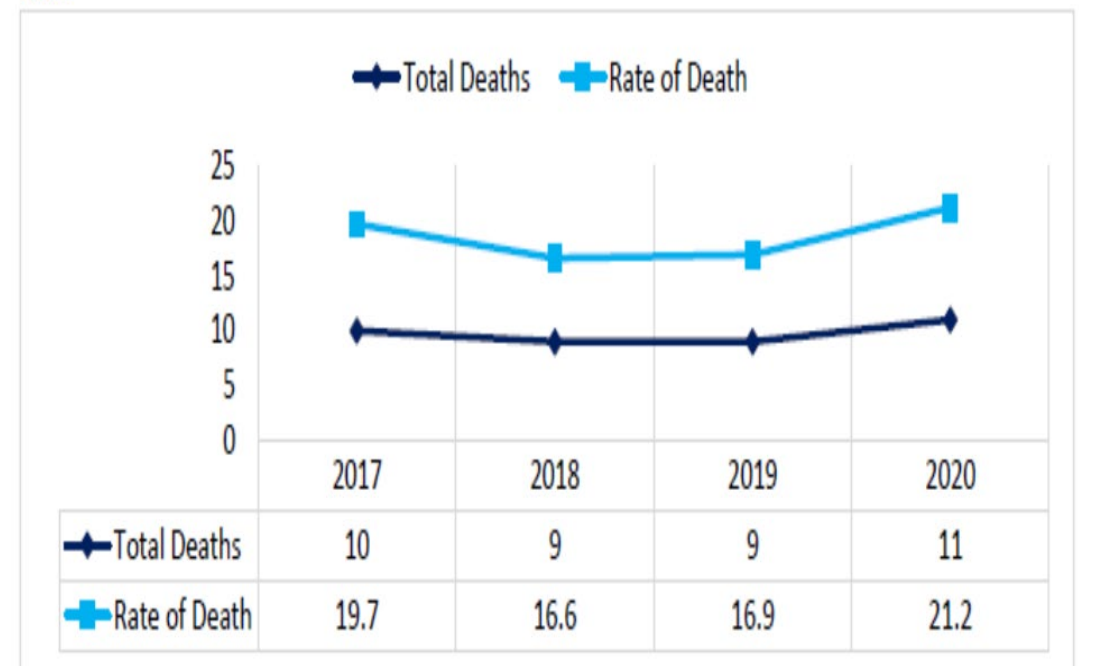
Maternal Mortality: All Causes & Pregnancy-Related

Figure 1: Total Number of Maternal* Deaths and Rate of Death from All Causes; Kentucky, 2013-2021



*Maternal death is defined as any female between the ages of 15-55 that was pregnant within one year prior to death or pregnant at death and died from any cause.
Data Sources: KY Vital Statistics files, linked live birth, and death certificate files years 2013-2021.

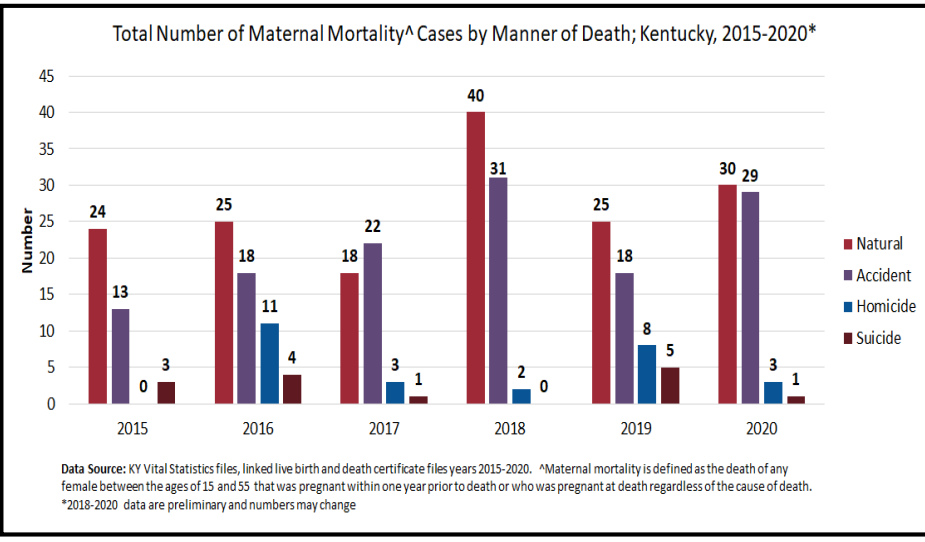
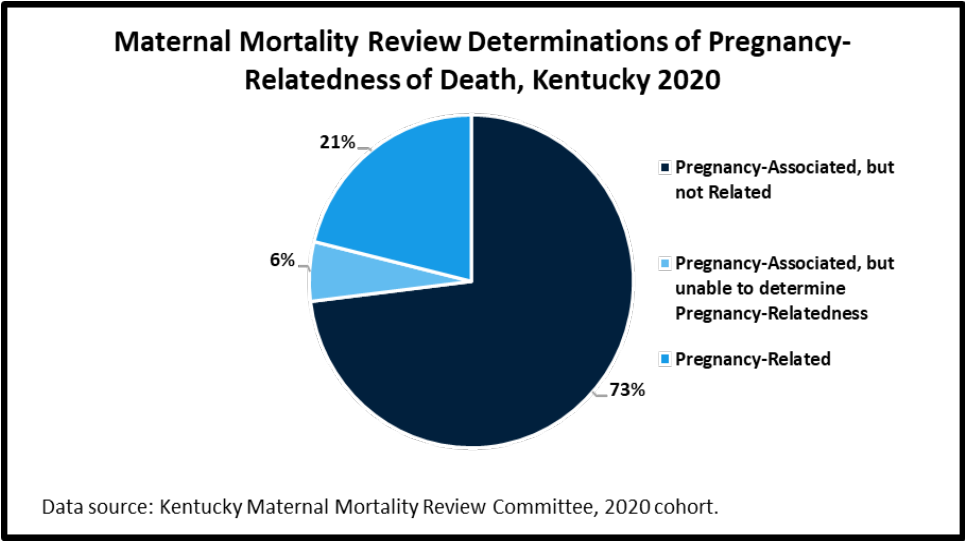
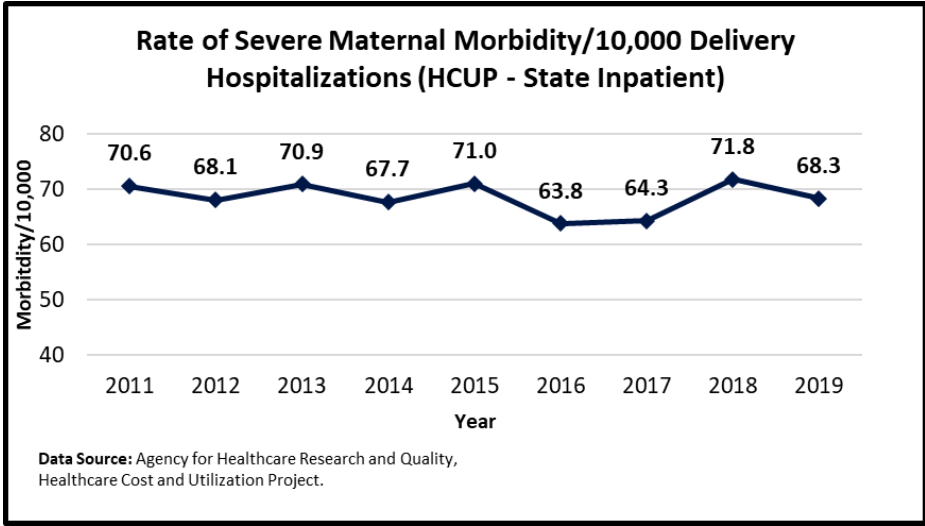
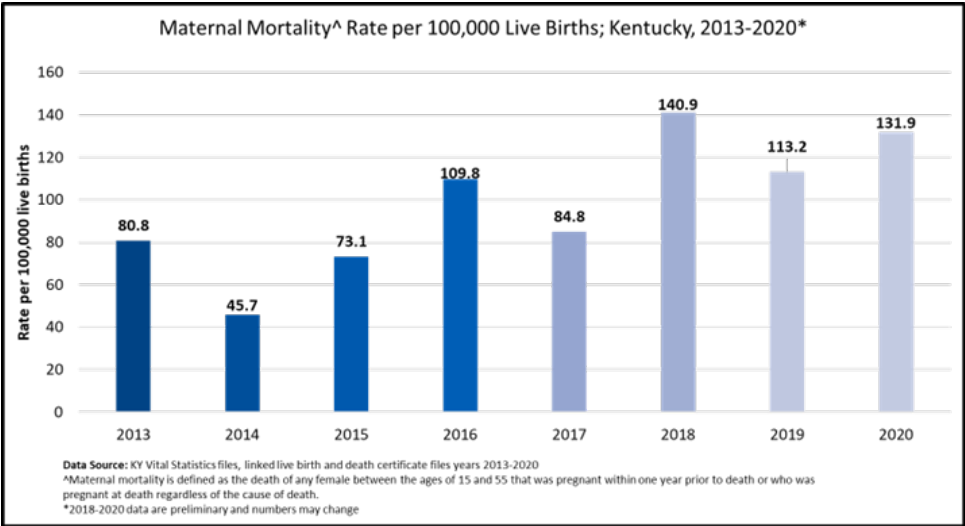
Figure 6: Total Number of MMRC Pregnancy-Related Deaths and Rate of Deaths; Kentucky MMR 2017-2020*



KY Vital Statistics 2013-2021; MMRC report: 2024

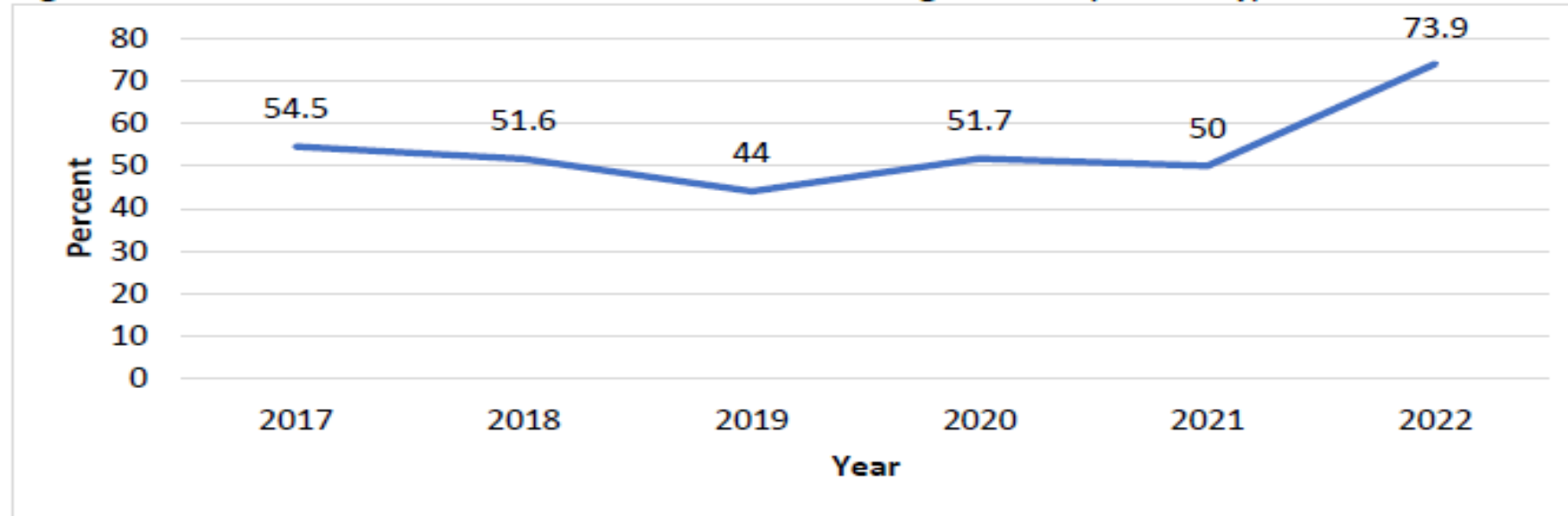
Women/Maternal Health

Maternal Morbidity/Mortality



Percent of Accidental Deaths (Drug Overdose)

Figure 3: Percent of Accidental Maternal Deaths due to Drug Overdose, Kentucky, 2017-2022*

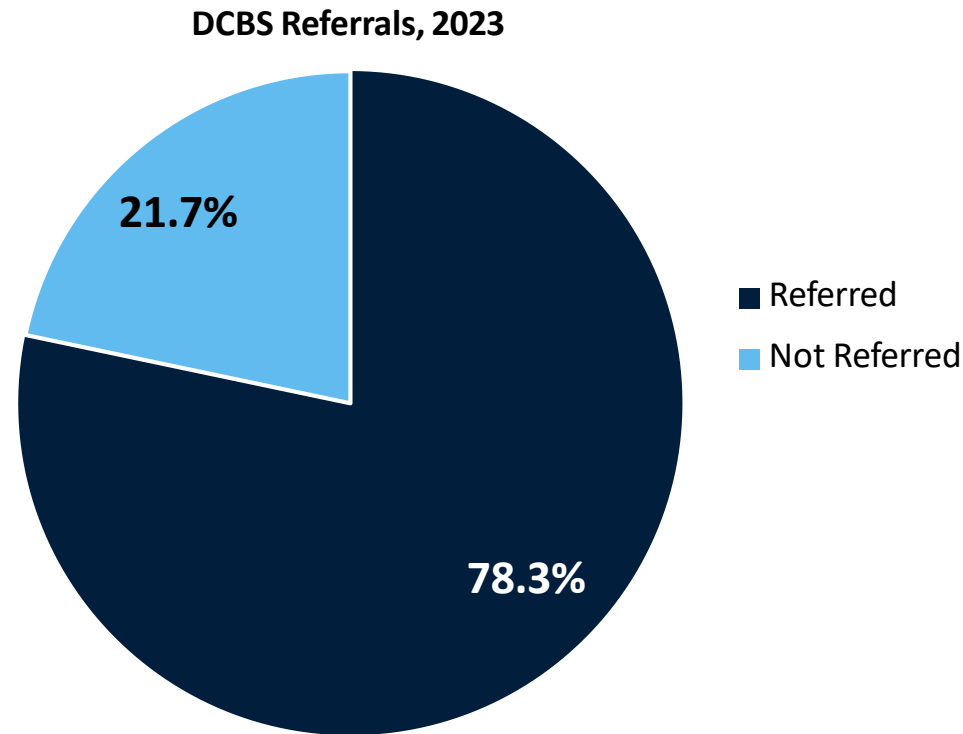


*Maternal death is defined as any female between the ages of 15-55 that was pregnant within one year prior to death or pregnant at death and died from any cause. Drug overdose is defined by the ICD-10 code X40-X49. The 2020-2022 data is preliminary, and numbers may change.

Data Source: KY Vital Statistics files, linked live birth, and death certificate files years 2017-2022.

Infant, Early Childhood & Adolescent Outcomes

Beyond Discharge



Of the cases referred to DCBS **67.7%** are accepted for investigation.



7 out of 10 children are discharged to the care of their biological parents



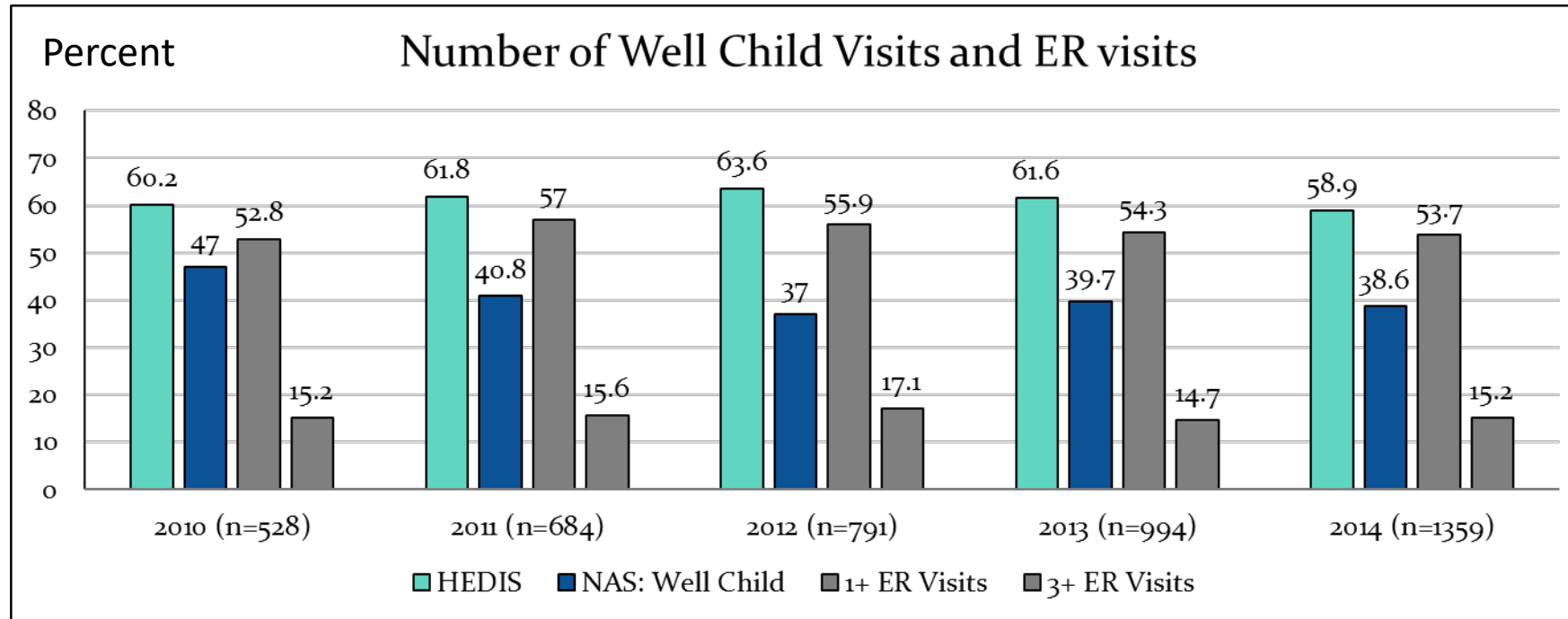
1 out of every 4 child is discharged to kinship care, foster care, or an adoptive parent



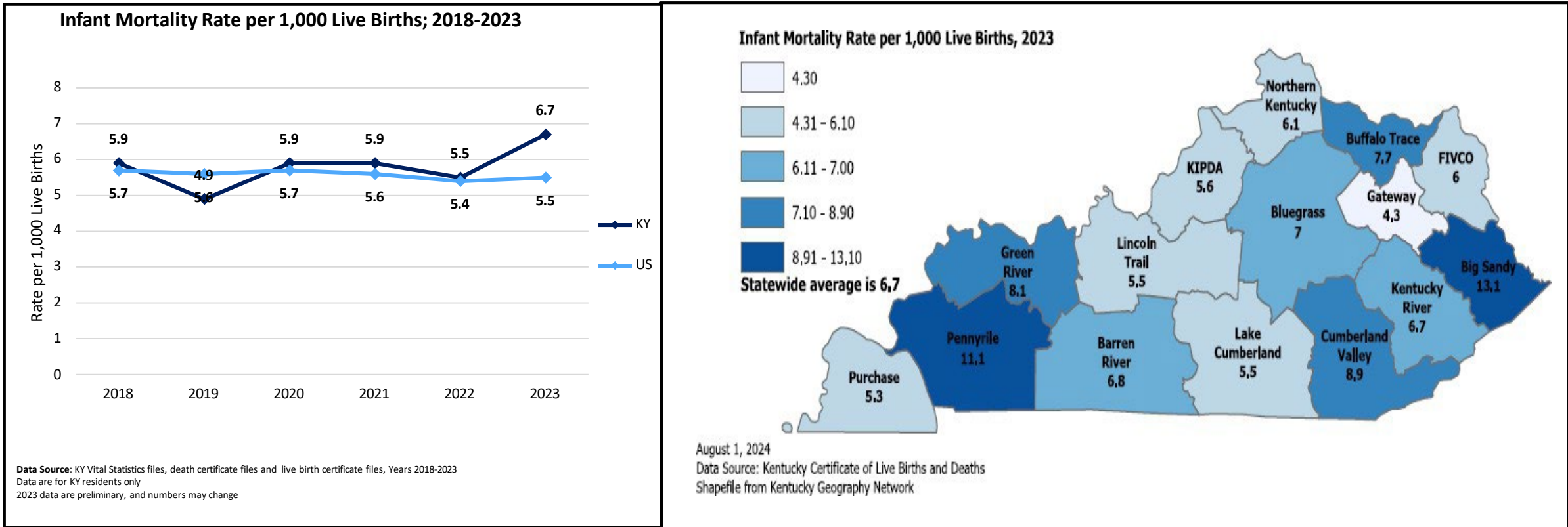
In fiscal year 2021, **73,000+** children entering foster care had parental drug abuse as a circumstance of removal

Kentucky Cabinet for Health and Family Services (CHFS). (2024). Neonatal Abstinence Syndrome in Kentucky: Annual Report on 2023 Public Health Neonatal Abstinence Syndrome (NAS) Reporting Registry.

State Data (NAS Cases and Post Discharge Health)



Infant Mortality



<https://www.chfs.ky.gov/agencies/dph/dmch/Documents/CFR%20Annual%20Report%202024.docx.pdf>

Leading Causes of Infant Mortality



US

- Congenital Malformations
- Preterm Births
- SIDS
- Unintentional Injuries
- Perinatal Conditions

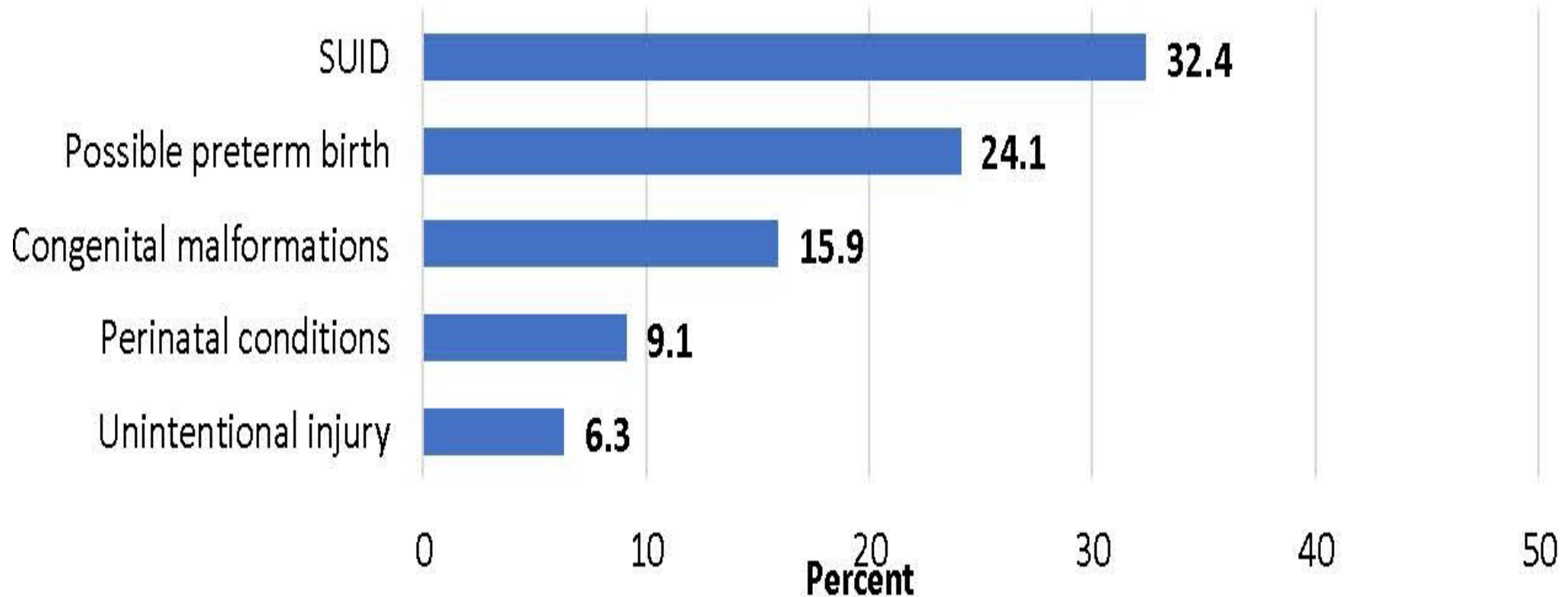


Kentucky

- SUID*
- Preterm Births
- Congenital Malformations
- Perinatal Conditions
- Unintentional Injuries

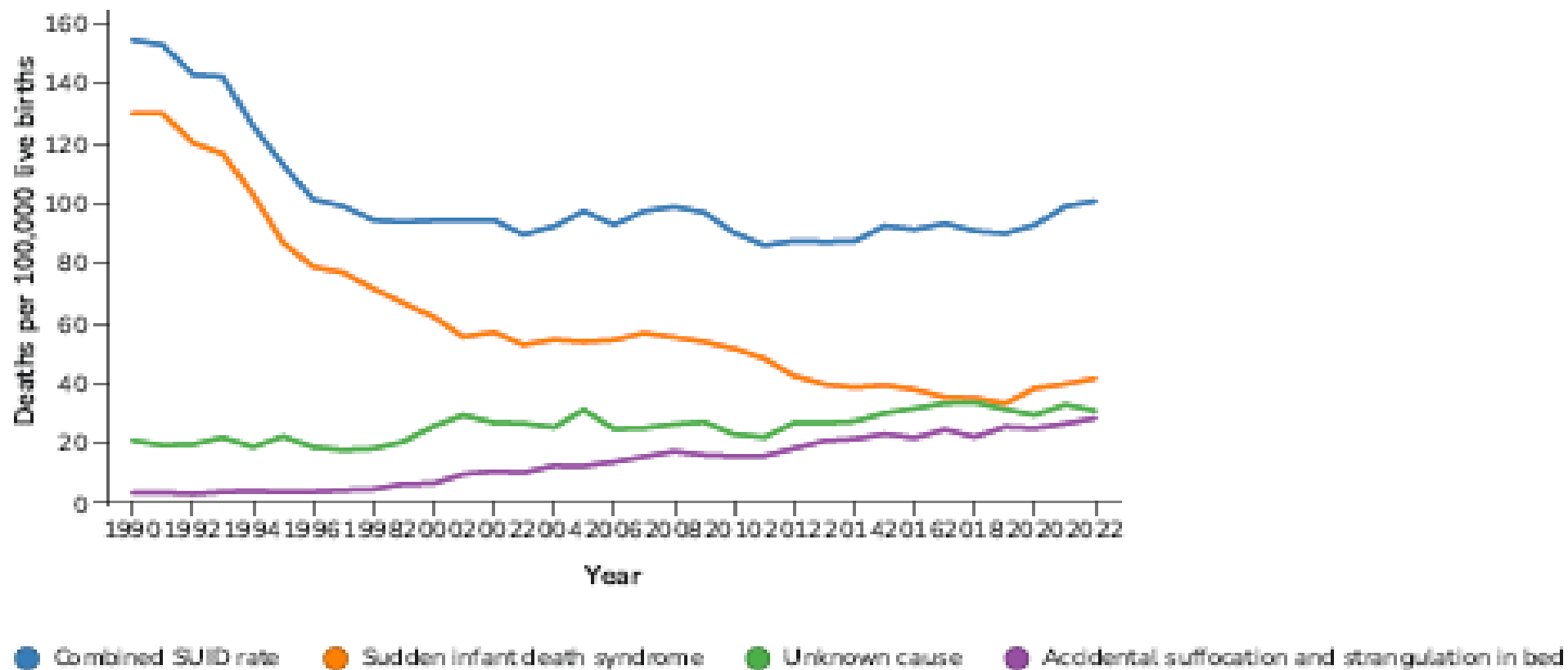
*SUID- includes SIDS, suffocation, unsafe sleep, and unknown causes after investigation

Leading Causes of Infant Mortality 2023



<https://www.chfs.ky.gov/agencies/dph/dmch/Documents/CFR%20Annual%20Report%202024.docx.pdf>

Trends in SUID Rates by Cause of Death 1990 - 2022

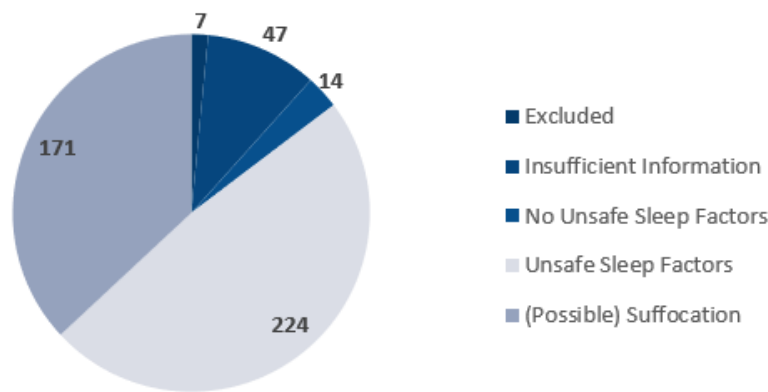


<https://www.cdc.gov/sudden-infant-death/data-research/data/sids-deaths-by-cause.html> Date Accessed 10/27/2025

Perinatal/Infant Health

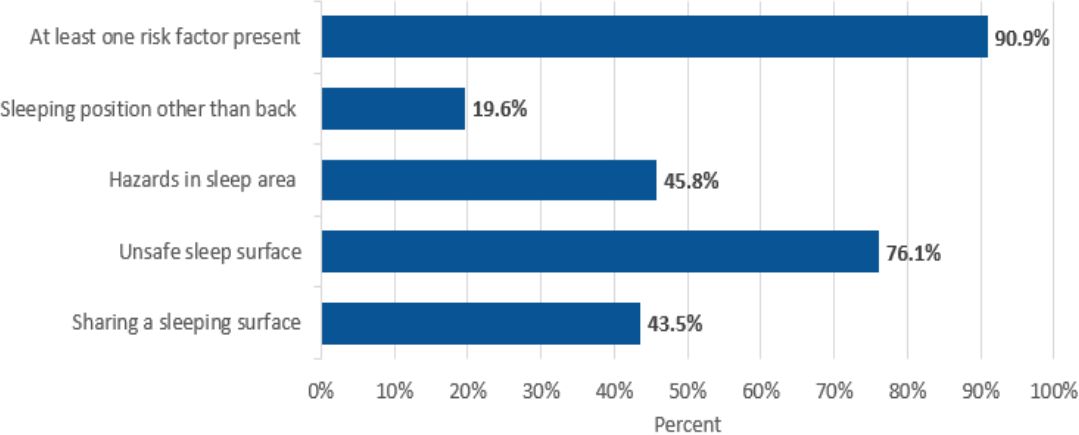
Safe Sleep (PRAMS)

Number of SUID Cases by CDC Algorithm Category
Kentucky 2016-2021



Data Source: Kentucky SUID case registry, 2016-2021 and KY vital statistics files, live birth certificate files, 2016-2021
Data are for KY residents only
2021 data are preliminary, and numbers may change

PRAMS Participant Responses Regarding Safe Sleep Risk Factors
Kentucky 2021



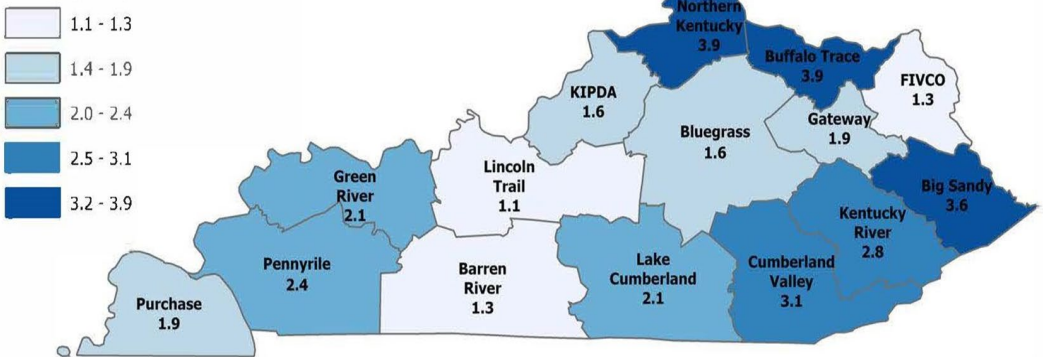
Data Source: Kentucky Pregnancy Risk Assessment Monitoring System, 2021, Kentucky Department for Public Health
Note- Included responses are not mutually exclusive.

Kentucky Cabinet for Health and Family Services (CHFS). (2024). Child Fatalities in Kentucky: Annual Report on 2023 Child Fatality Data Reviews and Reports; KY PRAMS 2021;

NAS and SUID Rates by Area Development Districts

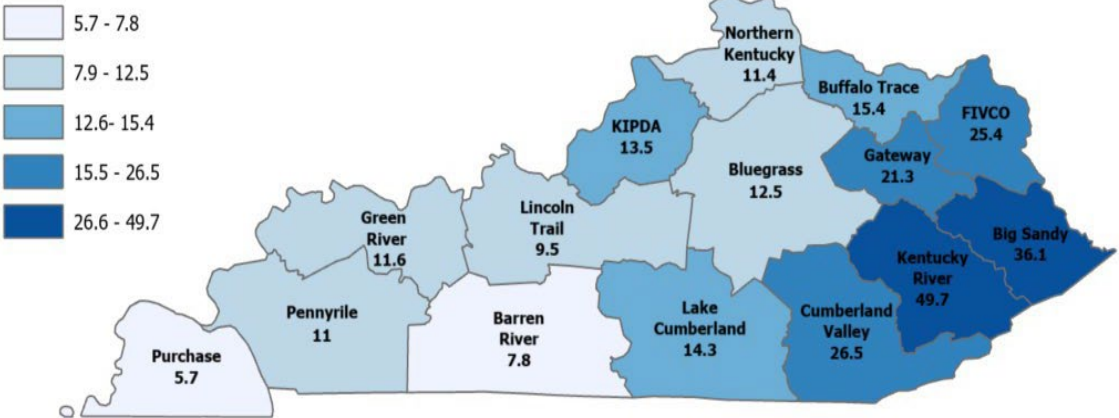
KY rate 15.2/1000: US 5.9/1000

Kentucky SUID rates per 1,000 Live Births, by ADD, 2019-2023



Data Source: Kentucky Office of Vital Statistics, Death Certificate Data, Years 2019-2023
*All data are preliminary and subject to change.

Kentucky NAS Rates by ADD; 2023

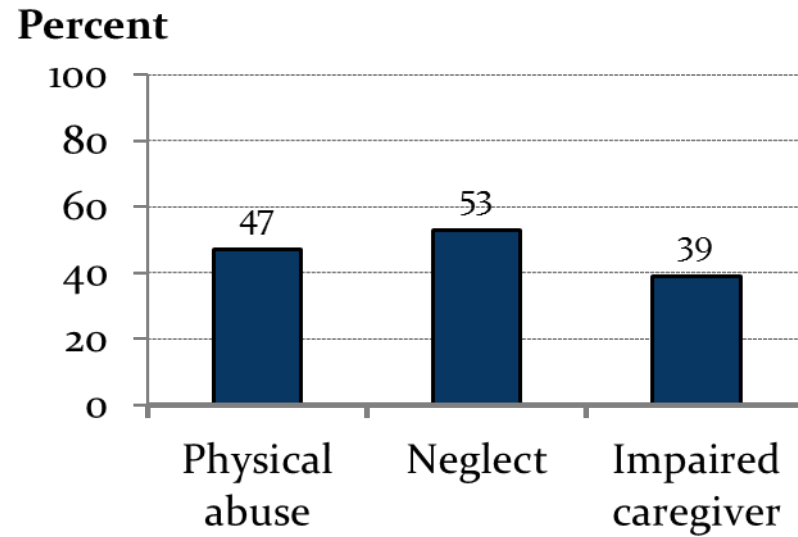


Child Abuse in Kentucky

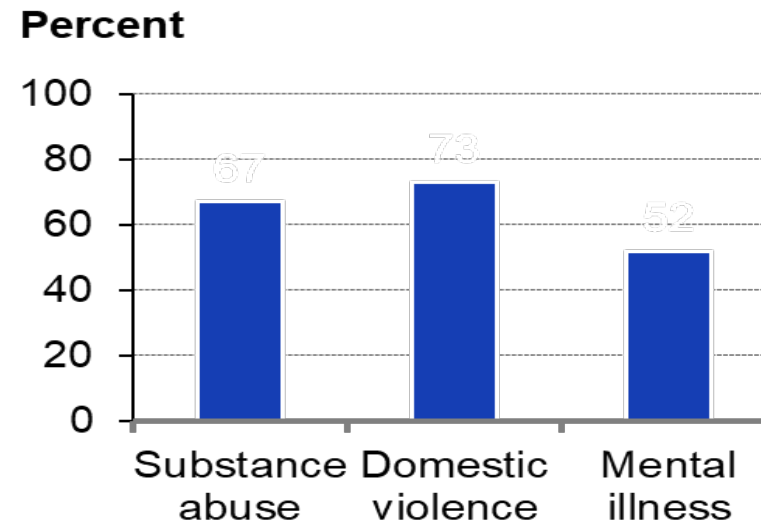
 2023: 14.2/1000 children (Rank #4)

 2022: 12.1/1000 children (Rank # 12)

Child Fatalities/Near Fatalities (KY 2011-2015)

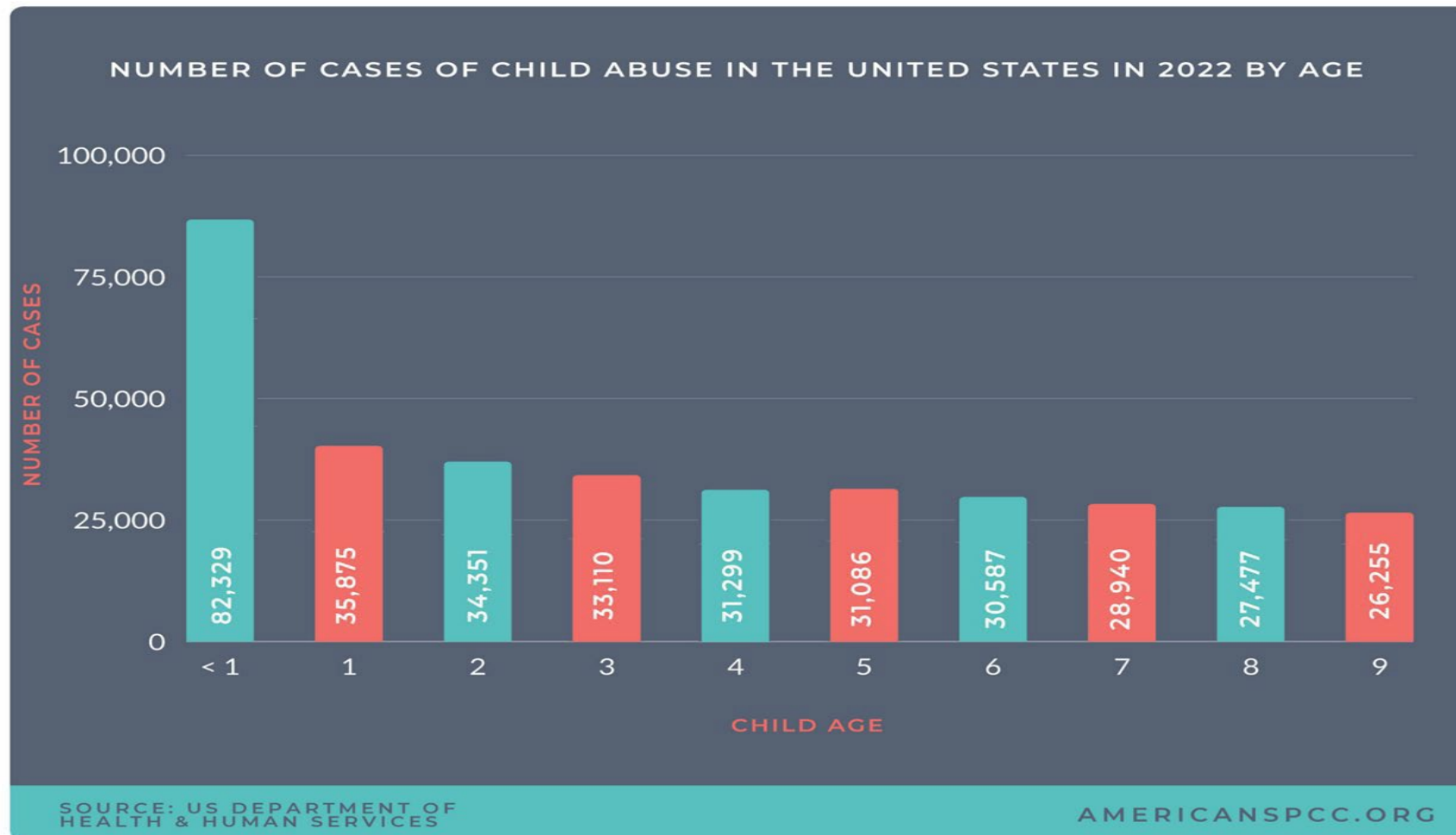


Categories of maltreatment



Risk factors in fatalities/near fatalities

Cases of Child Abuse By Age (USA -2022)



Addressing and Prevention of Perinatal/Infant Health Morbidities

- Preterm births
- Infant Mortality
- SUID / Unsafe Sleep
- Unintentional Injuries (accidents/maltreatment)
- Neonatal Abstinence Syndrome (NAS)

**HANDS with statewide reach for
Prevention, Promotion and Protection**

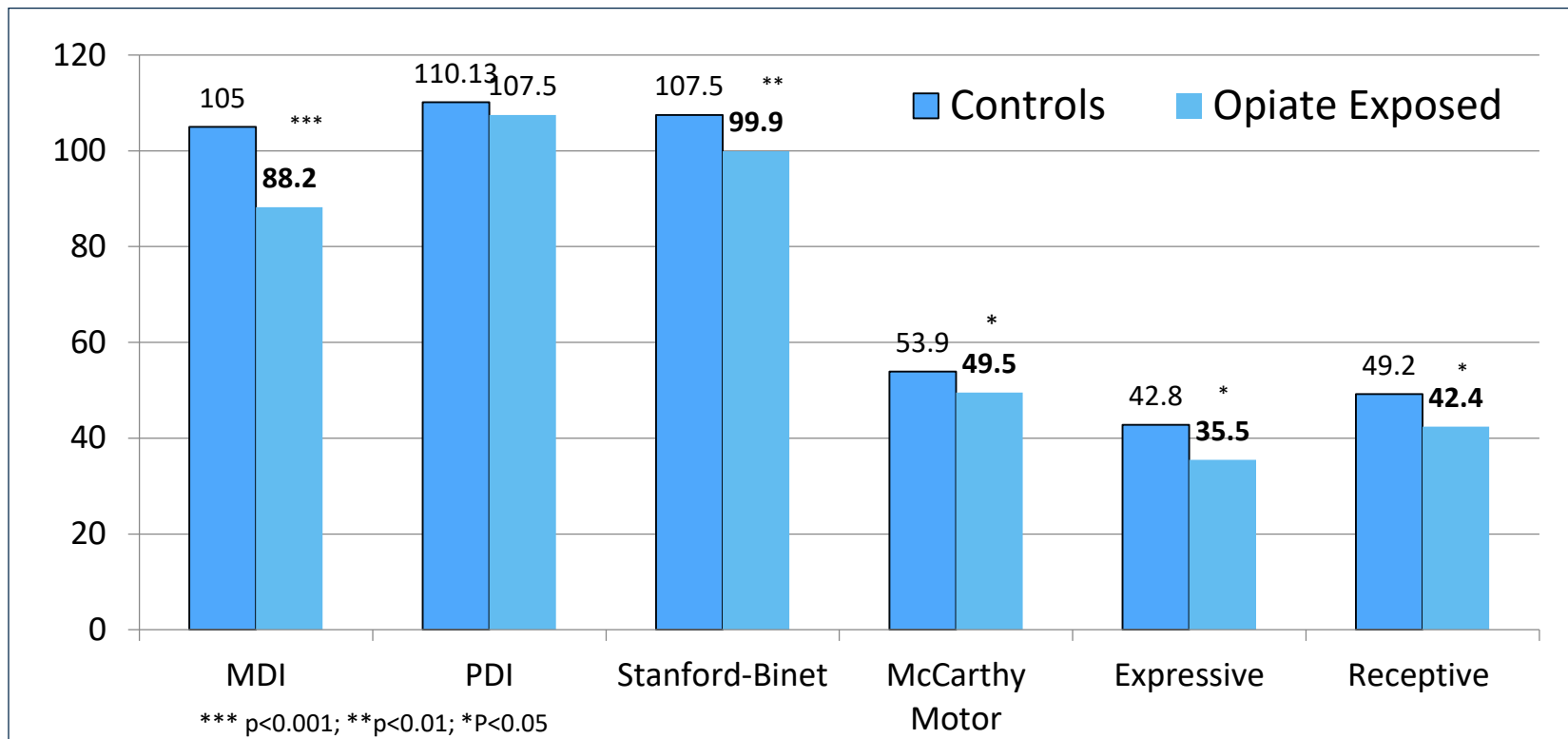
If those with NAS survive beyond early childhood, what else can we expect?

Neurodevelopmental Outcomes Of Infants Exposed to Opiate In-utero

- 🛡️ **Hunt et al, 2008 (133 cases/103 controls)**
- 🛡️ Cases: mothers compliant with methadone program
- 🛡️ Controls: negative for drug use history and drug screen
- 🛡️ Follow-up at 18 months and 36 months

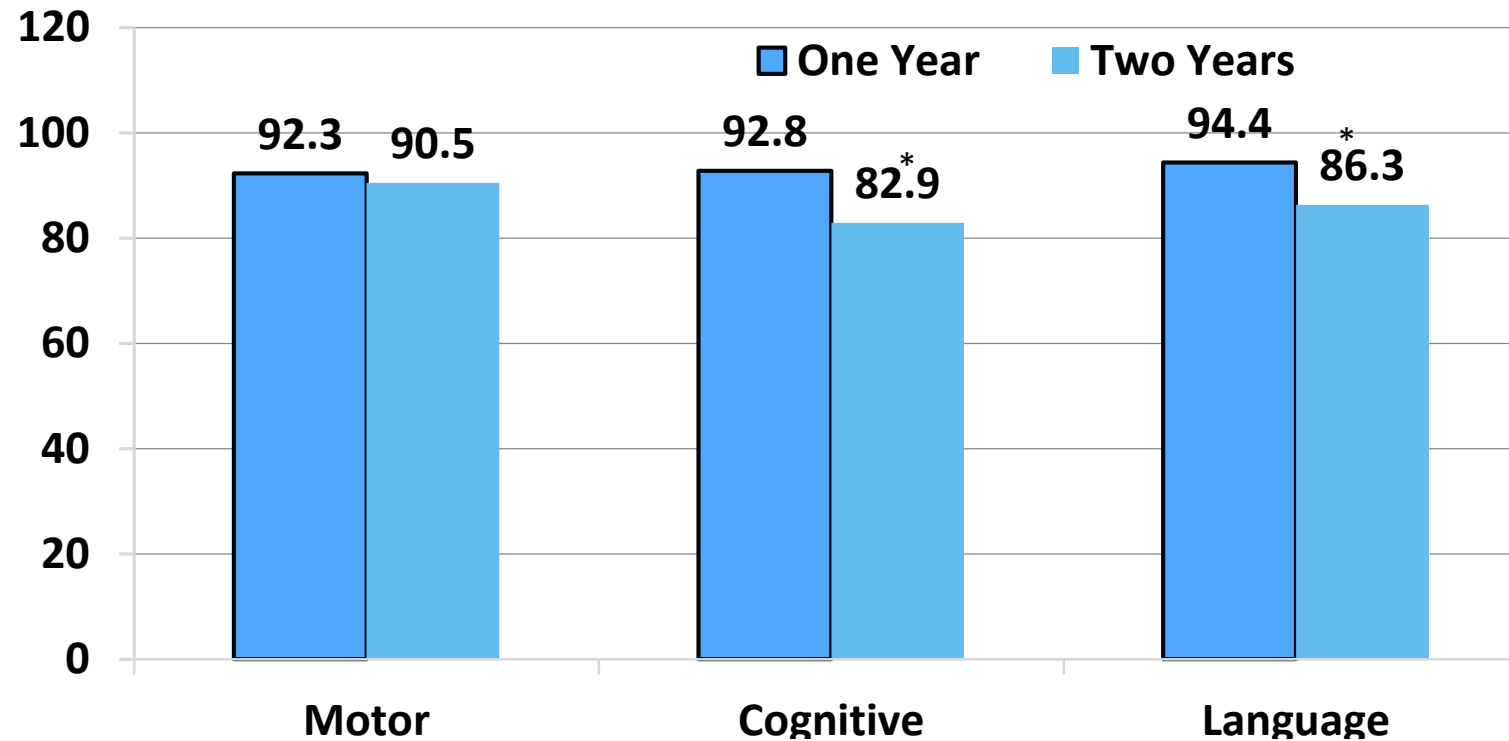
Early Human Development 2008; 84:29-35

Outcomes of Exposed Versus Controls



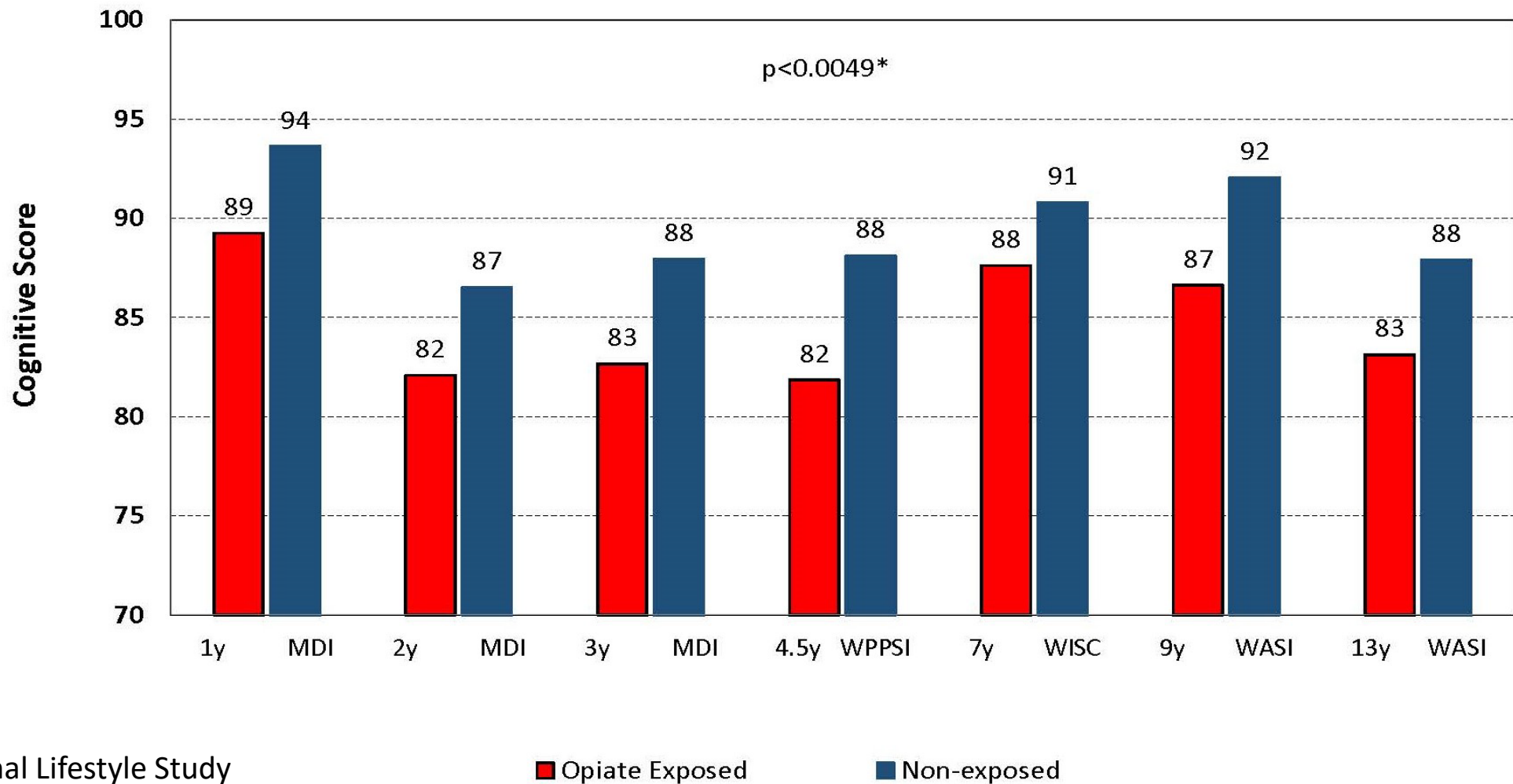
Hunt et al. *Early Human Dev* 2008 ; 84:29-35

Developmental Outcomes of Infants Treated for NAS

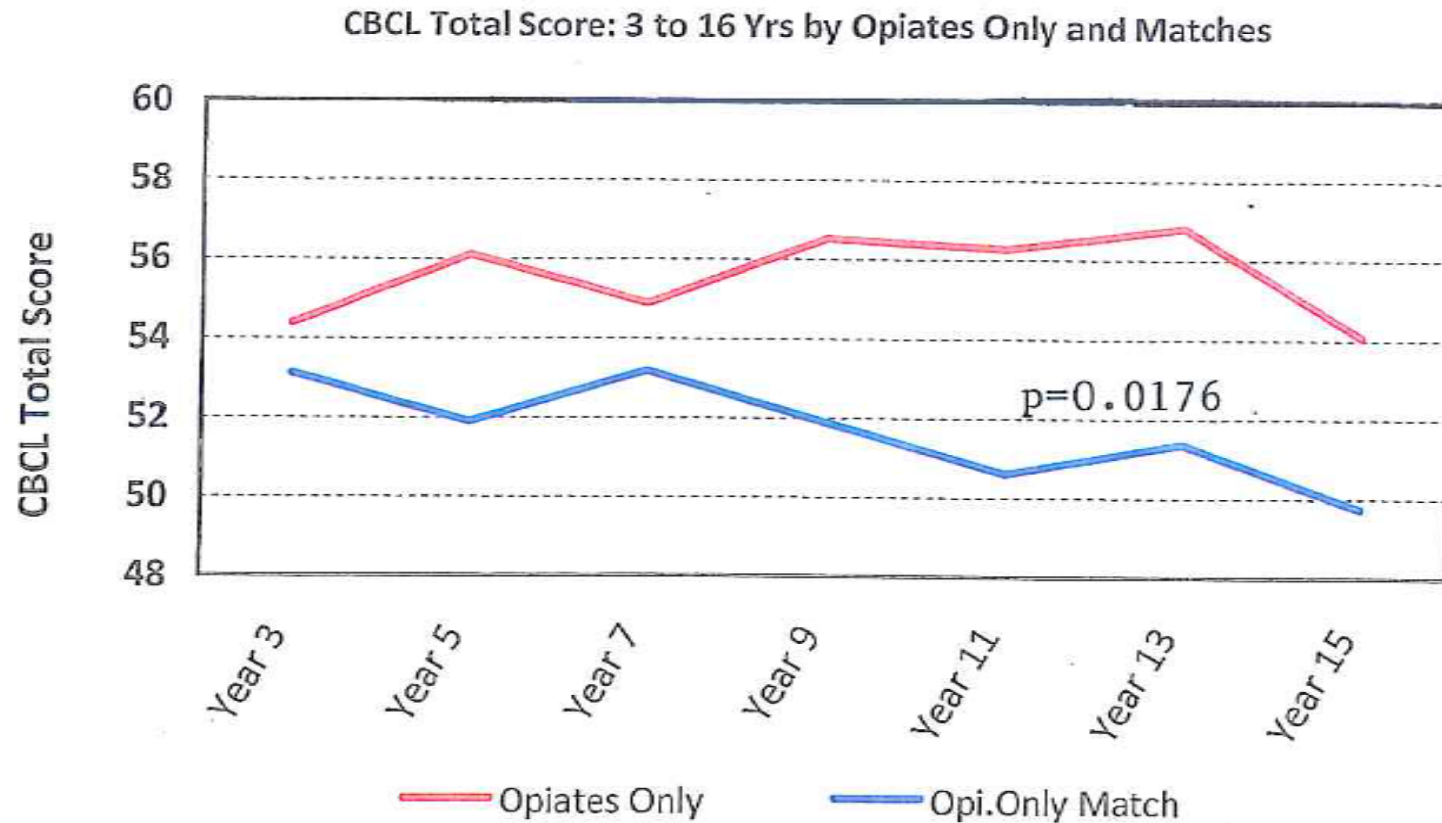


Mirsky et al. PAS 2017

Figure 2. Cognitive Outcomes: MDI, WPPSI, WISC & WASI at 1 to 13 years

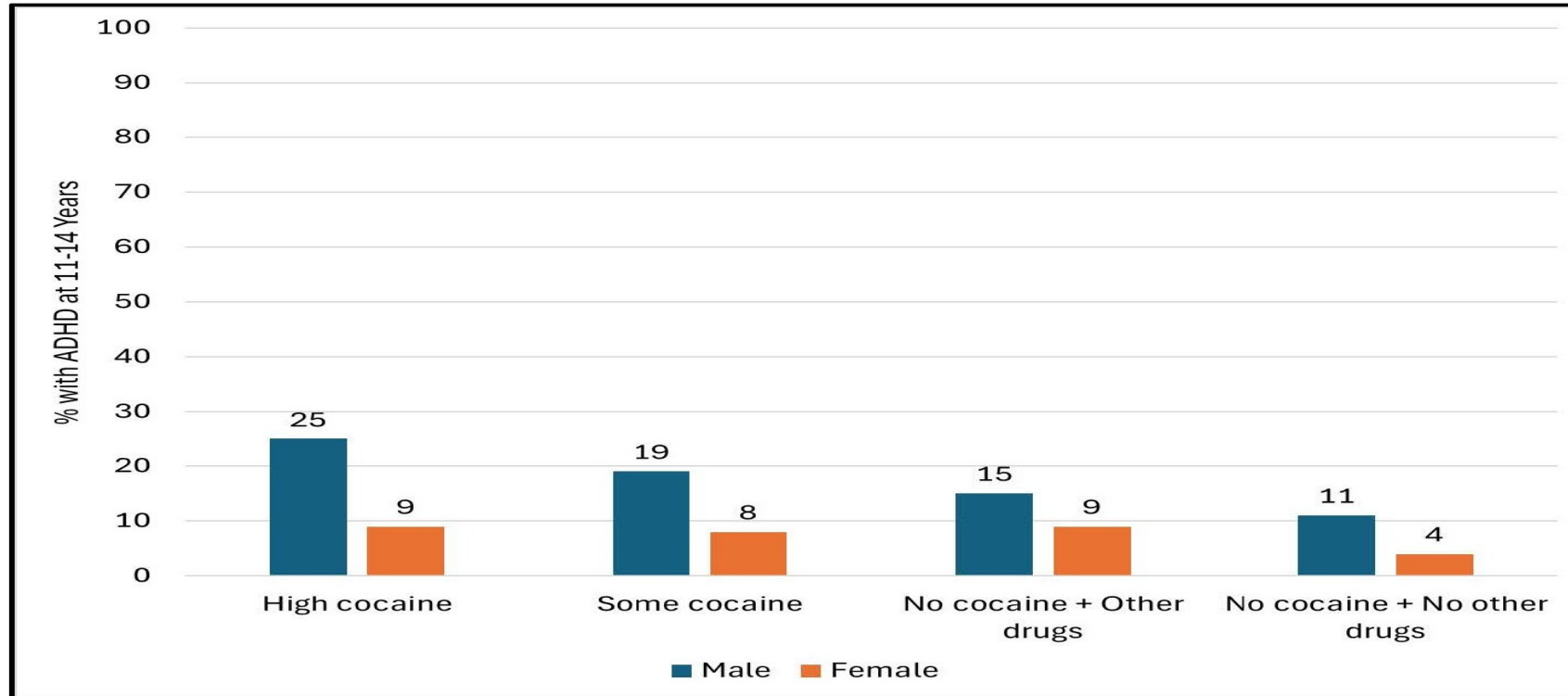


Behavior Outcomes (Total Problems Through 15 years)



Bauer et al. Maternal Lifestyle Study

Prenatal Cocaine Exposure & ADHD by Sex

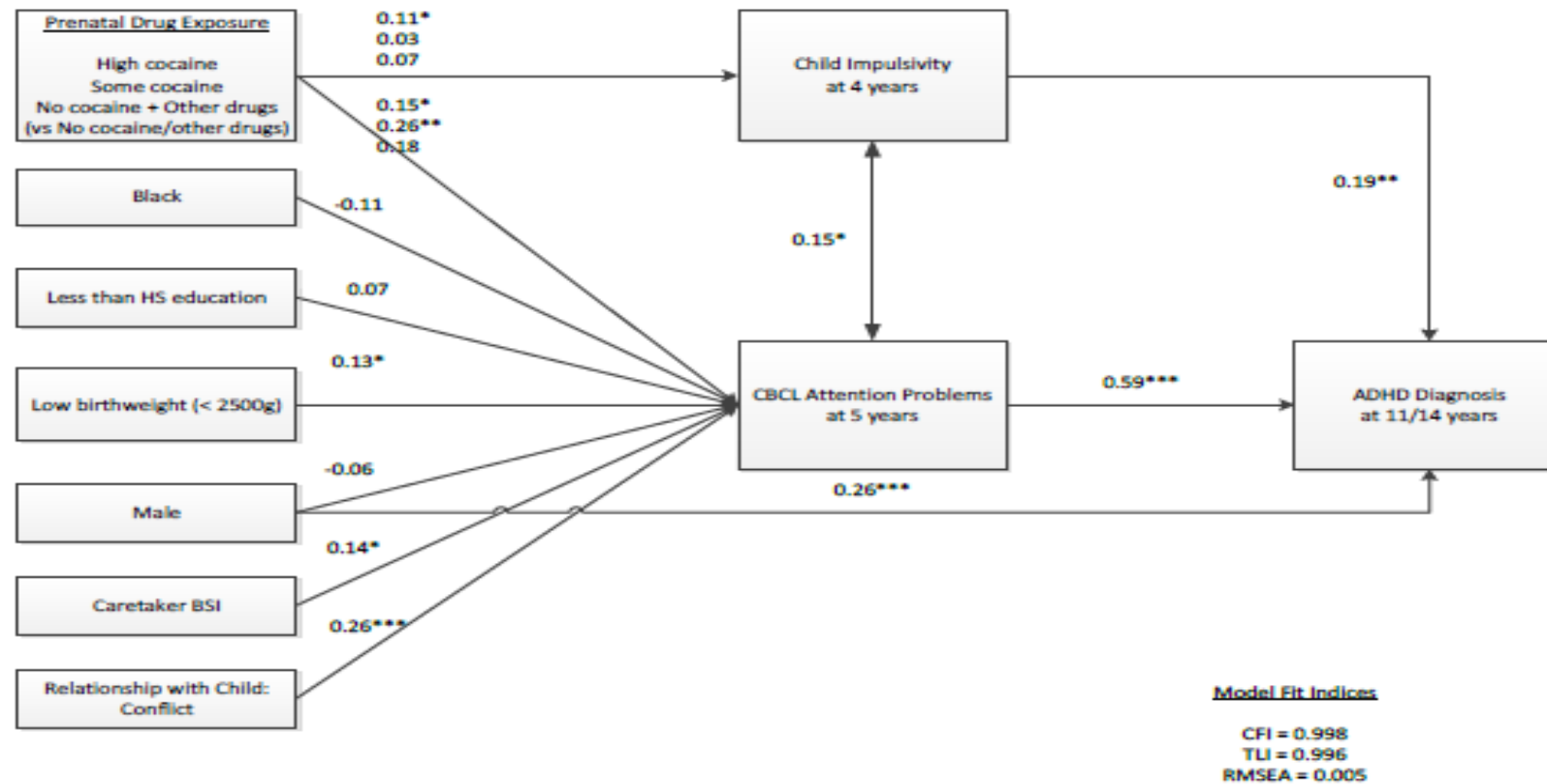


Note: Percentages are adjusted for male sex, black race, birth weight < 2500g, less than high school education, caretaker BSI, and relationship with child: conflict score.

Sithisarn et al, in press

Prenatal Cocaine Exposure and ADHD

Figure 2. Path Diagram of ADHD Diagnosis at 11 and/or 14 years. The risk factors and mediator variables (impulsivity and attention problems) are shown with the coefficients and corresponding notation of significance (p values).



* p < .05, ** p < .01, *** p < .001

Note: Model also controls for clustering of children by research centers.

Sithisarn et al. in press

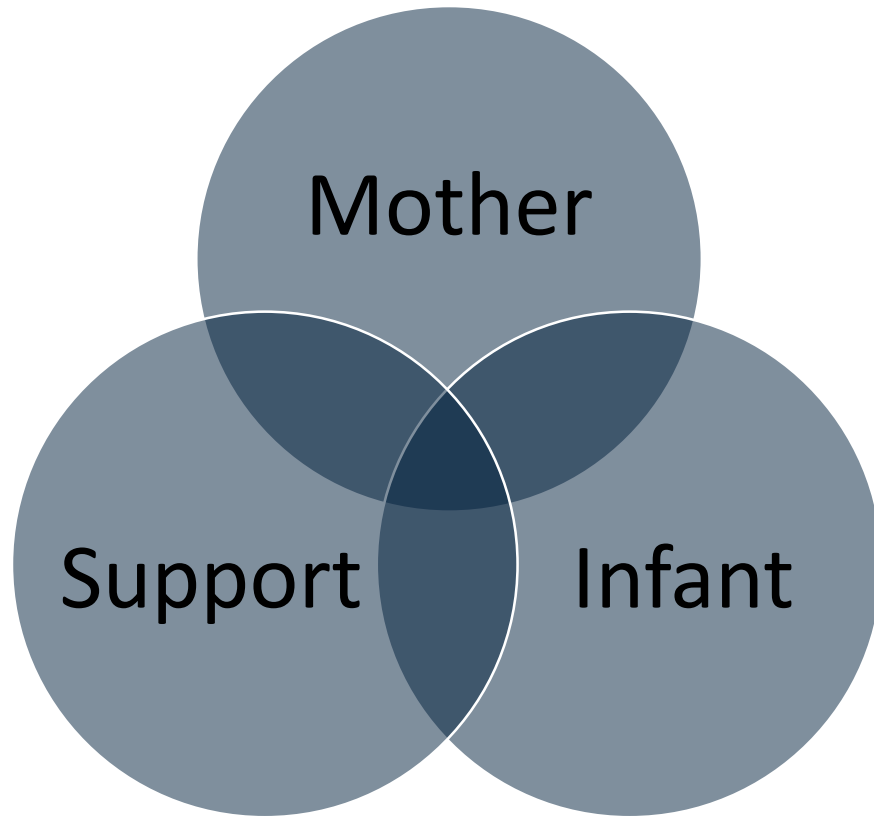
Goals of Treatment and Management

- 🛡️ Minimize symptomatology (supportive & pharmacologic)
- 🛡️ Promote growth and weight gain
- 🛡️ Promote caretaker-child interaction
- 🛡️ Strategies directed to social issues (Mothers, children, and families)
 - Goals directed to improve short-term and long-term outcomes
 - Endangered children (ACES, child abuse/neglect)
 - Environment
 - SDoH
 - Long-term behavioral problems
- 🛡️ Plan of Safe Care

Approach Directed to Enhance Outcomes of Neonatal Abstinence Syndrome (NAS)

-  Mother and infant **dyad**
-  Multifaceted
-  Coordinated
-  Collaborative
-  Integrated

INTEGRATION OF SERVICES (Plan Of Safe Care)



Directed to mother and infant dyad

- Multifaceted
- Coordinated
- Collaborative
- Integrated



Understanding unique NAS expressions in babies in the context of the maternal, familial functioning and the home environment

Pediatric Mental Health Care Access

Monitor & Address Early Childhood Behavioral Issues

KENTUCKY PEDIATRIC MENTAL HEALTH CARE ACCESS PROGRAM



KY MARK
MENTAL HEALTH CARE ACCESS FOR RESILIENCY IN KIDS

KY MARK is a professional capacity-building program designed to support primary care providers (PCPs) in offering mental and behavioral health care to their pediatric patients and to better understand when to refer to a specialist.

KY MARK offers providers professional education, a consultation line, and linkage to community resources. This program is funded by HRSA... and sponsored by the Kentucky Department for Public Health in partnership with child psychiatry teams from the University of Kentucky (UK) and the University of Louisville (UofL).

KY MARK OFFERS PROVIDERS:

PROFESSIONAL EDUCATION	CONSULTATION LINE	RESOURCES
CME opportunities to expand PCP capacity to screen for and treat pediatric mental and behavioral health care needs	Free consultation line with UK and UofL child psychiatry teams to discuss complex cases and professional questions	Linkage to community resources and referrals



To participate in KY MARK, register at www.kentuckymark.org

"The level of civilization attained by any society will be determined by the attention it has paid to the welfare of its children"... the Children's Bill of Rights

... Billy F. Andrews, 1964.

On behalf of the mothers, babies,
and families of Kentucky



THANK YOU