

*We're slow to believe what it hurts us to believe. Ovid*

## When it's *just* a bump on the head: interpreting skull fractures in the context of child maltreatment



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### Goals

- Recognize that not all skull fractures in children are the same
- Understand nuances in skull fractures in children
  - Importance of developmental level
  - Challenges of dating skull fractures
  - Importance of the full picture
- Develop a more sophisticated approach to responding to skull fractures in children

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### Take Home Points

- Skull fractures in children can occur from rather innocuous events.
- Not ALL skull fractures are concerning for abuse.
- The complexity of the skull fracture does not greatly increase the concern for abuse.
- It is necessary to look at the whole picture to determine level of concern for abuse.
- Involvement of a Child Abuse Physician can help in the decision making around cases of skull fractures in children.
- Reporting to child protective services is not benign.

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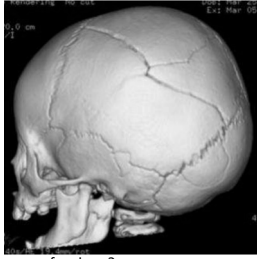
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**Question**

5-month-old presents to ED after reported fall off bed. No other stigmata of abuse.



What is your level of concern for abuse?

- a) High
- b) Medium
- c) Low
- d) Indeterminate

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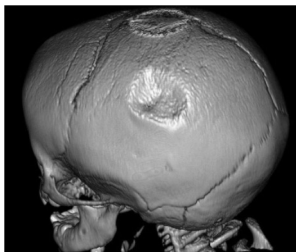
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### What's the conundrum?



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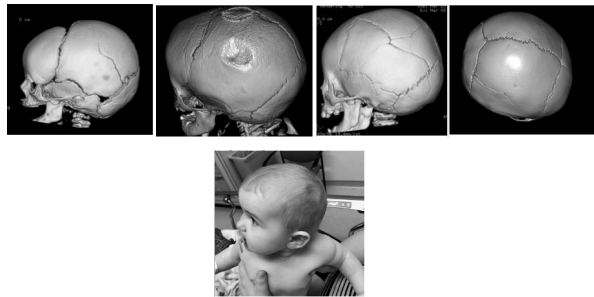
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### What's the conundrum?

What are we worried about?



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### Missed cases of abusive head trauma

In the current study, we found that 31.2% of children who were clinically symptomatic after AHT were misdiagnosed as having other conditions. Infants have few ways to demonstrate illness or injury. Nonspecific signs, such as vomiting, fever, and irritability, are seen in a myriad of conditions, including many benign, self-limited illnesses. The difficulty, then, is to be able to discern when these signs and symptoms indicate potentially serious or fatal pathology.

JENNY C. ANALYSIS OF MISSED CASES OF ABUSIVE HEAD TRAUMA. JAMA 1999.

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## Bias

**The Issue:** Families of color face both structural and interpersonal racism in health care and in other systems that drive racial and ethnic disparities in health and well-being. Implicit and explicit racial biases compounded by a lack of trust and dignity, as well as punitive policies and systems, including in child welfare involvement, often lead to worse health outcomes for Black pediatric patients and other patients and families of color. Pediatricians have a role to play in calling out racism in health care systems.

### Racial Differences in the Evaluation of Pediatric Fractures for Physical Abuse

Wesley G. Laine, MD, MPH

**Context** Child maltreatment is a significant problem within US society, and minority

Disparities in the Evaluation and Diagnosis of Abuse Among Infants With Traumatic Brain Injury

Influence of Race and Socioeconomic Status on the Diagnosis of Child Abuse: A Randomized Study



The Perils of Child "Protection" for Children of Color: Lessons From History

Musal Raz, MD, PhD, MPH; Alan Dettliff, MD, PhD; Frank Edwards, PhD

### Confronting Racism In Pediatric Care

A pediatric care pediatrician calls on his profession to address racism in pediatric care. BY BENJAMIN DANIELSON

DANIELSON B. CONFRONTING RACISM IN PEDIATRIC CARE. HEALTH AFFAIRS. NOV 2022. 40:11 1681-1685

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## Abusive Head Trauma

- Approximately 20-30/100,000 children less than 1 year of age sustain abusive head trauma annually
- 1,200 seriously injured children, 80 deaths each year
- Abusive head trauma is the most common cause of lethal child abuse
- Coincident with the normal peak of crying 2-4 months of age

Keenan HT, Runyan DK. A. A population-based study of inflicted traumatic brain injury in young children. *JAMA*. 2013;290(5):621-626  
Ellingson K, Leventhal J, Weiss H. Using Hospital Discharge Data to Track Inflicted Traumatic Brain Injury. *Amer J Preventative Medicine*. 2008;34(4)

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## Abusive head trauma

This.....



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### Abusive head trauma

This.....

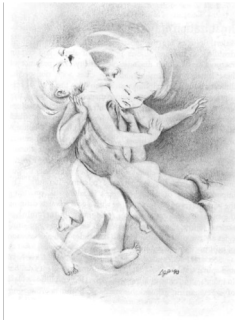


Figure 1.3. The shaken infant, illustrated by Laura Perry MD, based on descriptions by pediatricians. With permission from Kerzman PH, Diagnostic imaging in infant abuse. Review article. AJP 1996;150:98-121

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### Abusive head trauma

Or this...



The impact of the infant's head against a solid surface magnifies the forces suffered by the brain by 10 to 50 times compared to the forces caused by shaking alone.

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### Abusive head trauma

Not this



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### Case 1

6-week male referred to emergency department by PCP for evaluation of a new scalp hematoma first noted by parents 1 day ago. They noted swelling over the back of the head while giving the child a bath. They denied any trauma or injury to the head. The child was otherwise well appearing, breastfeeding normally.



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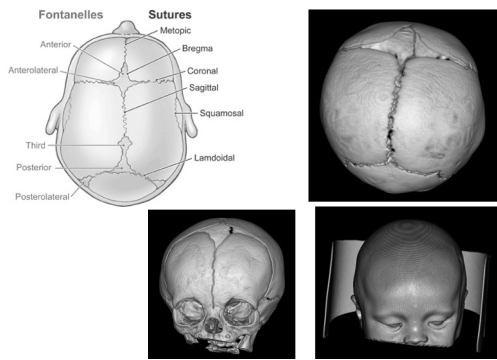
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### Normal infant skull



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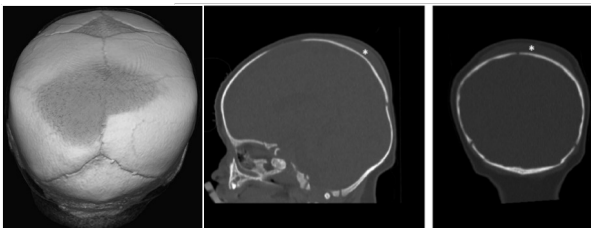
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### Case 1 – next steps?



- Physical Exam
- Skeletal survey
- Head imaging
- Blood work
- Photos
- Social Work evaluation
- CAP consult ?
- CPS report ?

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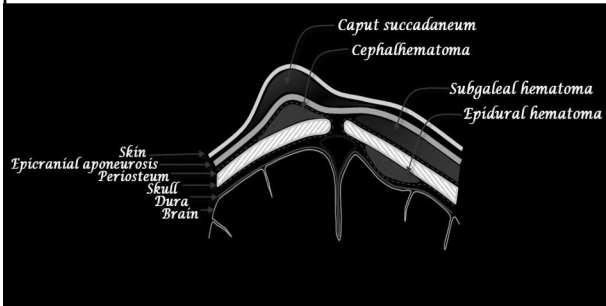
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## Bumps on the head



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## Not everything is abuse

Delayed Subaponeurotic Fluid Collections  
*A Benign Cause of Scalp Swelling in Infancy*

Alexander M. Stephan, MD,\* Kenneth W. Feldman, MD,† Jeffrey P. Ojjen, MD,‡ and James B. Metz, MD, MPH†

- 3.5 – 18 weeks of age
- Fluid collections in the loose connective tissue
- No overlying bruises or redness

Consultation with CAP may be helpful to help identify findings that may or may not be concerning for abuse.

STEPHAN AM, ET AL. PEDIATRIC EMERGENCY CARE. 2021 JUL 1;37(7):E408-E411.

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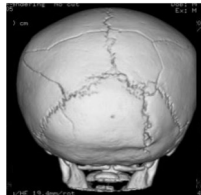
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## Case 2

A 6-month old girl is brought to the emergency department 5 hours after her mother reports that the child fell off the changing table. She states that she stepped away for a second and when she turned around she saw the child fall to the carpeted floor. The child cried immediately and consoled after a few minutes. She has been sleeping a bit more but the parents are concerned as the bump on her head has been getting bigger.



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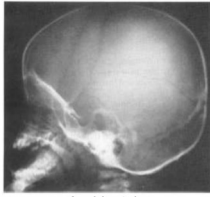
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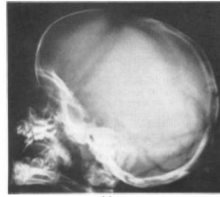
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## Complex skull fractures



Accidental



Abuse

**Hobbs' conclusion:** "Accidents usually resulted in single, narrow, linear fractures most commonly parietal, with no associated intracranial injury. The results suggest that for a skull fracture in a young children where a minor fall is alleged, it is possible to recognize abuse by consideration of the fracture type alone."

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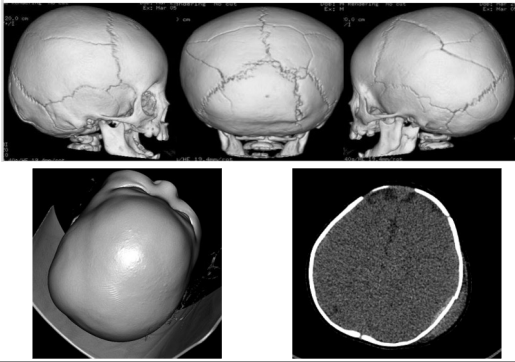
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## What has changed?



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## Complex skull fractures and abuse

ORIGINAL ARTICLE

Are Complex Skull Fractures Indicative of Either Child Abuse or Major Trauma in the Era of 3-Dimensional Computed Tomography Imaging?

James B. Metz, MD, MPH,\* Jeffrey P. Olson, MD,† Francisco A. Perez, MD, PhD,† Stephen L. Dang, MD,† Emily C. B. Brown, MD,‡ Rebecca T. Winters, MD,‡ Carolee Janney, MD, MBA,‡ Megan C. Nelson, MA,§ Shelle N. Grant, PhD,‡ and Kenneth W. Feldman, MD,‡

The positive predictive value of a complex skull fracture for abuse is 7%

**TABLE 3.** Number of Cases Reported for Mechanism of Injury of 143 Patients With 3D CT

Type	Simple	Complex	Total
Fall	65	51	116
Short (<4 ft)	33	28	61
Higher (≥4 ft)	17	20	37
Height unknown	15	3	18
MVA	0	2	2
Hit by objects	0	6	6
Other	1	3	4
Unknown	1	3	4

Accidental cohort 2011 to 2012.  
MVA indicates motor vehicle accident.

Metz, et al. *Pediatric Emergency Care*. 2022 Jan 1;38(1):e200-e204.

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## Delay in Care

ISSUES 20 April 2020 | REVIEW 1 December 2019 | ACCEPTED 1 November 2019  
DOI: 10.1111/acta.14348

REGULAR ARTICLE

ACTA PAEDIATRICA WILEY

Delays in care seeking for young children with accidental skull fractures are common

James B. Metz<sup>1</sup> | Jeffrey P. Ojien<sup>2</sup> | Francisco A. Perez<sup>2</sup> | Stephen L. Done<sup>2</sup> | Emily C.B. Brown<sup>3</sup> | Rebecca T. Wiestler<sup>2</sup> | Carole Jenny<sup>2</sup> | Sheila Ganti<sup>4</sup> | Kenneth W. Feldman<sup>1</sup> 

**Conclusion:** Delayed care seeking is common for minor, but not major accidental infant and toddler skull fractures. Most followed delayed onset of signs and symptoms. Delayed care seeking alone should not imply child abuse.

TABLE 1 Symptoms leading to evaluation of accidentally injured children who were brought to care acutely or after delays

	Children seen acutely n (% of 161)	Children with delays in care n (% of 36)
Scalp/Soft tissue swelling	47 (29.2)	27 (75.0)
Injury event itself	75 (46.6)	1 (2.8)
Altered consciousness	30 (18.6)	1 (2.8)
Vomiting	18 (11.2)	4 (11.1)
Rashiness	6 (3.8)	5 (13.9)
Seizure	9 (5.6)	0 (0)
Pain	4 (2.5)	0 (0)
Seizure	0 (0)	1 (2.8)
Other, not documented	1 (0.6)	1 (2.8)

TABLE 3 Delay in care for children with simple and complex skull fractures, listed as a %

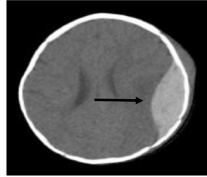
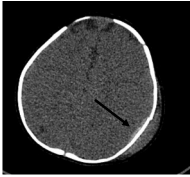
Category	Simple Fractures n = 120 (57.5%)	Complex Fractures n = 90 (42.5%)
Unknown if delay occurred	8 (6.7)	4 (4.4)
Delay but of unknown duration	1 (0.8)	0 (0)
No delay	87 (72.5)	74 (82.2)
6-24 h	2 (1.7)	1 (1.1)
12-24 h	4 (3.3)	4 (4.4)
Other SDH	38 (31.6)	7 (7.7)
1-2 days	1 (0.8)	1 (1.1)
2-3 days	4 (3.3)	1 (1.1)
3-4 days	1 (0.8)	1 (1.1)
4-5 days	0 (0)	0 (0)
5-6 days	2 (1.7)	1 (1.1)
6-7 days	1 (0.8)	0 (0)
>7 days	3 (2.5)	1 (1.1)

Note: Complex versus simple fractures, delay versus no delay: RR = 0.65 (0.34-1.22).

METZ JB, OJ IEN JP, PEREZ FA, ET AL. DELAYS IN CARE SEEKING FOR YOUNG CHILDREN WITH ACCIDENTAL SKULL FRACTURES ARE COMMON. *ACTA PAEDIATRICA*. 2021;110:1189-1194.

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## Extraaxial blood and fractures



Often parietal and underlie a fracture

TABLE 2 Etiology of Injury by Hemorrhage Type

	SDH (n = 59)	EDH (n = 34)	OR	95% CI
Nonaccidental	28 (47%)	2 (6%)	14.4	3.0-96.0
Unintentional	25 (42%)	31 (91%)	0.2	0.06-0.55
Neglect	0 (0%)	1 (3%)	IND*	NS†
Uncertain	6 (10%)	0 (0%)	IND*	NS†

Abbreviations: SDH, subdural hemorrhage; EDH, epidural hemorrhage; OR, odds ratio; CI, confidence interval.  
\*OR indeterminate.  
†P > .05.

SHUGERMAN R, ET AL. EPIDURAL HEMORRHAGE: IS IT ABUSE? *PEDIATRICS* 1996;97(5)

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## Soft tissue swelling and skull fractures

- Clinically apparent STS is present in ~3/4 of children with skull fractures
- There was no difference in clinical STS with simple (79%) versus complex (68%) fractures.
- No difference in subjects with fractures from minor (77%) versus major (70%) trauma.
- Unintentionally injured infants did not differ from abused for detectable STS (74% vs 50%).
- Parietal and frontal bones most frequently sustained fractures and most consistently had associated STS

TABLE 5 Number (%) of Skull Fractures Versus Presence of Clinically Apparent STS in 98 Subjects With Simple Fracture of a Single Skull Bone

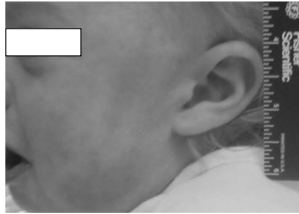
	All Fractures	Fractures With STS
Occipital	16 (16.3%)	12 (75%)
Parietal	68 (69.4%)	66 (97.1%)
Temporal	5 (5.1%)	3 (60%)
Frontal	9 (9.2%)	9 (100%)
Sphenoid	0	0

METZ JB, OJ IEN JP, ET AL. FRACTURE-ASSOCIATED BRUISING AND SOFT TISSUE SWELLING IN YOUNG CHILDREN WITH SKULL FRACTURES: HOW SENSITIVE ARE THEY TO FRACTURE PRESENCE? *PEDIATRIC EMERGENCY CARE*, 2020

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**Case 3**

A 4-month old male is brought in to the ED after the parent found the child on the floor seizing after and unwitnessed fall off the bed. In the ED he is irritable, noted to have soft tissue swelling of his scalp and bruising to the face. Head circumference is measured at >95%.



Next Steps?

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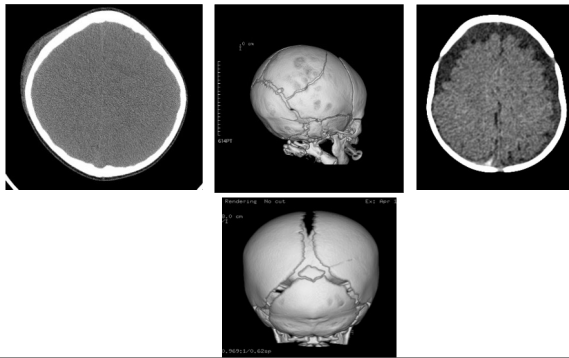
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**Head imaging**



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**Occult injuries in children with skull fractures**

There is currently no consensus about which screening studies should be undertaken to identify abusive injuries in infants with apparently isolated skull fractures.

What is your practice?

DEVE K, ET AL. OCCULT ABUSIVE INJURIES IN INFANTS WITH APPARENTLY ISOLATED SKULL FRACTURES. J TRAUMA ACUTE CARE SURG, VOLUME 74, NUMBER 6

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## Occult injuries in children with skull fractures

### Skeletal Surveys in Infants With Isolated Skull Fractures

Joanne N. Wood, MD; Cindy W. Christian, MD; Cynthia M. Adams, MD; David M. Rubin, MD, MSCE  
*Pediatrics* 2009

**Conclusion:** Skeletal surveys were ordered frequently for infants with isolated skull fractures, but they rarely added additional information, beyond the history and physical findings, to support a report to child protective services.

### Occult abusive injuries in infants with apparently isolated skull fractures

Deye, Katherine P. MD; Berger, Rachel P. MD, MPH; Lindberg, Daniel M. MD for the ExSTRA Investigator  
*J. Trauma & Acute Care Surgery* 2013

**Conclusion:** Infants with apparently isolated skull fractures are an important fraction of consultations for physical abuse. Additional fractures are identified in a small subset of the skeletal surveys completed in these children.

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## Occult injuries in children with skull fractures (cont.)

### Yield of skeletal surveys in children $\leq 18$ months of age presenting with isolated skull fractures

Antoinette L. Laskey<sup>1</sup>, Timothy E. Stump, Ralph A. Hicks, Jodi L. Smith, *J. Pediatrics* 2013

**Conclusion:** The skeletal survey in patients with isolated skull fractures revealed additional fractures in 6% of patients.

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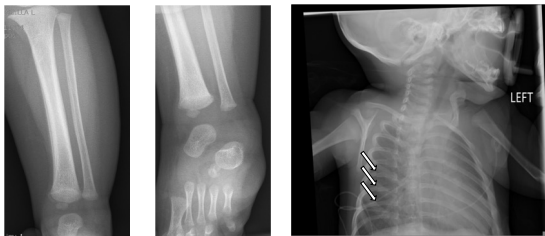
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## Occult injuries



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## WHEN TO REPORT?

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### Take Home Points

- Skull fractures in children can occur from rather innocuous events.
- Not ALL skull fractures are concerning for abuse.
- The complexity of the skull fracture does not greatly increase the concern for abuse.
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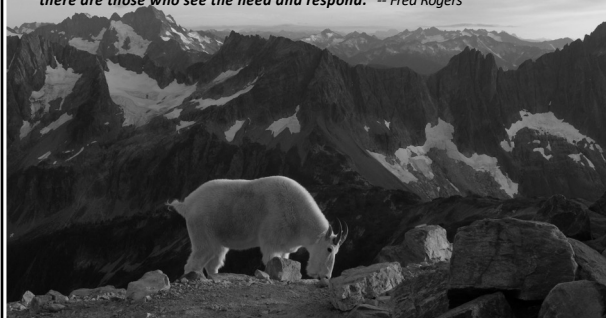
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### Thank you

*"We live in a world in which we need to share responsibility. It's easy to say, 'It's not my child, not my community, not my world, not my problem.' Then there are those who see the need and respond." -- Fred Rogers*



James Metz, MD  
James.Metz@uvmhealth.org

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