

Meeting the antibiotic metric for open fractures: A race against time

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INTRODUCTION

- Patients with open fractures are at increased risk of wound infection.
- Current recommendations from the American College of Surgeons (ACS) are to administer intravenous (IV) antibiotics to patients with an open fracture within 60 minutes of arrival to a trauma center.
- Our medical center noted low compliance with this metric in children.
- The purpose of this study was to assess the factors related to delayed administration of antibiotics in pediatric open fractures.

MATERIALS & METHODS

- The trauma registry at our Level 1 ACS Pediatric Trauma Center was utilized to identify patients with an open fracture who were not given IV antibiotics within 60 minutes of arrival from October 2020 to May 2024.
- A retrospective chart review was performed on each patient to capture the
 - Type of injury
 - Trauma activation status
 - Time of placement of the antibiotic order
 - Time of administration of the antibiotic
 - Confounding factors contributing to delay.
- Variables were analyzed to identify opportunities for improvement (Fig 1)

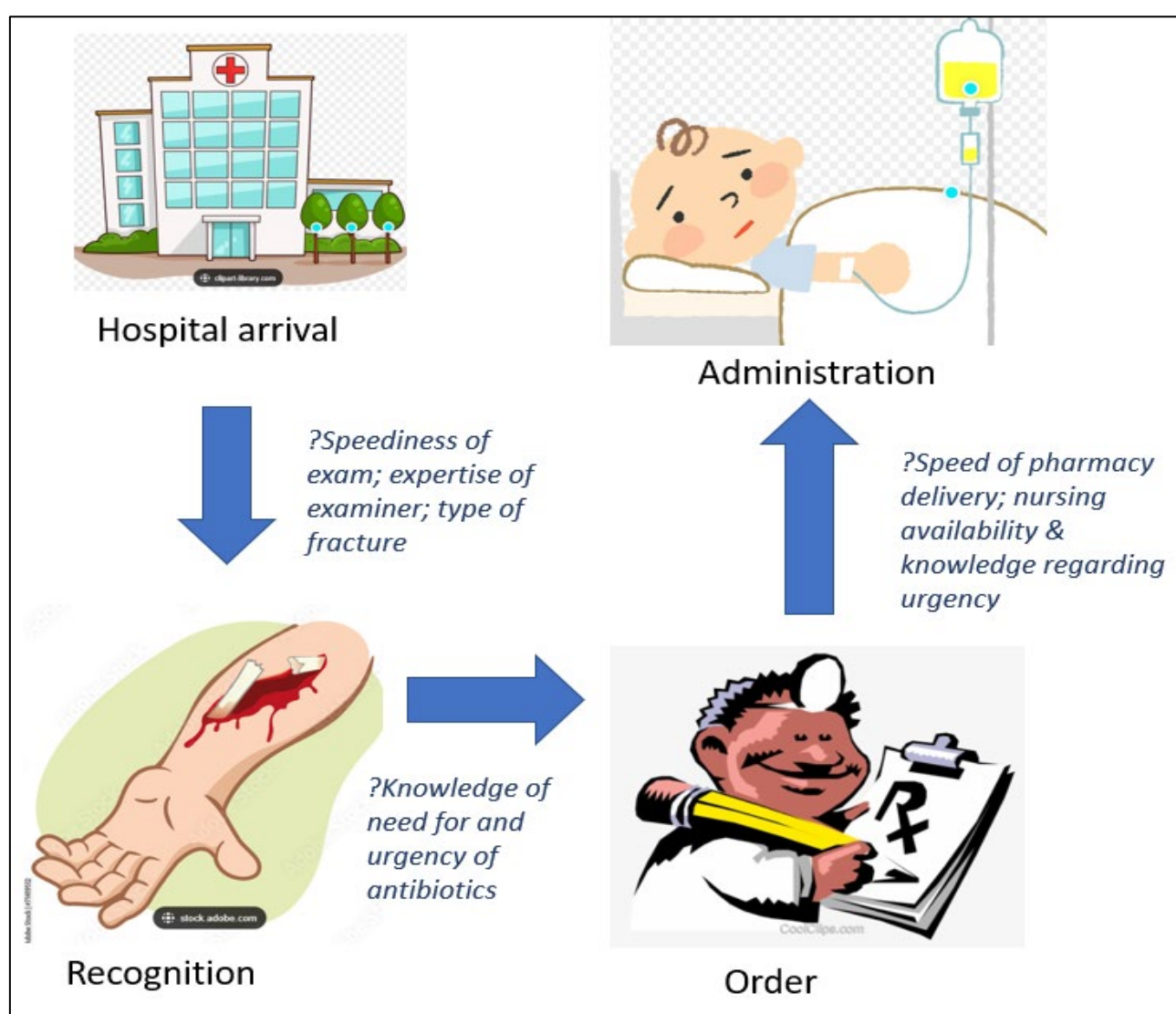


Figure 1. Factors affecting antibiotic administration

RESULTS

- Delay of antibiotic administration greater than 60 minutes was identified in 21 patients.
- There were 11 long bone extremity fractures, 3 skull fractures, 3 facial fractures, 2 hip fractures and 2 digit fractures.
- After literature review and interdisciplinary review, we determined that antibiotics should not be required for non-contaminated skull fractures. This led to a protocol change as found in Figure 2.
- Ten of 11 patients with long bone extremity fractures did not have a formal trauma activation.
- Five had orders within 60-minutes but a delay in administration.
- Other factors include delayed recognition of the open fracture, often due to dressings applied prior to arrival, and delayed patient evaluation due to lack of trauma activation.
- Of activated traumas, those with antibiotic delay were overwhelmingly less obvious on initial physical exam, including face, digit and hip fractures as noted in Figure 3.

REFERENCES

1. ACS TQIP: Best Practices in the Management of Orthopaedic Trauma
2. Harmon et al. Infection after penetrating brain injury – An Eastern Association for the Surgery of Trauma multicenter study oral presentation at the 32nd annual meeting of the Eastern Association for the Surgery of Trauma, January 15-19, 2019, in Austin Texas.
3. McFall, C, et al. Contemporary management of Pediatric open skull fractures: a multicenter pediatric trauma center study. J Neurosurg Pediatr 27: 533-537, 2021.
4. Ratilal BO, Costa J, Pappamikail L, Sampaio C. Antibiotic prophylaxis for preventing meningitis in patients with basilar skull fractures (Review). Cochrane Library

PROPHYLACTIC ANTIBIOTICS FOR TRAUMATIC OPEN FRACTURE IN PEDIATRICS		
Antimicrobial prophylaxis should be administered in the trauma bay as soon as possible, ideally within 1 hour of injury. Doses and frequencies listed detail/describe open fracture prophylaxis while awaiting closure. For antibiotic dosing prior to any operative incision and intraoperative dosing frequency, see surgical prophylaxis guidelines on CareWeb. Contact pharmacy with dosing questions.		
Fracture or Wound Type† (Gustilo classification)	Suggested Regimen Initiate within 1 hour of arrival to UK	
	Primary	Type I (Anaphylactic) Penicillin Allergy
Type I or II – Blunt or Penetrating (including GSW) ≤10 cm long without significant soft tissue damage, flap, or avulsion	Cefazolin 30 mg/kg IV Q8H Maximum per dose 2000 mg (if >120 kg max 3000 mg)	Clindamycin 10 mg/kg IV Q6H Maximum per dose 900 mg
Type III – Blunt or Penetrating (including GSW) >10cm wound with extensive soft tissue damage or traumatic amputation	Cefazolin 30 mg/kg IV Q8H Maximum per dose 2000 mg (if >120 kg max 3000 mg) PLUS †Gentamicin 6 mg/kg IV x 1 dose	*Clindamycin 10 mg/kg IV Q6H Maximum per dose 900 mg PLUS †Gentamicin 6 mg/kg IV x 1 dose
Soil or Fecal Contamination Type I or Type II Farm-related injury or fecal contamination and ≤10 cm wound without extensive soft tissue damage, flaps, or avulsions	Cefazolin 30 mg/kg IV Q8H Maximum per dose 2000 mg (if >120 kg max 3000 mg) PLUS Penicillin G Potassium 66,667 units/kg IV Q4H Maximum per dose 4 million units	*Clindamycin 10 mg/kg IV Q6H Maximum per dose 900 mg
Soil or Fecal Contamination Type III Farm-related injury or fecal contamination and >10cm wound with extensive soft tissue damage or traumatic amputation	Cefazolin 30 mg/kg IV Q8H Maximum per dose 2000 mg (>120kg 3000mg) PLUS †Gentamicin 6 mg/kg IV x 1 dose PLUS Penicillin G Potassium 66,667 units/kg IV Q4H Maximum per dose 4 million units	*Clindamycin 10 mg/kg IV Q6H Maximum per dose 900 mg PLUS †Gentamicin 6 mg/kg IV x 1 dose
FRESH Water Injury Leading to Open Fracture	Levofloxacin 10 mg/kg IV/PO Maximum per dose 750 mg PLUS Graded Fracture Antibiotics	Levofloxacin 10 mg/kg IV/PO Maximum per dose 750 mg PLUS Graded Fracture Antibiotics
SALT Water Injury Leading to Open Fracture	Doxycycline 2.2 mg/kg IV/PO Q12H Maximum per dose 100 mg PLUS Ceftriaxone 50 mg/kg IV Q24H Maximum per dose 2000 mg	CONSULT Pediatric AMS*
Open Mandible* or Open Facial Fracture	Ampicillin/Sulbactam 50 mg/kg IV Q6H Maximum per dose ampicillin 2000 mg	Clindamycin 10 mg/kg IV Q6H Maximum per dose 900 mg
Open Skull Fracture, Sinus, Anterior or Posterior Table, or Closed Facial Fracture (non-contaminated)	None	None
CSF Leak	None PLUS Pneumococcal Vaccination Prior to Discharge*	None PLUS Pneumococcal Vaccination Prior to Discharge*
Contaminated open skull fracture, sinus, anterior or posterior table or closed facial fracture	See applicable antibiotic coverage contaminated fractures	See applicable antibiotic coverage contaminated fractures

Fig 2. Excerpt from revised institutional open fracture guideline

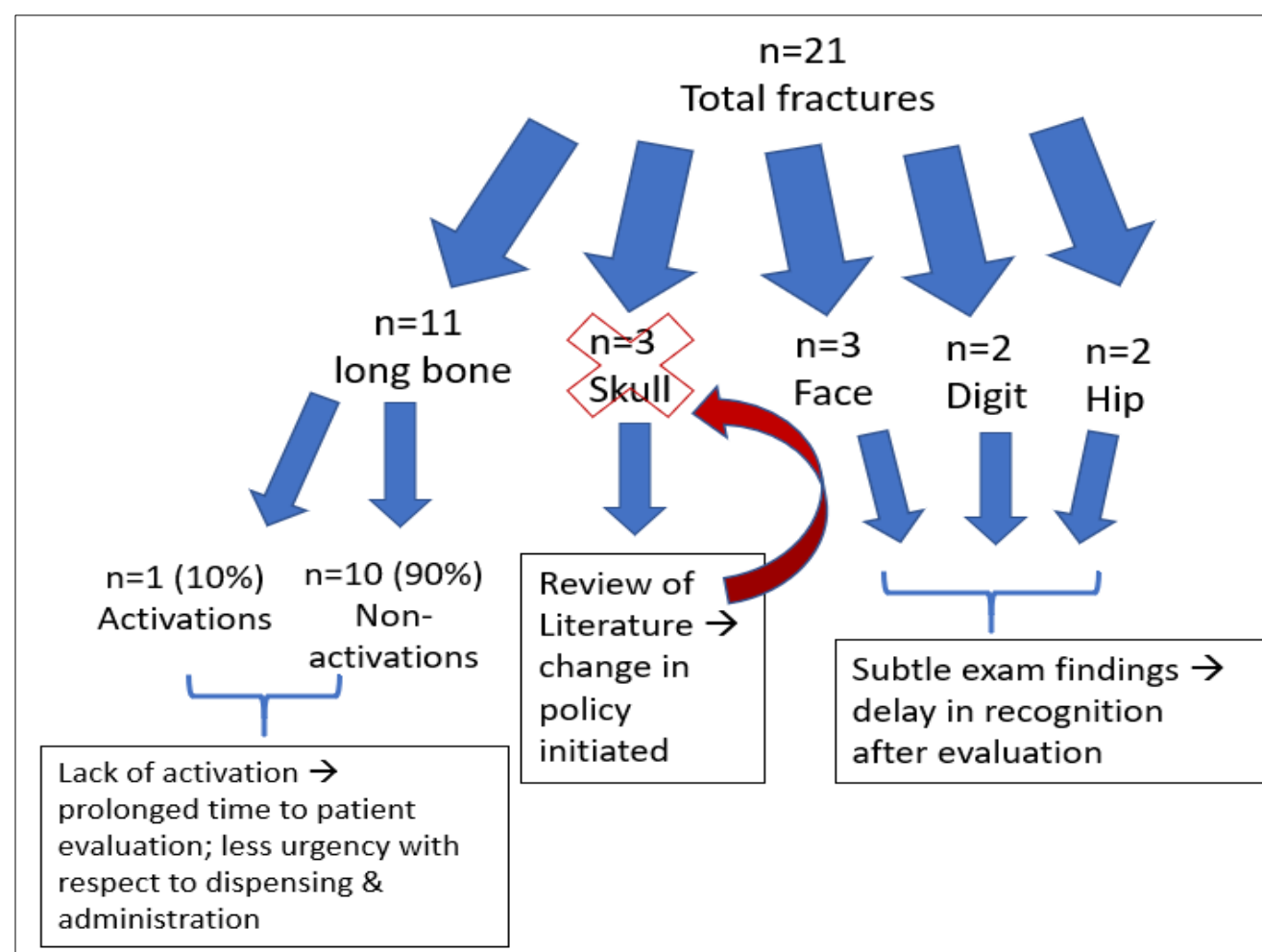


Fig 3. Identification of areas of antibiotic delay

DISCUSSION/CONCLUSION

- Frequent review of literature and protocols is necessary to ensure appropriate care is being provided and that metrics are being tracked.
- Trauma activation status plays a role in time to antibiotic administration in open fractures. However, given limited resources, not all traumas can be activated.
- Quality programs focusing on prompt evaluation of suspected fractures with emphasis on open fractures, exposure of sites even if dressed prior to arrival, and timely imaging will be crucial to improving this metric.
- Potential areas of intervention:
 - Provider education
 - Wider publicization of protocols in place
 - Order sets including instruction to administer antibiotics within 1 hour of arrival to trigger special attention by pharmacy and nursing