

DESCRIPTIVE ANALYSIS OF PEDIATRIC SURGICAL ANTIMICROBIAL PROPHYLAXIS IN FOUR UNIVERSITY TEACHING HOSPITALS IN QUEBEC

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INTRODUCTION

Antimicrobial prophylaxis is used in surgical patients to prevent wound infection which is associated with increased patient morbidity and increased costs for the health-care system. The Therapeutic Drug Management Program (TDMP) is composed of five university hospitals in Quebec working together to evaluate and optimize the use of medication.

OBJECTIVES

To describe how surgical antimicrobial prophylaxis was used in pediatric patients in our hospitals, and to review if prescription was in compliance with the most recently published guidelines.

METHODS

- Retrospective descriptive analysis for pediatric patients who underwent selected surgeries between April 1st 2012 and March 31st 2013 in four university hospitals.
- A random sampling procedure was used due to the large number of patients.
- Required information was gathered from medical charts.
- Up to 20 children per hospital for each selected surgery were included.
- Selected surgeries: cardiac, appendectomy, closed fracture, scoliosis
- Compliance criteria:** choice of antibiotic, dosage, duration and timing.
 - Compliance was established according to the **number of antibiotics prescribed** and not the number of patients.
 - Compliance for each criterion was evaluated separately.

RESULTS

Population and surgery characteristics

Table 1 - Patient baseline characteristics (N=222)	
Sex	
Girls	95 (43%)
Boys	127 (57%)
Age	
Mean (median)	8.3 (8.6)
[range]	[3 days-17.9 years]
Weight (kg)	
Mean (median)	31.8 (25.5)
[range]	[0.8-102]

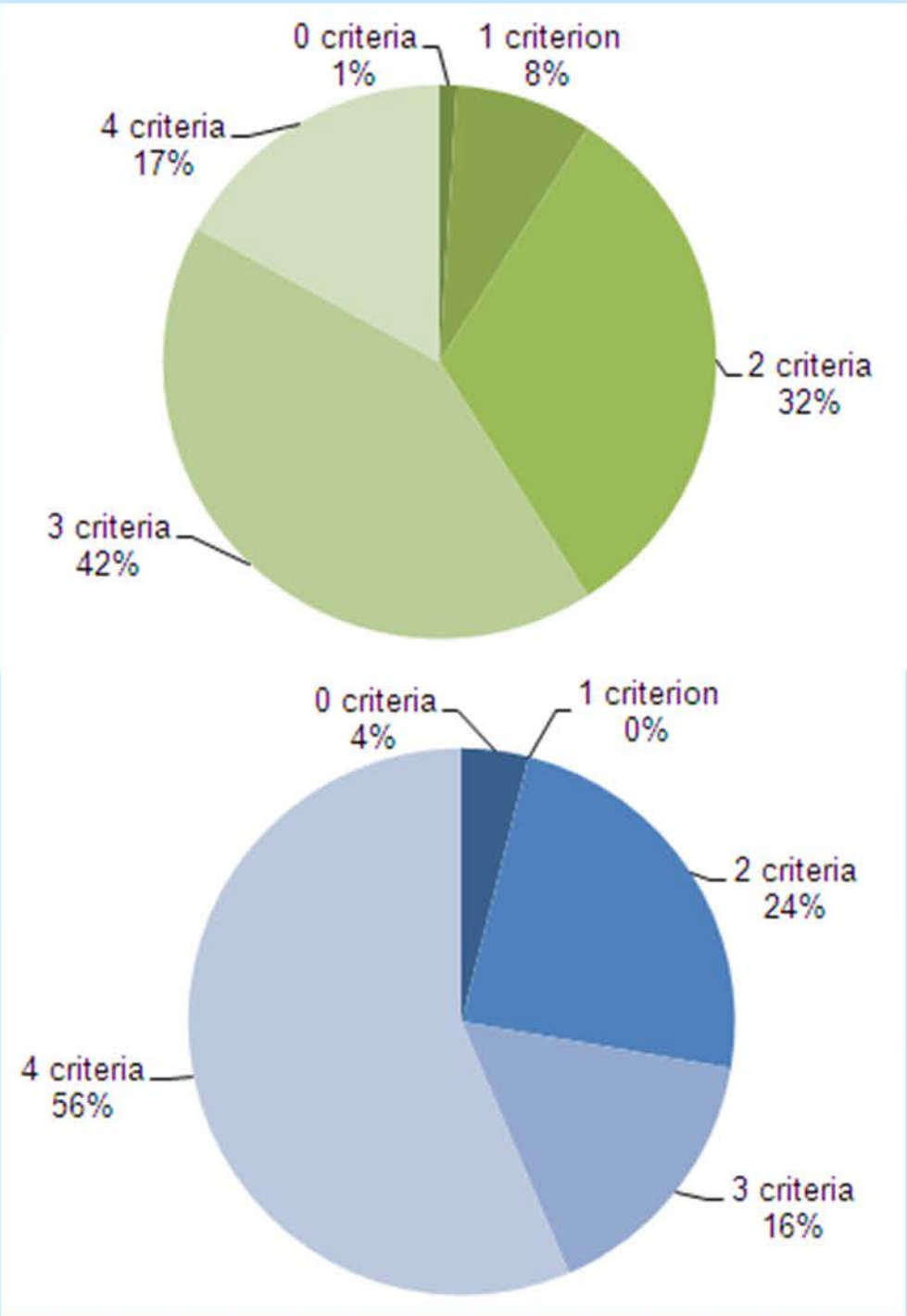
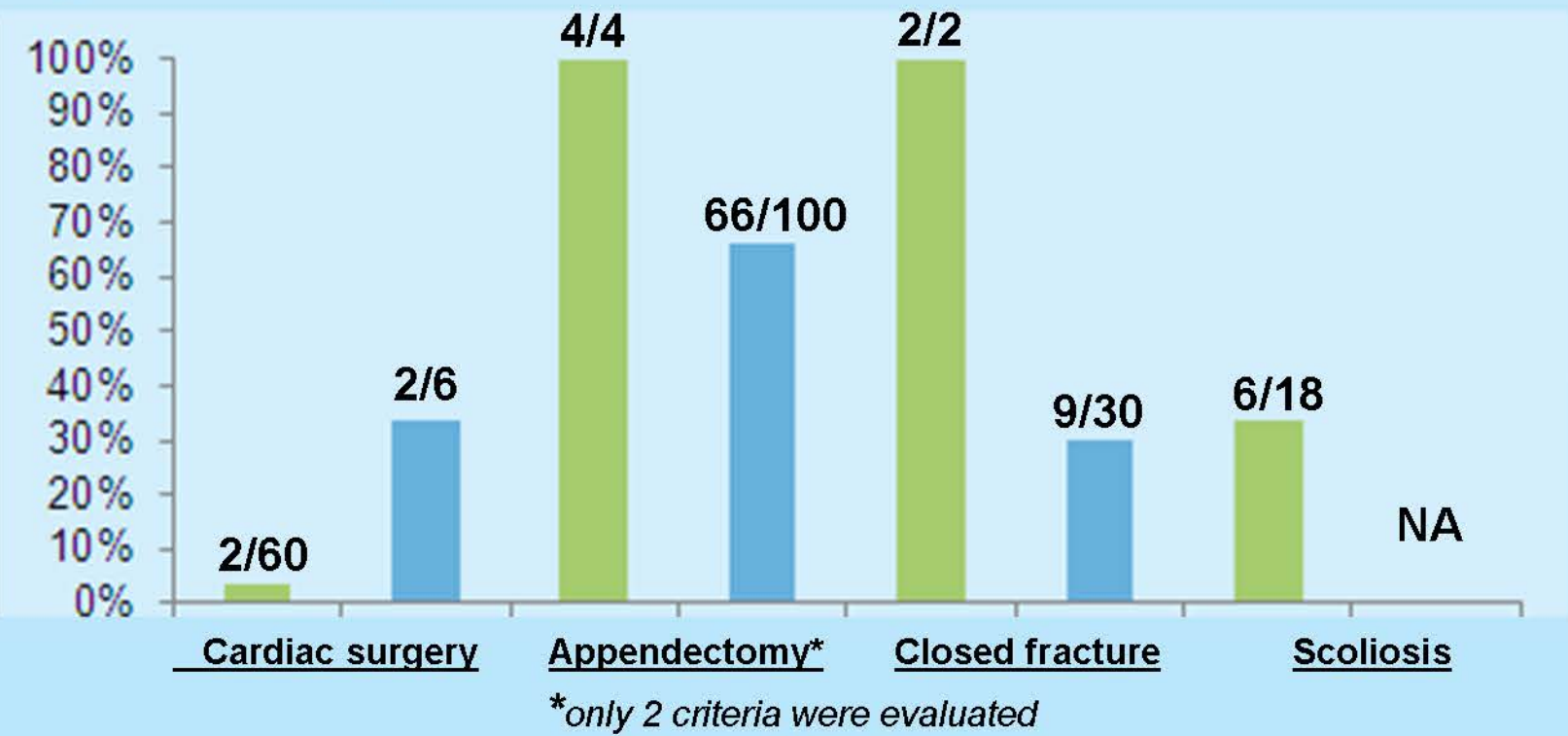
Table 2 - Population distribution according to the type of surgery*		
	Elective	Emergency
Cardiac surgery (N=65)	59 (91%)	6 (9%)
Appendectomy (not complicated) (N=78)	2 (3%)	76 (97%)
Closed (simple) fracture (N=61)	3 (5%)	58 (95%)
Scoliosis (N=18)	18 (100%)	N/A

*Some patients did not receive antimicrobial prophylaxis
N/A: not applicable

Overall compliance

Four criteria: choice, dosage, duration, timing

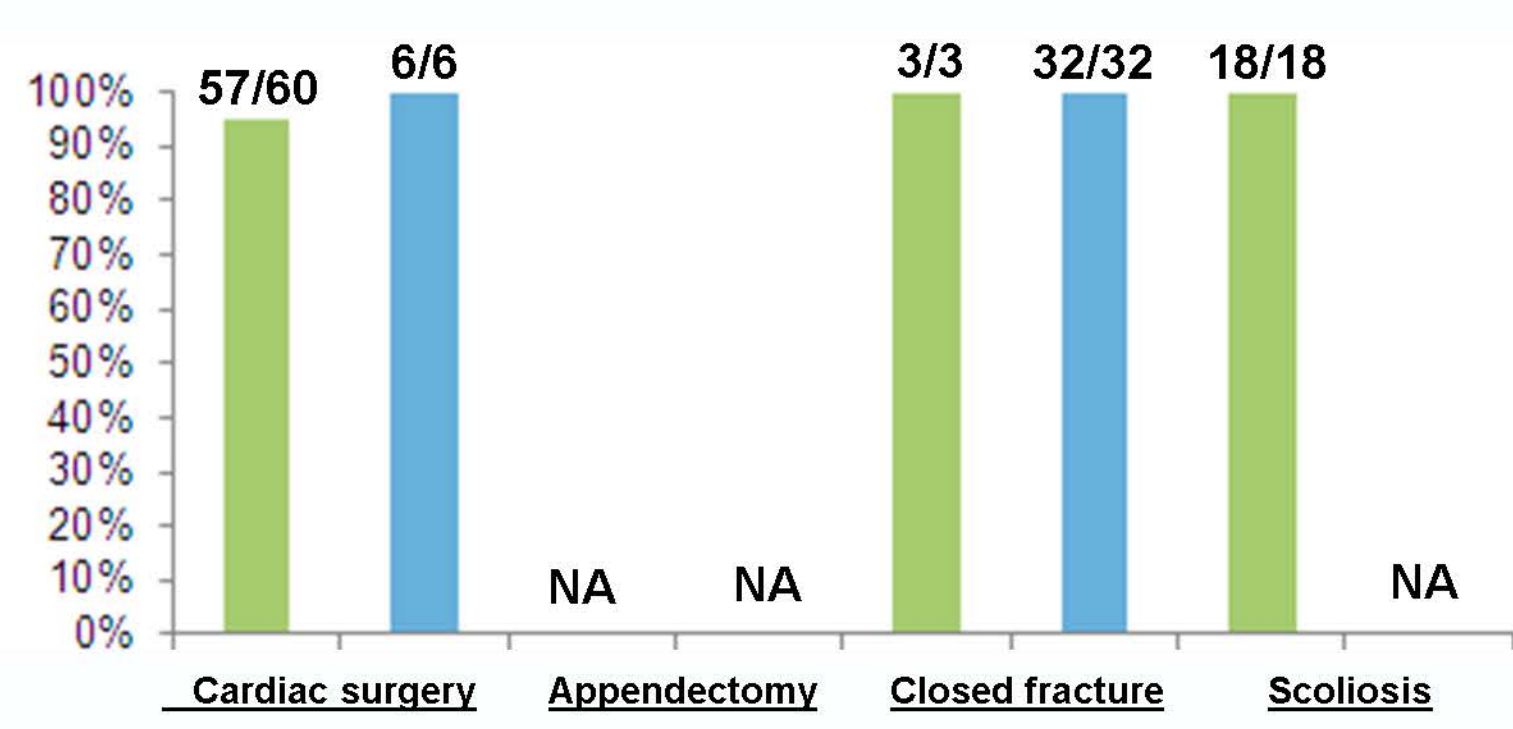
Figure 1. Compliance to the four criteria



Choice of antibiotic

Compliance criterion: chosen antibiotic had to be recommended in the guidelines.¹

Figure 2. Adequate choice of antibiotic



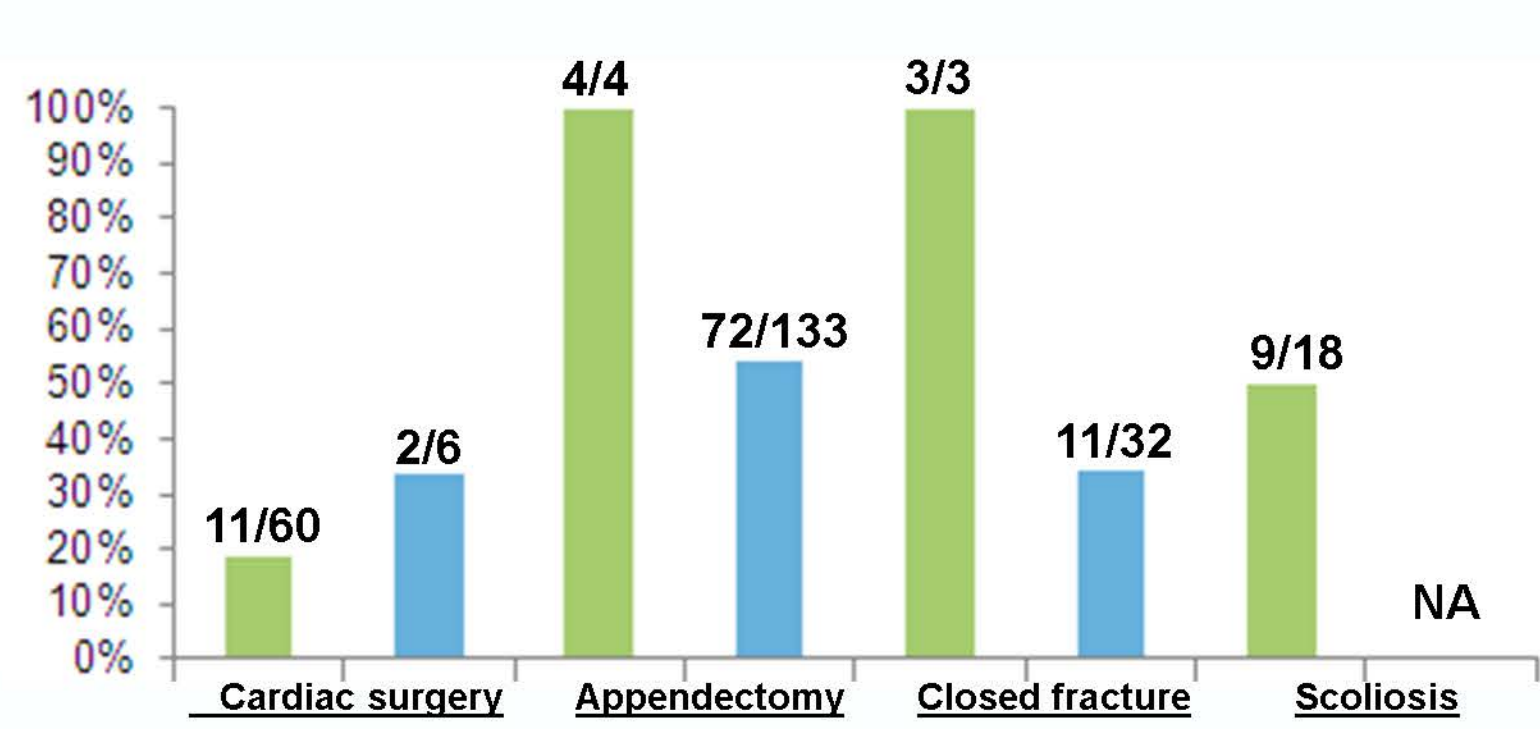
Comments:

- Appendectomy: choice was not assessed because a preemptive antibiotherapy is often prescribed before obtaining the confirmation of the final diagnosis.
- Scoliosis emergency: not applicable

Antibiotic dosage

Compliance criterion: prescribed dose had to be recommended in the guidelines¹ or in a pediatric dosage reference². Compliance was based on the first dose administered.

Figure 3. Adequate dosage



Comments:

- Appendectomy: 33/133 (25%) unknown (aminoglycosides).
- Scoliosis emergency: not applicable

Deviations are explained by:

- Many pediatric doses are variable:
 - Cefazolin: doses varied between 13 and 80mg/kg (recommended: 25-30mg/kg)
 - Aminoglycosides: doses varied between 0.5 and 7.5mg/kg (recommended: 2.5mg/kg)
- Many pediatric doses were too low:
 - Piperacillin-tazobactam: 75-80mg/kg (recommended: 100mg/kg)
 - Metronidazole: 10mg/kg (recommended: 15mg/kg)

Table 3 - Dosage variability example: cefazolin

Weight-adjusted doses			
	Antibiotics (N)	Conformity (N) (%)	Non conformity (N) (%)
< 25mg/kg	18	0 (0)	18 (100)
25-30 mg/kg	8	8 (100)	0 (0)
>30 mg/kg	40	2 (5)	38 (95)
Fixed-doses			
Dose	Antibiotics (N)	Conformity (N) (%)	Non conformity (N) (%)
1g	24	6 (25)	18 (75)
2g	15	13 (87)	2 (13)

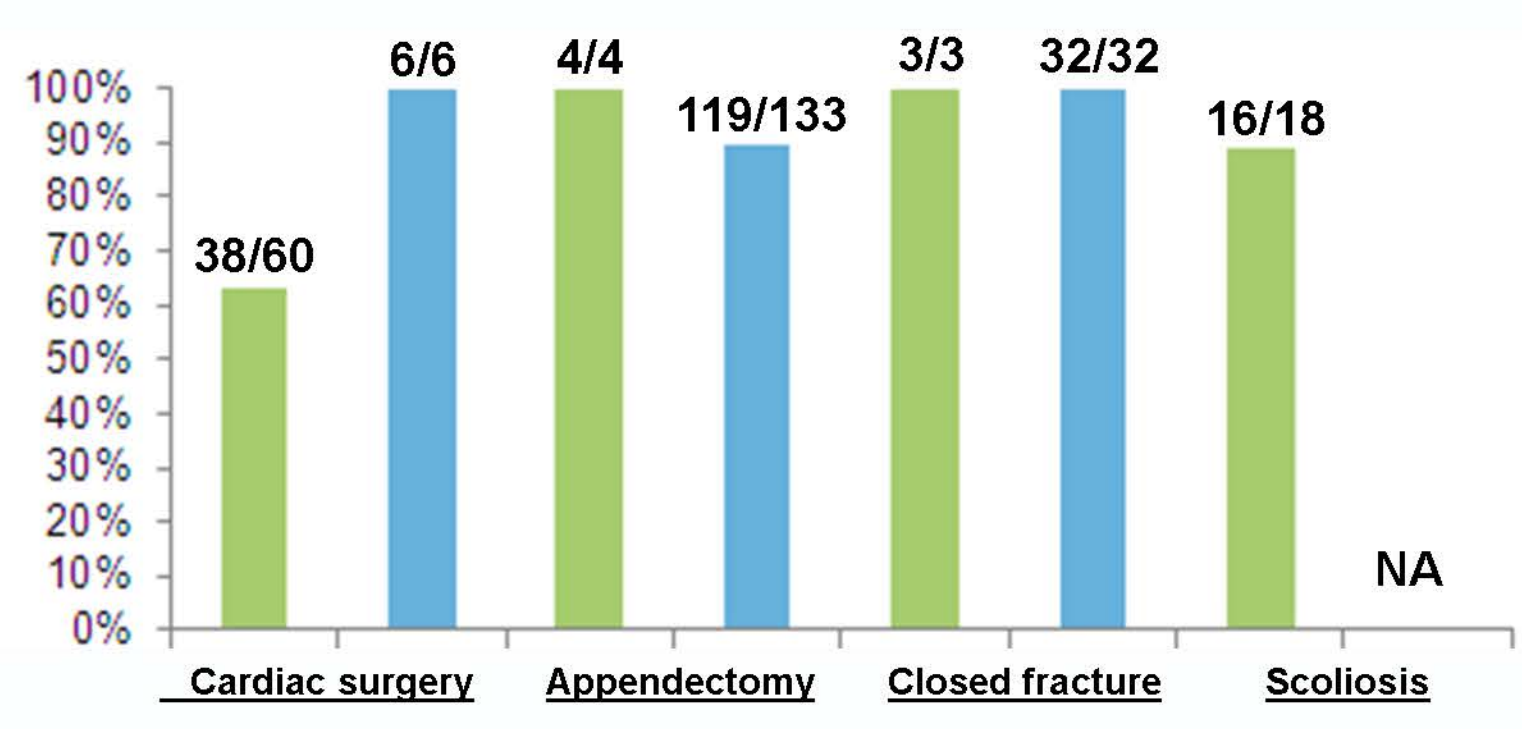
Comments:

- Many weight-adjusted doses for cefazolin are higher than recommended
- Fixed doses may not be as accurate as weight-adjusted doses

Duration of prophylaxis

Compliance criterion: 24 hours or less (excluding the preoperative dose).

Figure 4. Adequate duration of antimicrobial prophylaxis



Comments:

- In the current guidelines, the preoperative dose is included in the recommended duration¹. In our study, compliance for duration was evaluated by excluding the preoperative dose because the latest guidelines were published during the study period and because the previous guidelines recommended not to take the preoperative dose into account.
 - Some patients did not receive a preoperative dose
 - Some patients did receive a peroperative dose for short surgeries
- Duration was characterized by:
 - one dose only (42.2%)
 - ≤ 24h (42.2%)
 - >24h (15.6%)
- Cardiac surgery: duration may differ from the adult recommendations in the guidelines because of the complexity and the lack of evidence for some pediatric cardiac surgeries.

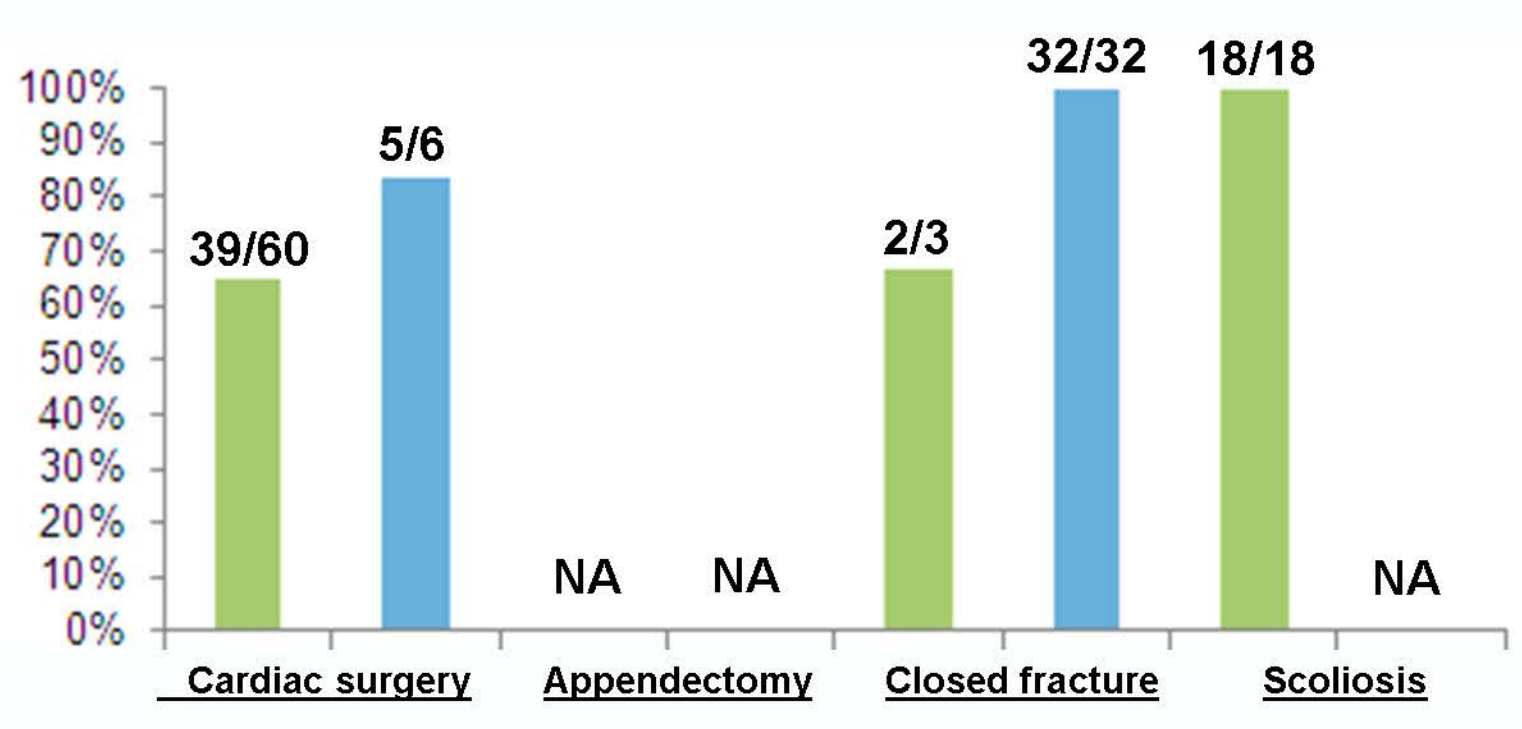
Deviations are explained by:

- Antimicrobial prophylaxis lasting more than 24 hours

Timing

Compliance criterion: dose administration completed 60 minutes or less prior to incision. Compliance was based on the first dose administered.

Figure 5. Adequate timing of administration



Comments:

- Appendectomy: timing could not be assessed because antibiotics are often prescribed before the final diagnosis is confirmed (preemptive treatment)
- This criterion has been the most difficult to assess because the exact time of the end of antibiotic administration was rarely available.
- The exact time for the end of administration was frequently not recorded (78%). Compliance was assumed based on local practices for each hospital (eg. cefazolin administered over 5 minutes in one hospital or over 15 minutes in another hospital).

Deviations are explained by:

- Too late: antibiotic administration that is not completed within 60 min prior to incision; more frequent with a long infusion.
- Too early: antibiotic administration completed more than 60 minutes prior to incision (eg. cardiac surgery).

LIMITATIONS

- Retrospective data collection
- New guidelines¹ (Feb 2013) published during the study:
 - Compliance criteria had to be adjusted to take into account old and new guidelines (eg. duration of prophylaxis taking into account preoperative dose in new guidelines).
 - Results are probably better than reality (eg. timing, duration)
- Pediatric guidelines are based on adult recommendations; clinicians do not always agree with these consensus recommendations (particularly for dosage).
- Compliance is difficult to establish for some criteria (eg. timing of administration) because of different practices between hospitals.

CONCLUSIONS

For several types of surgeries, a relatively low percentage of pediatric patients received optimal prophylactic antibiotic treatment based on the four essential criteria.

RECOMMENDATIONS

- Optimize antibiotic stewardship** for surgical prophylaxis (eg. knowledge transfer, educational meetings, automatic stop order, dissemination of information on the new guidelines and the results of this study).
- Elaborate preprinted orders**, especially for complicated surgeries (eg. orthopedic surgery).
- Prescribe doses of antibiotics for the pediatric population based on weight, until the **maximum** dose is obtained which corresponds to the adult dose.
- Prescribe a **single dose** of antibiotic if possible. The maximum duration of 24 hrs of prophylaxis (including the preoperative dose) should be explained to practitioners.
- Comply with the intraoperative recommended antibiotic **redosing interval** for prolonged procedures.
- Review the mode of administration** of antibiotics (especially for long infusions) to complete administration adequately prior to incision.
- Improve documentation** for surgical antimicrobial prophylaxis in patient charts regarding the timing of administration (infusion start time and end time).
- Conduct a **follow-up study** to assess whether practice has improved.

References

- Bratzler DW, Dellinger EP, Olsen KM. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health Syst Pharm 2013;70:195-283.
- Taketomo CK, Hodding JH, Kraus DM. Pediatric & Neonatal Dosage Handbook. 20th edition. Hudson: Lexicomp; 2013.2269 p.

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