

CLINICAL AND ECONOMIC IMPACT OF THE IMPLEMENTATION OF AN ANTIBIOTIC FLOWCHART FOR COMPLICATED URINARY TRACT INFECTION IN A TERTIARY CARE HOSPITAL IN COLOMBIA

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ABSTRACT

Background: Complicated urinary tract infection (cUTI) is one of the most common diagnoses in the emergency department (ED) and a major cause of mortality. A prompt and appropriate empiric antibiotic therapy prevents complications and reduces the length of stay, healthcare costs and mortality. The aim of this study was to determine the clinical and economic impact of the implementation in the ED of an antibiotic flowchart for cUTI.

Methods: Adult patients admitted to the ED of a tertiary care hospital in Colombia, between January and August 2016, treated with empiric antibiotics for cUTI were included and followed until completion of their antibiotic regimen. An antibiotic flowchart which considered risk factors for multidrug-resistant bacteria and patient stratification by severity was implemented to guide cUTI treatment. Patients who were treated empirically following the flowchart were considered the adherent group, and those not treated according to the flowchart were the non-adherent group. Clinical and economic outcomes were compared between groups. Data was analyzed using descriptive and inferential statistics.

Results: A total of 80 patients with cUTI were included; 54 (68%) were adherent and 26 (32%) were non-adherent. The mean age was 65 years old; 50 (62%) women and 30 (38%) men. *Escherichia coli* was the most common bacteria isolated (74%). Complications occurred more frequently in the non-adherent group (35% vs. 11%, $p = 0.01$). Antibiotic change after culture result was more common in the non-adherent group (62% vs. 28%, $p = 0.03$). The odds of clinical improvement at the end of antibiotic treatment following the flowchart was 93% compared with not following it (95% CI 0.01-0.45, $p = 0.005$). Regarding clinical and imaging tests, the median cost per patient in the non-adherent group was \$278 USD vs. \$174 USD in the adherent group ($p < 0.05$).

Conclusions: Our findings demonstrate that clinical and economic outcomes are significantly better for patients in the ED treated for cUTI according to an antibiotic flowchart. Flowcharts for other common infections should be implemented and measured as they seem to be a very efficient way to implement prompt and appropriate empiric antibiotic therapy in the ED.

BACKGROUND

- Complicated urinary tract infection (cUTI) is very frequent in patients presenting to the ED, and is a common cause of severe sepsis and septic shock affecting between 8.6% and 30.6% of these patients (1,2).
- The mortality for patients admitted to intensive care units with septic shock from a urinary source is reported to be 10% to 20% (3).
- Diagnosis and management guidelines may contribute to both identification of risk factors for antimicrobial resistance and improved empirical treatment of cUTIs (4).
- For patients with cUTI, there is limited evidence regarding the association between appropriate antibiotic use and better clinical and economic outcomes, including mortality, admission to the intensive care unit, length of stay and reduced costs.

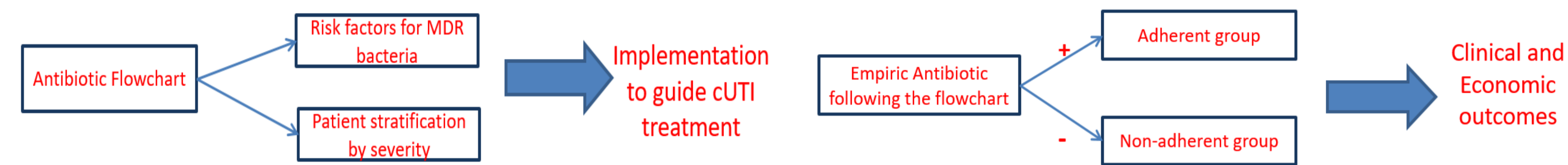
METHODS

- We conducted a prospective cohort study in one tertiary care hospital located in Cali, Colombia. The recruitment of cases was between January and August 2016.

INCLUSION CRITERIA	EXCLUSION CRITERIA
Adult patient (≥18 years old)	Positive cultures before initiating empiric treatment
Patient admitted to the ED	Death within the first 24 hours of empiric treatment
Diagnosis of cUTI	Urine culture taken after initiating of empiric treatment
Empiric treatment for cUTI	Negative culture

Enrolled subjects were followed until completion of antibiotic regimen

* Diagnosis according to Centers for Disease Control and Prevention (CDC) criteria



- Multiple talks and worksheets were given to the ED staff before the study started to ensure a good flowchart training and high adherence.
- Data was analyzed using descriptive and inferential statistics.
- Ethics committees of CIDEIM as well as of the participating hospital approved the study protocol.

RESULTS

- A total of 80 patients with cUTI met the selection criteria and were included in the study. Of these patients, 54 (68%) were the adherent or exposed group and 26 (32%) were the non-adherent group.
- Fifty patients were women (62%) and 30 were men (38%).
- The main microorganism isolated was *Escherichia coli* (74%), followed by *Klebsiella pneumoniae* (10%).
- The bivariate analysis between relevant variables in both groups (exposed and unexposed) is shown in Table 1.
- At the end of antibiotic regimen, complete symptom resolution was more frequent in the adherent group (46% vs. 15%). This result was statistically significant and was confirmed by the multivariate analysis (Table 2).
- Lactic acid, bilirubin, arterial blood gases, electrolytes, x-rays and nuclear magnetic resonance were more frequently ordered in the non-adherent group. In contrast, urinalysis was ordered more frequently in the adherent group. The total costs were much higher in patients who were not treated according to the flowchart (Table 3).

Table 1. Bivariate analysis.

VARIABLE	Relative risk (95% CI / p value)
Sex	1.12 (0.60-2.09/ $p=0.711$)
Age	0.87 (0.72-1.07/ $p=0.251$)
Comorbidities	
Overall presence	0.94 (0.78-1.13/ $p=0.547$)
Diabetes	1.34 (0.54-3.34/ $p=0.509$)
Neurologic disease	0.62 (0.31-1.23/ $p=0.183$)
Urinary tract alteration	1.44 (0.51-4.04/ $p=0.473$)
Cardiovascular disease	0.96 (0.70-1.32/ $p=0.818$)
Recurrent UTI	0.74 (0.40-1.53/ $p=0.341$)
Previous antibiotic therapy	1.06 (0.56-2.01/ $p=0.832$)
Severe sepsis	0.24 (0.079-0.72/ $p=0.006$)
Time between onset of symptoms and ED arrival	0.90 (0.59-1.36/ $p=0.644$)
Antibiotic prescription by specialist	0.89 (0.68-1.15/ $p=0.419$)
Urgent care specialist	1.20 (0.41-3.47/ $p=0.729$)
Urologist	0.77 (0.27-2.12/ $p=0.616$)
Internist	1.12 (0.48-2.58/ $p=0.782$)
MDR bacterial isolates	0.96 (0.50-1.84/ $p=0.909$)
ESBL bacterial isolates	0.85 (0.43-1.67/ $p=0.652$)
Antibiotic change after culture result	0.45 (0.26-0.76/ $p=0.003$)
Complications	0.32 (0.12-0.80/ $p=0.011$)
Clinical improvement (48 hours)	1.22 (0.98-1.53/ $p=0.020$)
Clinical improvement (end of treatment)	1.10 (0.96-1.28/ $p=0.062$)
Mortality	0.16 (0.01-1.46/ $p=0.062$)

Table 2. Multivariate analysis.

VARIABLE	Odds Ratio (95% CI / p value)
Age	1.01 (0.66-1.54/ $p=0.955$)
Neurologic disease	0.29 (0.04-1.98/ $p=0.208$)
Severe sepsis	0.59 (0.05-6.86/ $p=0.678$)
Time between onset of symptoms and ED arrival	0.90 (0.59-1.36/ $p=0.644$)
Antibiotic change after culture result	0.26 (0.05-1.33/ $p=0.107$)
Complications	1.14 (0.12-10.44/ $p=0.908$)
Clinical improvement (48 hours)	0.90 (0.25-3.28/ $p=0.885$)
Clinical improvement (end of treatment)	0.072 (0.01-0.45/ $p=0.005$)
Mortality	0.96 (0.90-1.03/ $p=0.286$)

Table 3. Number and costs of clinical and imaging tests in adherent and non-adherent groups.

Clinical and imaging tests	Adherent group Median (range)	Non-adherent group Median (range)	p value
Hemogram	3 (0-9)	3 (0-12)	0.086
C-reactive Protein	2 (0-9)	2 (0-5)	0.168
Lactic acid	0 (0-3)	1 (0-7)	0.0001
Creatinine	1 (0-9)	2 (0-9)	0.077
Bilirubin	0 (0-0)	0 (0-2)	0.003
Arterial blood gas	0 (0-6)	0 (0-8)	0.029
Electrolytes	1 (0-9)	2 (0-14)	0.040
BUN	0 (0-9)	0 (0-6)	0.235
Urinalysis	1 (0-2)	0 (0-1)	0.004
X rays	0 (0-5)	1 (0-6)	0.041
Ultrasound	0 (0-2)	0 (0-3)	0.702
Tomography	0 (0-2)	0 (0-2)	0.267
Nuclear magnetic resonance	0 (0-0)	0 (0-2)	0.04
Total Costs	USD 174 (45-646)	USD 278 (52-862)	<0.05

CONCLUSIONS

- To our knowledge, this is the first observational cohort study to assess the clinical and economic impact of the implementation of an antibiotic flowchart for cUTI in the ED in Colombia.
- The adherent group had a better clinical outcome at the end of antibiotic treatment. The odds of clinical improvement at the end of antibiotic treatment following the flowchart was 93% compared with not following it (95% CI 1%-45%).
- The median cost per patient in the non-adherent group was \$278 USD vs. \$174 USD in the adherent group ($p < 0.05$).
- Our findings demonstrate that clinical and economic outcomes are significantly better for patients in the ED treated for cUTI according to an antibiotic flowchart which is based on patient stratification and risk factors for acquiring a MDR bacteria. Flowcharts for other common infections should be implemented and measured as they seem to be a very efficient way to implement prompt and appropriate empiric antibiotic therapy in the ED.

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