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Uncovering Judgment Biases in Emergency Triage:
A Public Health Approach Based on Large Language Models

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Introduction:

- Emergency triage: **rapid assessment and categorization of patients** based on the severity of their conditions.
- Judgment biases are cognitive shortcuts in decision-making leading to **over-generalization based on stereotypes or incomplete information**.
- LLMs **match or surpass human medical decision-making accuracy.**

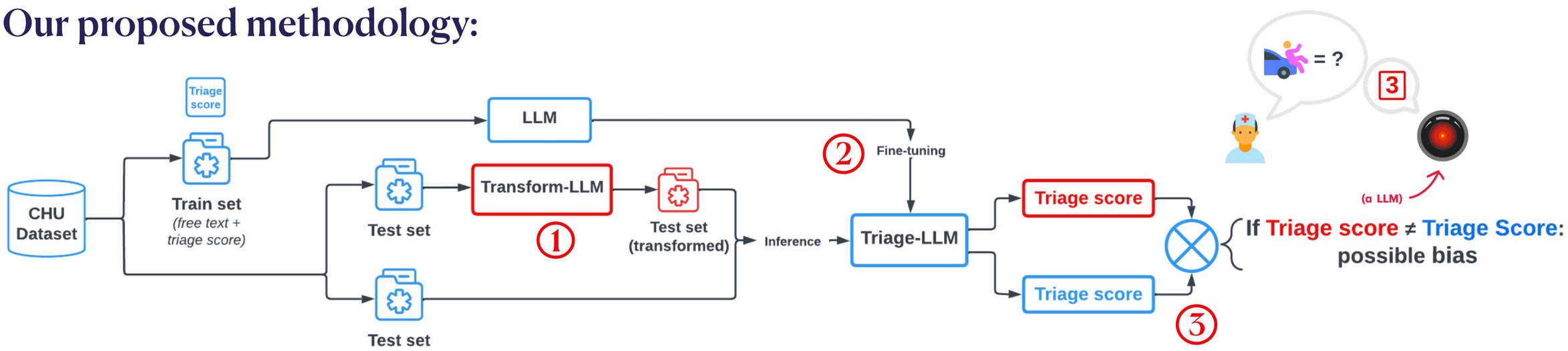
Are there variables which influence decision-making in emergency medicine, but shouldn't?
If so, how can we identify them when discrimination testing is too difficult or even unethical?

Main hypothesis: State-of-the-art LLMs can be used to answer this question.

Available data:

- **< 480,000 admissions** to the adult ED of the Bordeaux University Hospital (CHU Bordeaux), from 2013 to 2021.
- Each contains: **HPI notes, vital parameters, CC, patient context, nurse context + the associated triage score.**
- Triage is made on a 5-level scale: **1 = risk of death, 5 = not at risk of death.**

Our proposed methodology:



1. Few-shot clinical note transformation

- Using **Mixtral 8x22B v0.1, 7-shot configuration**.
- Instructed to change all references to a patient's gender towards the opposite gender (counterfactual sampling).
- Manually evaluated 100 random samples from test set.

Original synthetic extract (male)

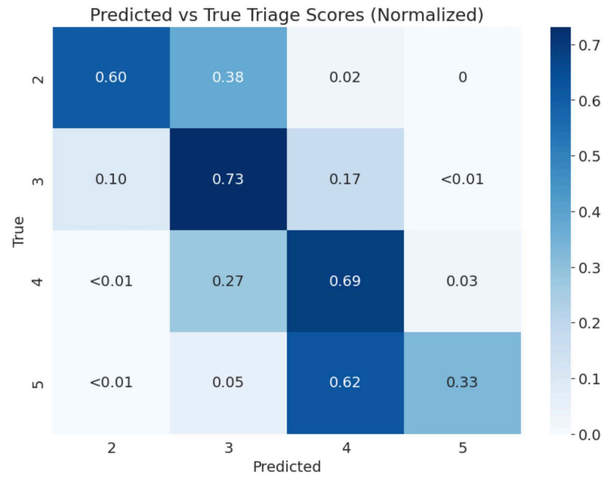
Sexe patient(e): **M**, Anamnèse patient(e) : **Patient** qui se plaint d'une d thoracique ECG fait et vu par medecin en box : GSC 14, [...] ne se dit pas **gêné** pour respirer , ps de diarrhée

Transformed synthetic extract (female)

Sexe patient(e): **F**, Anamnèse patient(e) : **Patiente** qui se plaint d'une d thoracique ECG fait et vu par medecin en box : GSC 14, [...] ne se dit pas **gênée** pour respirer , ps de diarrhée

2. LLM-based automatic emergency triage

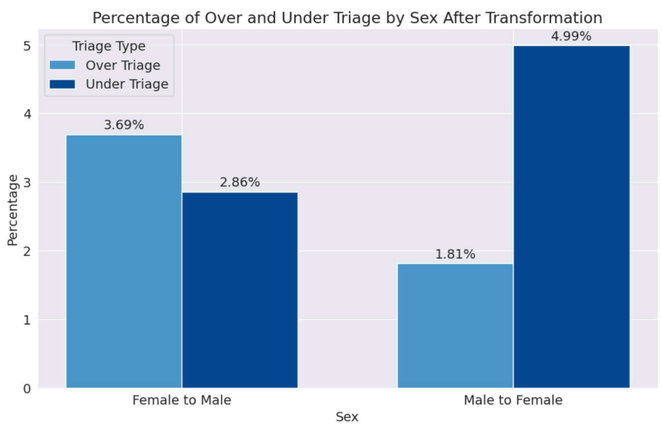
- 4 different LLMs-**Mistral 7B, BioMistral 7B, Mixtral 8x7B, Llama 3 8B-fine-tuned** on train partition to predict triage scores.
- Obtained weighted Cohen's **kappa of 0.71**: similar to human triage nurses in the literature.
- **Mistral 7B** selected for **downstream task** of triaging both versions of test set.



Model Name	Precision	Recall	Specificity	F1	κ	MAE
Mistral 7B	**0.67**	**0.67**	0.81	**0.67**	**0.71**	**0.34**
BioMistral 7B	0.66	0.66	0.81	0.65	0.69	0.35
Mixtral 8x7B	0.64	0.62	0.79	0.61	0.65	0.39
Llama 3 8B	**0.67**	**0.67**	**0.82**	0.66	**0.71**	**0.34**

3. Downstream task - bias detection

- **Compared predicted triage scores between original and transformed** samples with a paired t-test ($p<0.001$).
- On samples which originally indicated male sex, transformed towards **female**: **higher percentage of samples triaged as less critical** (≈ 5%) compared to those which were triaged as more critical (1.81%) after the transformation.
- On samples which originally indicated female sex, transformed towards male, less pronounced difference.
- We interpret this difference as **female patients being more likely to be under-triaged with respect to their male counterparts.**



Conclusion and Perspectives

- **LLMs are capable of imitating human medical decision-making**, serving as a proxy for discrimination testing.
- A **triage 'silver standard' through expert consensus** could make evaluation of the automatic triage models more robust.
- A portion of the differences may come from imitated biases, but **there may also be algorithmically-induced biases**.
- All information available during triage is not explicit: **implementation of multi-modal triage** in the near future.

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