Digital Triage System

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What is Digital Triage System?

The Digital Triage System is an AI-driven medical companion designed to optimize patient flow. It uses advanced Natural Language Processing to analyze clinical symptoms and instantly determine the correct medical specialty, required interventions, and urgency level.

Current Challenges in Clinical Triage

1. **Critical Overcrowding**

Healthcare facilities are facing unprecedented patient volumes. Manual triage processes are too slow to handle the surge, leading to dangerous wait times and delayed treatment for high-risk patients.

2. The "Wrong Door" Phenomenon

Misrouting is a major inefficiency. Patients with complex symptoms are often sent to the wrong specialty (e.g., Cardiology instead of Gastroenterology), wasting valuable specialist resources and delaying diagnosis

3. Unstructured Data & Human Error

Clinical notes are messy, unstructured, and full of jargon. Relying solely on tired medical staff to interpret this data leads to inconsistencies, missed rare diagnoses, and triage errors due to cognitive fatigue

Proposed Solution: Hybrid AI Architecture

We propose a multi-model ecosystem that decouples clinical routing from risk assessment to ensure maximum safety and precision.

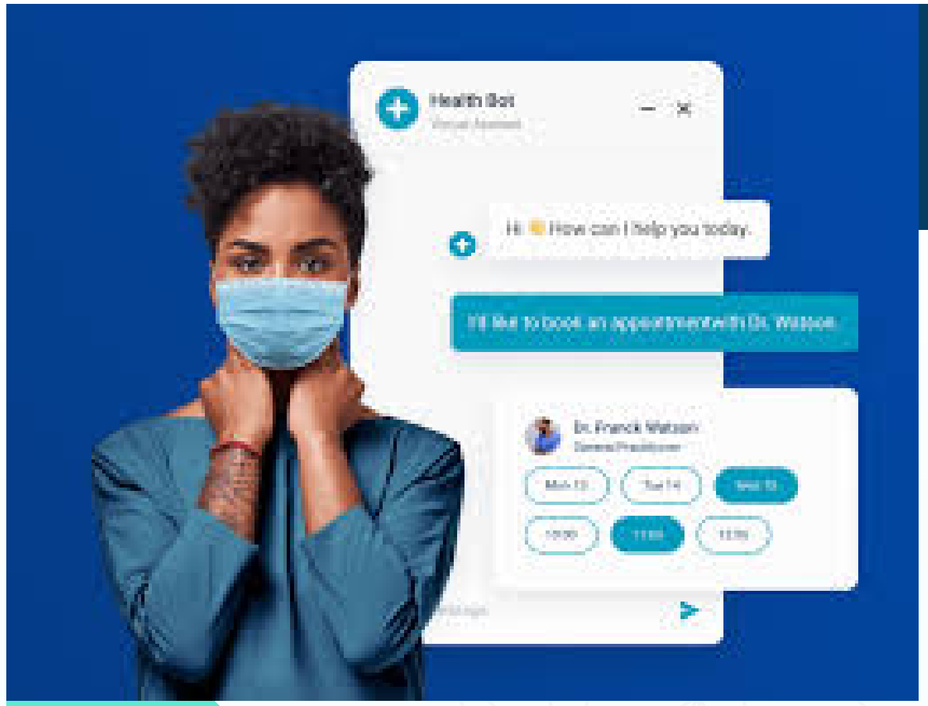
The "Dual-Brain" Approach:

- Engine A (Routing): Determines the medical specialty and required procedure.
- Engine B (Safety): Independently evaluates patient severity and discharge risk.
- Data-Driven: Powered by large-scale Transformers (BERT models) fine-tuned on over 250,000 clinical records.
- Goal: To replicate the holistic decision-making process of an experienced triage nurse in milliseconds.

The AI Engines: Routing, Action & Risk

Our solution integrates two specialized Transformer models, each optimized for a specific clinical task:

- 1. The Specialty Router (BioBERT):
  - Task: Maps symptoms to the correct department (e.g., Cardiology vs. Pulmonology).
  - Why: Specialized biomedical vocabulary ensures high precision on medical jargon.
- 2. The Safety Net (PubMedBERT):
  - Task: Predicts Discharge Disposition (Home vs. Admit/Expired).
  - Why: Acts as a fail-safe to flag critical patients who cannot be sent home.



From Raw Data to Clinical Insight

1. Exclusive & Restricted Data Access

- The Challenge: High-quality medical data is not publicly available due to privacy laws (HIPAA).
- Our Achievement: We gained authorized access to the MIMIC Database, a restricted clinical resource. This required passing rigorous ethical exams and obtaining CITI Program Certification.
- The Dataset: We worked with a specialized subset of real-world clinical notes, overcoming the scarcity of labeled medical data.

2. Overcoming Data Noise

- Real clinical records are "noisy" and imperfect. Despite accessing only a limited number of high-quality samples, our training methodology successfully extracted semantic patterns from this restricted corpus.

3. Standardized User Input

- To bridge the gap between complex hospital records and the patient, our solution simplifies the input into two core fields (as defined in our data schema):
  - Chief Complaint: The primary symptom (e.g., "Severe abdominal pain").
  - Medical History: The context (e.g., "History of diabetes, taking warfarin").

Clinical-Grade NLP Preprocessing

Standard NLP techniques are often destructive for medical text. We developed a domain-specific preprocessing pipeline:

- Preserving Negations:
  - Challenge: Standard NLP removes "stop words" like "no" or "not".
  - Innovation: We retained these particles. Distinguishing between "Chest pain" and "No chest pain" is critical for accurate triage.
- Abbreviation Retention:
  - Challenge: Filters often remove short words (<3 chars).
  - Innovation: We preserved vital medical acronyms like MI (Heart Attack), PE (Embolism), and ER, which carry high-density information.

Algorithmic Innovation: Handling Imbalance

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Precision Routing & Risk Assessment

Our dual-engine approach ensures that patients are not only sent to the right place but are also prioritized correctly.

🎯 Specialty Routing (BioBERT):

- Accuracy: 77.4% across 9 major medical specialties.
- Impact: Drastically reduces the "wrong door" rate compared to keyword-based systems.
- Example: Correctly distinguishes between cardiac and pulmonary chest pain.

🛡️ The Safety Net (PubMedBERT):

- Accuracy: 68.4% in predicting Discharge Disposition.
- Why it matters: Outperforms general clinical models in detecting high-risk patients who require immediate admission vs. those safe for home care.

Thank You

The Rise of Preventive Medicine: Catching Illness Before It Starts