Automatic detection of pneumonia from signs and symptoms: a feasibility study to explore a machine-learning model suitable for incorporation with mobile phone apps and wearable sensors.

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Event Website: https://www.globalcea.org/icehtmc

The Team / Workgroup

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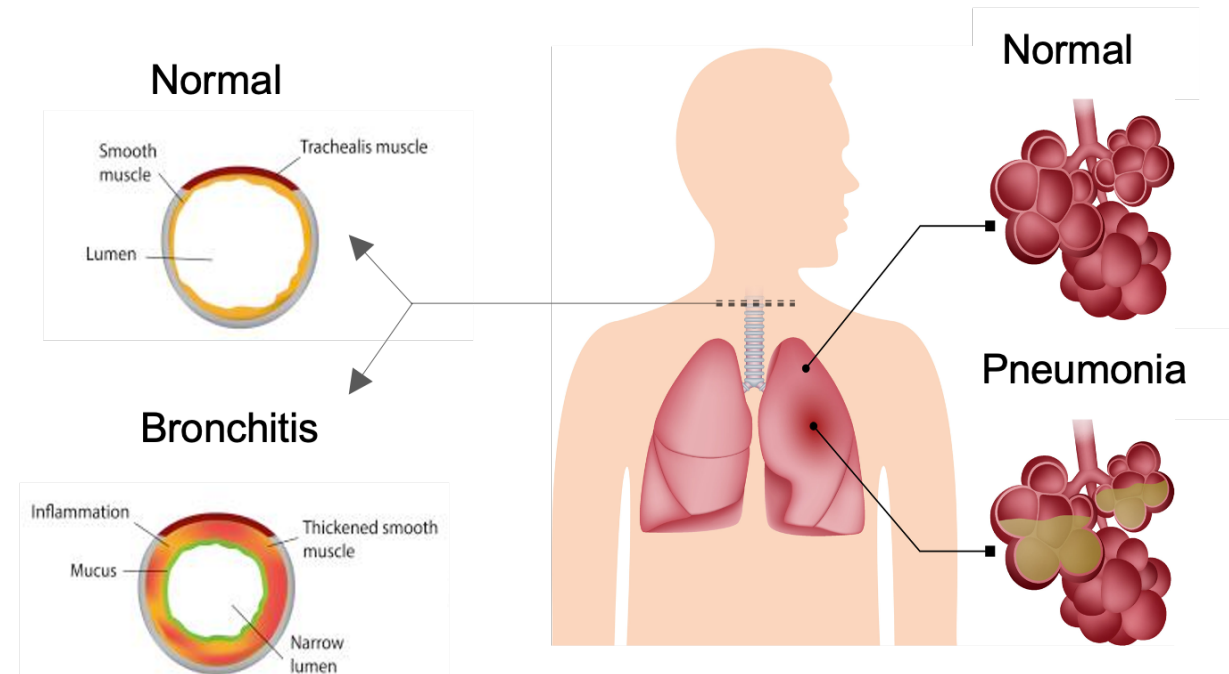
Dr Almir Badnjevic
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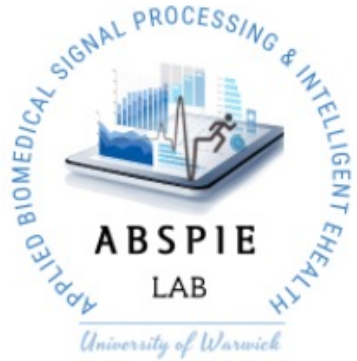
Description

Background:

Pneumonia diagnosis is challenging due to:

- low specificity of symptoms

- varied clinical presentation

- lack of accessible diagnostic tests

Machine Learning (ML) is a promising tool to overcome these challenges and to distinguish pneumonia from other respiratory diseases (i.e., bronchitis).

Aim: Investigate feasibility of a ML model to distinguish pneumonia from bronchitis.

Analysis workflow
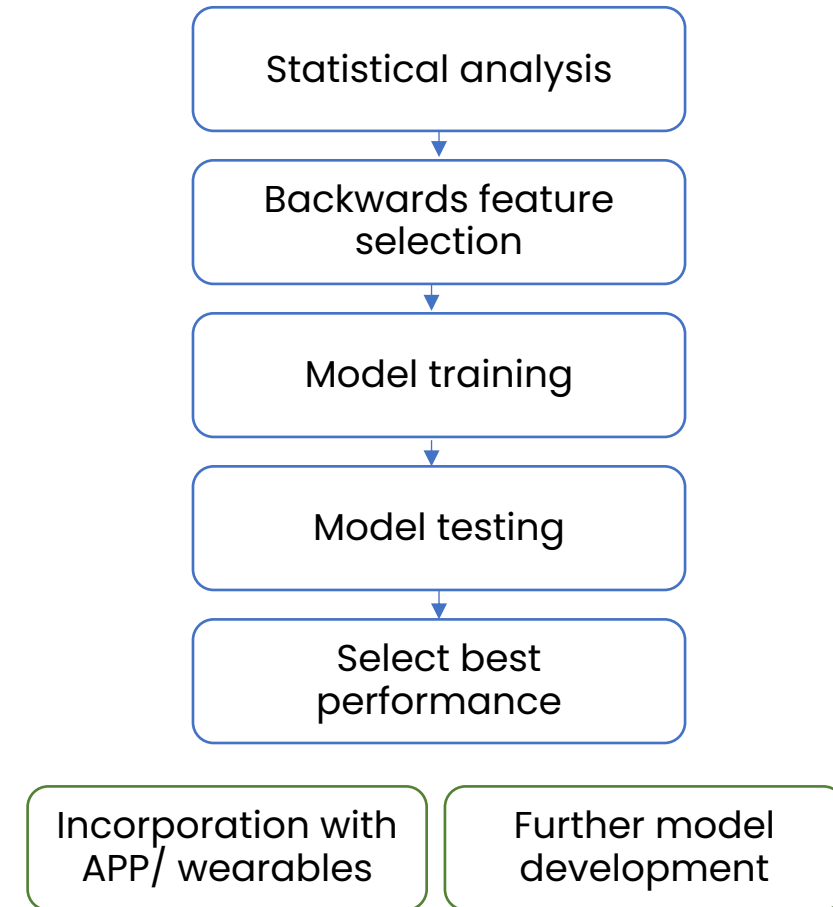
Dataset:

4500 patients

60% pneumonia

40% bronchitis

- Laboratory test results
- Population characteristics
- Symptoms and signs

Model criteria:

- Evidence based and interpretable
- Use easily recognised symptoms and signs as predictors
- Able to distinguish between patients with bronchitis and pneumonia

Statistical analysis

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Backwards feature selection

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Model training

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Model testing

↓

Select best performance

Incorporation with APP/ wearables

Further model development
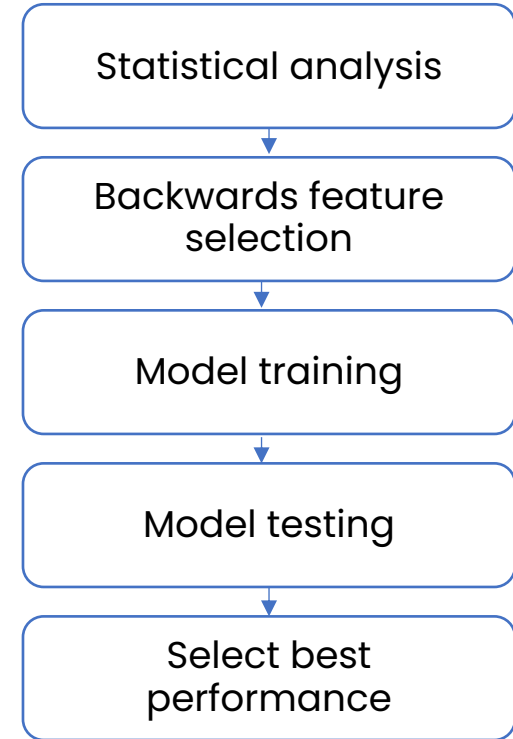
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Original Research Article

A machine learning model for supporting symptom-based referral and diagnosis of bronchitis and pneumonia in limited resource settings

Katy Stokes [a], Rossana Castaldo [b] ✉, Monica Franzese [b], Marco Salvatore [b], Giuseppe Fico [c], Lejla Gurbeta Pokvic [d], Almir Badnjevic [e], Leandro Pecchia [a]

Analysis workflow

Statistical analysis

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Backwards feature selection

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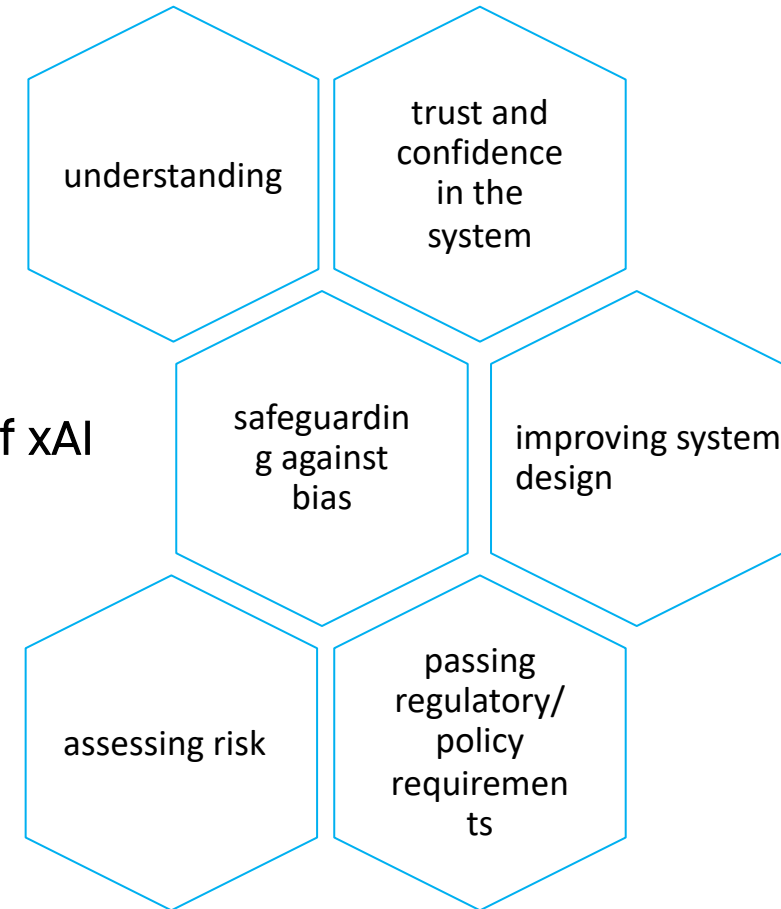
Further model development

Goals of the project and final users that will benefit

Goal: Design of a predictive Machine Learning model to distinguish bronchitis and pneumonia, which is suitable for incorporation into a diagnostic mobile app or integration with wearable sensors.

Those who will benefit:

- Other researchers seeking to develop diagnostic tools for clinical use

- Decision makers selecting the best diagnostic tool to implement

- Healthcare workers, especially those working in remote areas

- Patients who will receive fast and accurate diagnosis

Benefits of xAI

- understanding
- trust and confidence in the system
- safeguarding against bias
- improving system design
- assessing risk
- passing regulatory/ policy requirements

Results

Features:
Cough
Expectoration
Dyspnoea
Pleura pain
Sputum
Auscultation

Method	AUC	Sensitivity	Specificity
Decision Tree	93%	81%	84%
SVM (linear)	93%	78%	86%
Logistic Regression	93%	73%	88%

Fine Tree ROC Test data
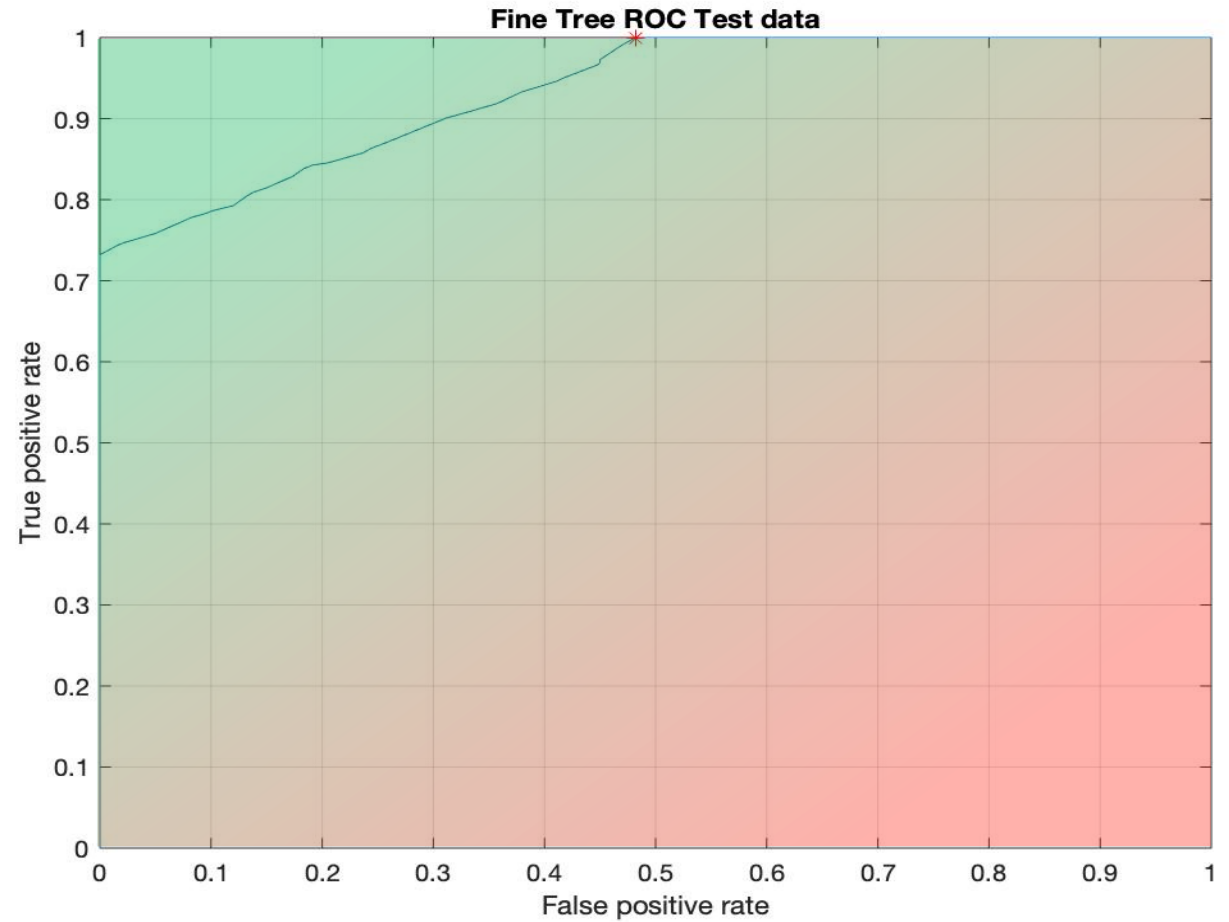
Future work

- Verify model using other data sources - data from low-income countries

- Design of a user-friendly mobile phone app
  - Input symptoms -> output suggested disease condition

- Incorporate other frequently presenting respiratory diseases

- Expand scope to detection of severity and underlying cause of pneumonia

- Explore improvements in performance
  - Incorporation of sensor readings: cough sound, temperature reading

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