Implication of Quantitative CT and Artificial Intelligence in COPD of Maori Population

人工智能和量化CT在慢阻肺毛利病人中应用

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Maori Health 毛利人的健康

- Maori, 15% of the national population. 15%总人口
- Lower life expectancy than non-Māori
- Higher rates of psychiatric illnesses
- Higher rates of all cancers, diabetes, COPD
- Increasing rates of suicide, especially among youth
- Lower educational achievement
- High rates of imprisonment (50% of prison population)
- Higher rates of cardiovascular disease yet lower rates of interventions

资料来源新西兰卫生部

2. COPD 慢阻肺
COPD Definition 慢阻肺

► Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.

► 慢性阻塞性肺病（COPD）是一种常见的，可预防和可治疗的疾病，其特征在于持续的呼吸症状和气流受限，这是由于气道和/或肺泡异常通常由显着暴露于有害颗粒或气体引起的。

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Chronic Obstructive Pulmonary Disease (COPD man慢阻肺)

► COPD is currently the 4th leading cause of death in the world.¹

► COPD is projected to be the 3rd leading cause of death by 2020.²

► More than 3 million people died of COPD in 2012 accounting for 6% of all deaths globally.

► Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and aging of the population.

COPD是目前世界上第四大死亡原因

预计到2020年，COPD将成为第三大死亡原因

2012年有超过三百万万人死于COPD，占全球死亡人数的6%。

在全球范围内，由于持续暴露于COPD危险因素和人口老龄化，预计未来几十年COPD负担将增加。

Prevalence of COPD

- Estimated 384 million COPD cases in 2010.
- Estimated global prevalence of 11.7% (95% CI 8.4%–15.0%).
- Three million deaths annually.
- With increasing prevalence of smoking in developing countries, and aging populations in high-income countries, the prevalence of COPD is expected to rise over the next 30 years.
- By 2030 predicted 4.5 million COPD related deaths annually.

COPD的患病率

2010年估计有3.84亿COPD病例。

估计全球患病率为11.7%（95% CI为8.4%-15.0%）。

每年有300万人死亡。

随着发展中国家吸烟率的增加以及高收入国家的人口老龄化，预计COPD的患病率将在未来30年内上升。

到2030年，预计每年有450万COPD死亡。
Economic and Social Burden 经济和社会负担

**Economic burden of COPD**

► COPD is associated with significant economic burden.
► COPD exacerbations account for the greatest proportion of the total COPD burden.

► European Union:
  - Direct costs of respiratory disease ~6% of the total healthcare budget
  - COPD accounting for 56% (38.6 billion Euros) of the cost of respiratory disease.

► USA:
  - Direct costs of COPD are $32 billion
  - Indirect costs $20.4 billion.

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Diagnosis and Initial Assessment 诊断和初步评估

**OVERALL KEY POINTS (1 of 2):**

► COPD should be considered in any patient who has dyspnea, chronic cough or sputum production, and/or a history of exposure to risk factors for the disease.

► Spirometry is required to make the diagnosis; the presence of a post-bronchodilator FEV1/FVC < 0.70 confirms the presence of persistent airflow limitation.

► The goals of COPD assessment are to determine the level of airflow limitation, the impact of disease on the patient’s health status, and the risk of future events (such as exacerbations, hospital admissions, or death), in order to guide therapy.

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### Post-bronchodilator FEV₁

**CLASSIFICATION OF AIRFLOW LIMITATION SEVERITY IN COPD (BASED ON POST-BRONCHODILATOR FEV₁)**

<table>
<thead>
<tr>
<th>GOLD 1:</th>
<th>Mild</th>
<th>FEV₁ ≥ 80% predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOLD 2:</td>
<td>Moderate</td>
<td>50% ≤ FEV₁ &lt; 80% predicted</td>
</tr>
<tr>
<td>GOLD 3:</td>
<td>Severe</td>
<td>30% ≤ FEV₁ &lt; 50% predicted</td>
</tr>
<tr>
<td>GOLD 4:</td>
<td>Very Severe</td>
<td>FEV₁ &lt; 30% predicted</td>
</tr>
</tbody>
</table>

**TABLE 2.4**

Reference: 2019 Global Initiative for Chronic Obstructive Lung Disease: https://goldcopd.org/
Artificial Intelligence 人工智能

Machine learning

“Algorithms that parse data, learn from that data, and then apply what they’ve learned to make informed decisions”

Deep learning is just a subset of machine learning.

深度学习只是机器学习的一个子集。

Convolutional Neural Network

A class of deep, feed-forward artificial neural networks, most commonly applied to analyzing visual imagery
Multislice CT scan: volume scan mode, for example, Siemens scanner (Sensation 16, 120 kVp, 125 mAs, 1.0 mm slice thickness, B35f reconstruction kernel)

Quantitative CT analysis:
- Commercial analysis software (using deep learning networks)
- The predicted total lung capacity (TLC);
- Overinflation volume was expressed as a % of the total lung volume (ie, %overinflation).
- CT % overinflation is an independent predictor of decline in FEV1.
- Multislice CT scanning: volume scan mode, for example, Siemens scanner (Sensation 16, 120 kVp, 125 mAs, 1.0 mm slice thickness, B35f reconstruction kernel)
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4. Research Project

Objectives:

- To investigate emphysematous lung destruction and airway remodelling in Maori patients.
- To investigate and confirm linear relationship between CT % overinflation and changes of FEV1 % predicted.
- To investigate the clinical value of CT scan before and after lung volume reduction surgery (LVRS).
- To investigate potential use of CT % overinflation in prediction of the progress of COPD.
- To investigate role of CT scan in early detection of COPD.

目标:

- 调查肺气肿肺部破坏和毛利人患者的气道重塑。
- 调查和确认CT%过度充气与预测的FEV1%变化之间的线性关系。
- 调查肺减容手术（LVRS）前后CT扫描的临床值。
- 调查CT%过度充气在预测COPD进展中的潜在用途。
- 调查CT扫描在早期发现COPD中的作用。
Potential applications 潜在应用

- An extra parameter to reflect airway obstruction in COPD patients other than FEV1/FVC of %predicted value. Especially for Maori people.
- May help to optimise the current FEV1 and FVC mathematical model.
- Maybe predict the lung volume reduction surgery (LVRS) effect.
- Lung cancer screening.
- 反映COPD患者气道阻塞的额外参数，除FEV1 / FVC %预测值外。特别是毛利人。
- 可能有助于优化当前的FEV1和FVC数学模型。
- 也许可以预测肺减容手术（LVRS）的效果。

Thank you