Life Cycle Assessment Framework for Diagnostic Imaging

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Lack of comprehensive LCA analysis of the environmental impact of Diagnostic imaging in the current literature

- Out of 17 original articles on environmental sustainability in radiology published since 2014, five described an LCA approach.
- Diagnostic imaging processes included in the system boundaries are energy consumption of imaging equipment (e.g., CT, MRI), HVAC systems, capital equipment production, staff and patient travel, use of consumables and waste disposal.

Study	Year	Country	Imaging technique	Aim/objective
Leapman et al	2023	USA	MRI, Ultrasound	**Estimate the environmental impact associated with prostate MRI examinations and prostate biopsy**
McAlister et al	2022	Australia	Chest X-ray, Mobile Chest X-ray, CT, MRI, Ultrasound	**Estimate the carbon footprint of five different diagnostic imaging modalities**
Esmaeili et al	2018	USA	MRI	**Estimate the environmental impact of MRI examinations**
Martin et al	2018	USA	CT, MRI, Ultrasound	**Estimate environmental impacts of various abdominal imaging examinations**
Esmaeili et al	**2015**	**USA**	**CT**	**Estimate the environmental impact of CT examinations**

- According to the GreenHouse Gas (GHG) Protocol Corporate Standard, it is essential to consider various aspects that span the entire diagnostic pathway of a patient.
- Among the five articles reviewed, only three discussed the Life Cycle (LC) impact assessment model, and merely two addressed the LC inventory database.

Introduction

The increasing focus on environmental sustainability is becoming essential in radiology sector, which is accredited for about 10% of the healthcare industry's carbon footprint. A multitude of research initiatives investigated the environmental impacts of diagnostic imaging. Life Cycle Assessment (LCA) stands as a prominent method for structural assessment of environmental impacts, offering a tool for examining the environmental consequences of specific processes. The aim of this study includes analysing existing LCA approaches in literature to identify their limitations and to suggest a comprehensive LCA framework for diagnostic imaging.

Methods and methodology

The study was structured in two distinct segments. Initially, a literature review was conducted to analyse existing publications on environmental sustainability in the field of radiology. The aim was to identify articles that addressed LCA specifically.

In the subsequent phase of the study, the focus shifted towards developing a detailed framework designed for the application of LCA within medical imaging practices. This segment emphasising how LCA can be effectively integrated to assess and minimise the environmental footprint of imaging technologies and procedures. It proposed a systematic approach to evaluate the entire lifecycle of imaging equipment—from manufacture and daily use to disposal and recycling—thereby providing insights into potential environmental impacts and offering guidelines to implement these practices effectively.

Results

This literature review scrutinizes studies on the environmental impact of diagnostic imaging via LCA, revealing a lack of comprehensive analysis in existing research. Most studies focus primarily on the energy consumption of imaging devices, a significant contributor to the carbon footprint. However, aspects like staff and patient travel, waste management, and the use of LCA software and databases vary across studies. It underscores the necessity for a unified LCA framework covering the preclinical, clinical, and post-clinical phases of diagnostic imaging to fully assess its environmental impact.

LCA Framework for Diagnostic Imaging