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LIFE CYCLE ASSESSMENT FRAMEWORK FOR DIAGNOSTIC IMAGING

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Abstract – The increasing focus on environmental sustainability is becoming essential in the diagnostic imaging 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, encompassing factors like electricity consumption, carbon emissions, and waste generation from these procedures. Life Cycle Assessment (LCA) stands as a prominent method for structural assessment of environmental impacts, offering a detailed framework for examining the environmental consequences of specific processes. The aim of this study includes analyzing existing LCA approaches in literature to identify their limitations and to suggest an elaborate framework for LCA application in diagnostic imaging. Out of 17 original articles on environmental sustainability in radiology published since 2014, but only a part, 29.4 % (5/17), described an LCA approach. The different characteristics of these studies provide valuable insights, enabling the proposal of a more comprehensive LCA research methodology. The reviewed articles did not present a uniform research outcome. According to the GreenHouse Gas (GHG) Protocol Corporate Standard, the optimal outcome for assessing environmental impact is the calculation of greenhouse gas emissions. For a thorough methodological approach in LCA, it is essential to cover all direct and indirect emissions associated with diagnostic imaging. All studies (100 %, 5/5) considered the electricity consumption of imaging equipment. Usage of consumables was included in 80 % (4/5) of studies. Only 40 % (2/5) of articles considered auxiliary equipment, such as computers and contrast-medium injectors, as well as heating, ventilation and air conditioning (HVAC) systems. Equipment manufacture, staff travel, and waste generation, though crucial to overall greenhouse gas emissions, were each covered in only 20 % (1/5) of the studies. The articles also varied in their LCA versions, with two employing the detailed Cradle-to-Grave approach, while others used partial Cradle-to-Gate and Input-Output LCA methods. The insights from this analysis could lead to a valuable framework for a new LCA methodological approach in diagnostic imaging. This novel approach is designed to overcome the limitations observed in existing research, offering a more comprehensive analysis. By enhancing the LCA framework, it will be possible to identify the phases in diagnostic imaging that have the most substantial environmental impact, allowing for the development of more targeted strategies to reduce GHG emissions associated with diagnostic procedures.

Keywords – Electricity consumption; environmental sustainability; GreenHouse Gas (GHG) emissions; healthcare sector; radiology; research methodology