Co-funded by the European Union

NetZeroAICT

Digital Contrast for Computerised Tomography

- Towards Climate Neutral and Sustainable Health Systems -

Towards NetZero Healthcare

Mitigating the environmental impact of radiology with novel AI imaging solutions

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Disclosure: R Lee is the Co-Founder and Chief Medical Officer of AiSentia

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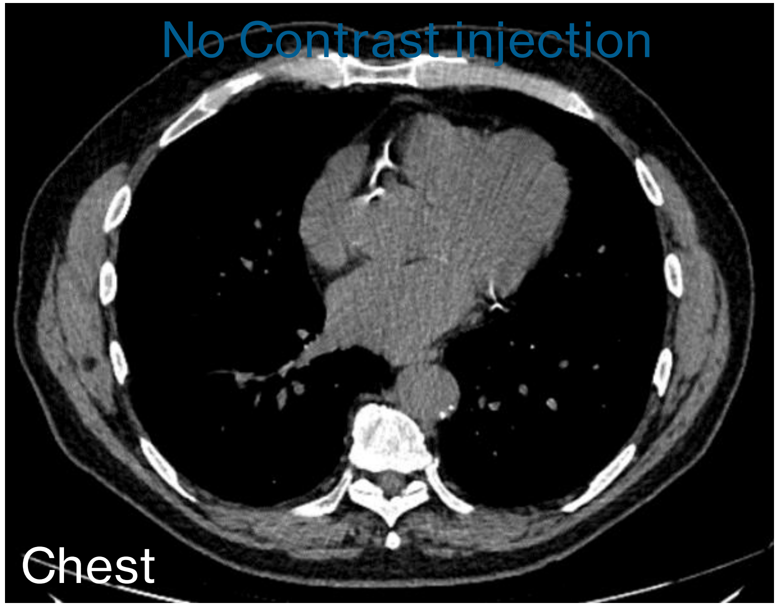
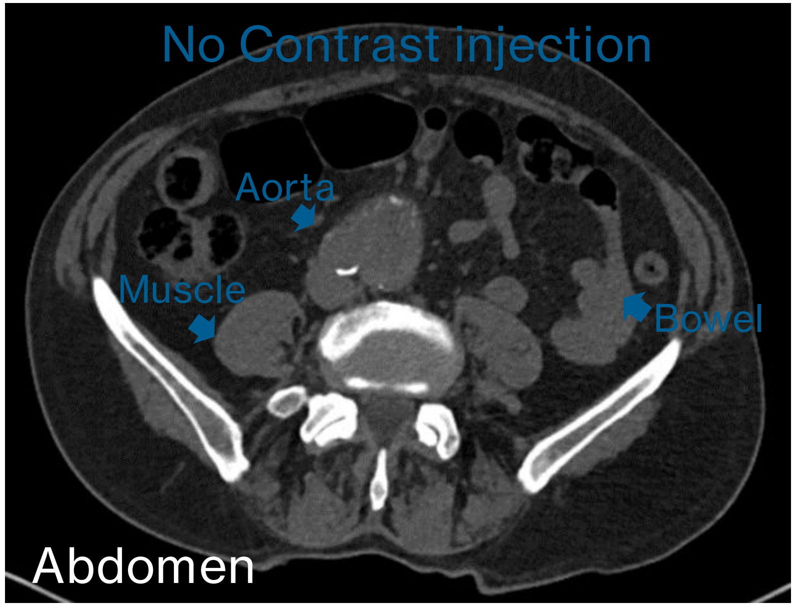
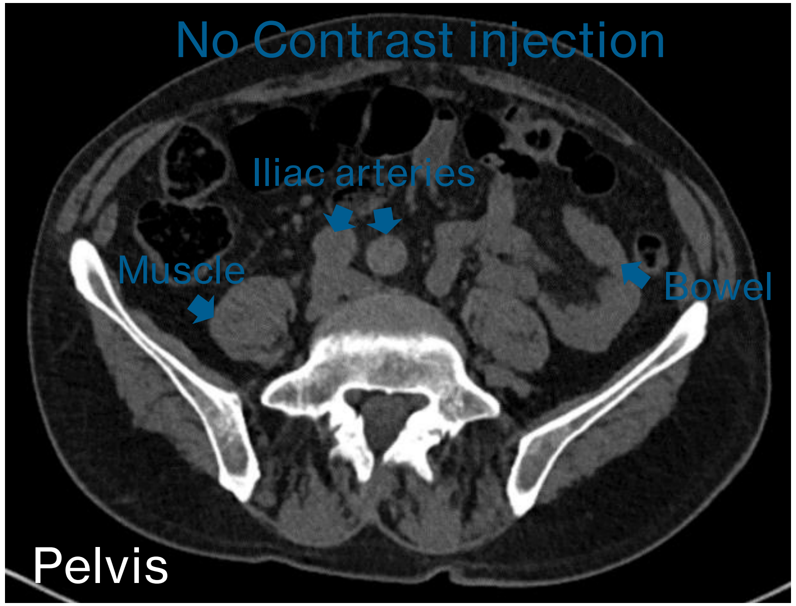
› 300 million CT scans are performed globally / year





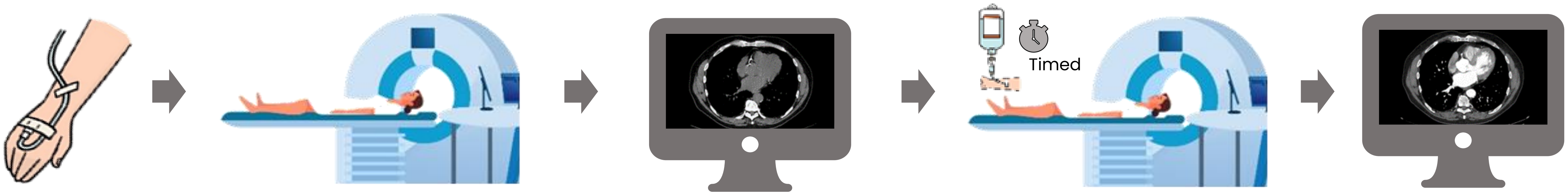


A non-contrast CT contains much information that human eyes can't see.

~**60% of CT scans** have intravenous iodinated radiocontrast media (**RCM**) injection to obtain **Contrast-Enhanced CT scans**

Conventional Patient Journey for a Contrast Enhanced CT

Needle IV line → **1st scan no injection** → **Non-Contrast CT** → **2nd scan contrast injection** → **Contrast CT**



Problems associated with the intravenous injection of contrast agent

Needle ('Drip') insertion-related complications:

- Pain and discomfort
- Bleeding, haematoma
- Contrast leakage out of the drip: skin necrosis
- Injury of the nearby artery: pseudoaneurysm, ischaemia

Contrast related complications:

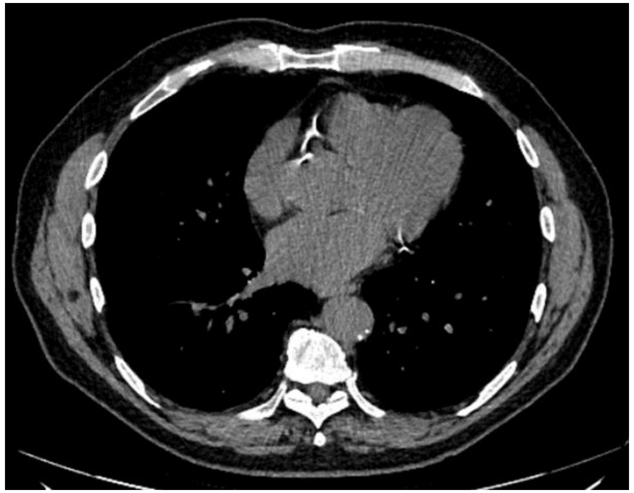
- Contrast allergy / anaphylactoid reactions
- Kidney toxicity:
  - contrast-induced nephropathy
  - renal failure requiring dialysis/death (rare but devastating)

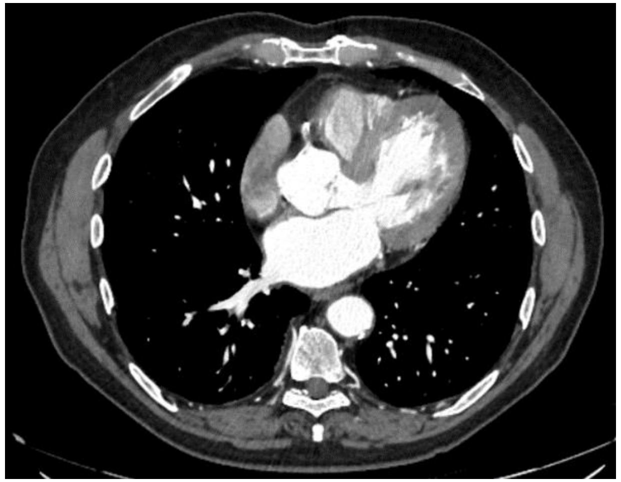
Cost of service provision:

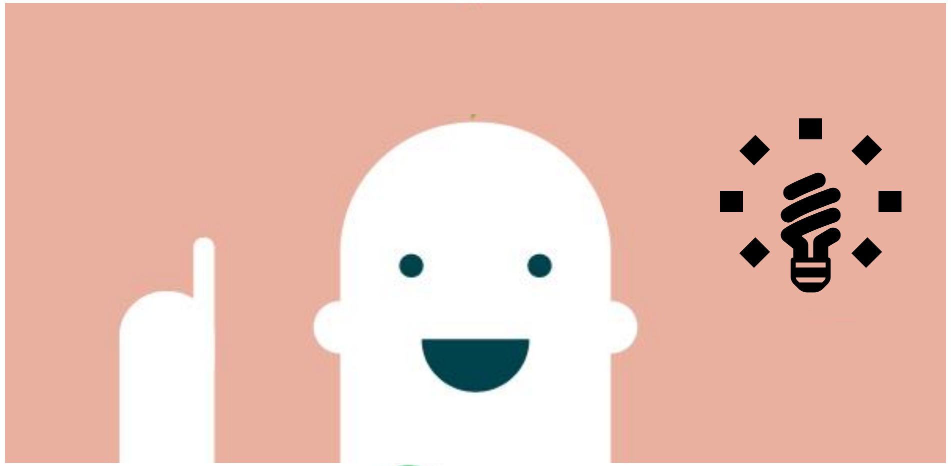
Contrast agent, longer scan, management of complications

Lack of supply chain resilience

What if we could generate contrast enhanced CT images without the need to inject intravenous contrast?







ANNALS OF SURGERY

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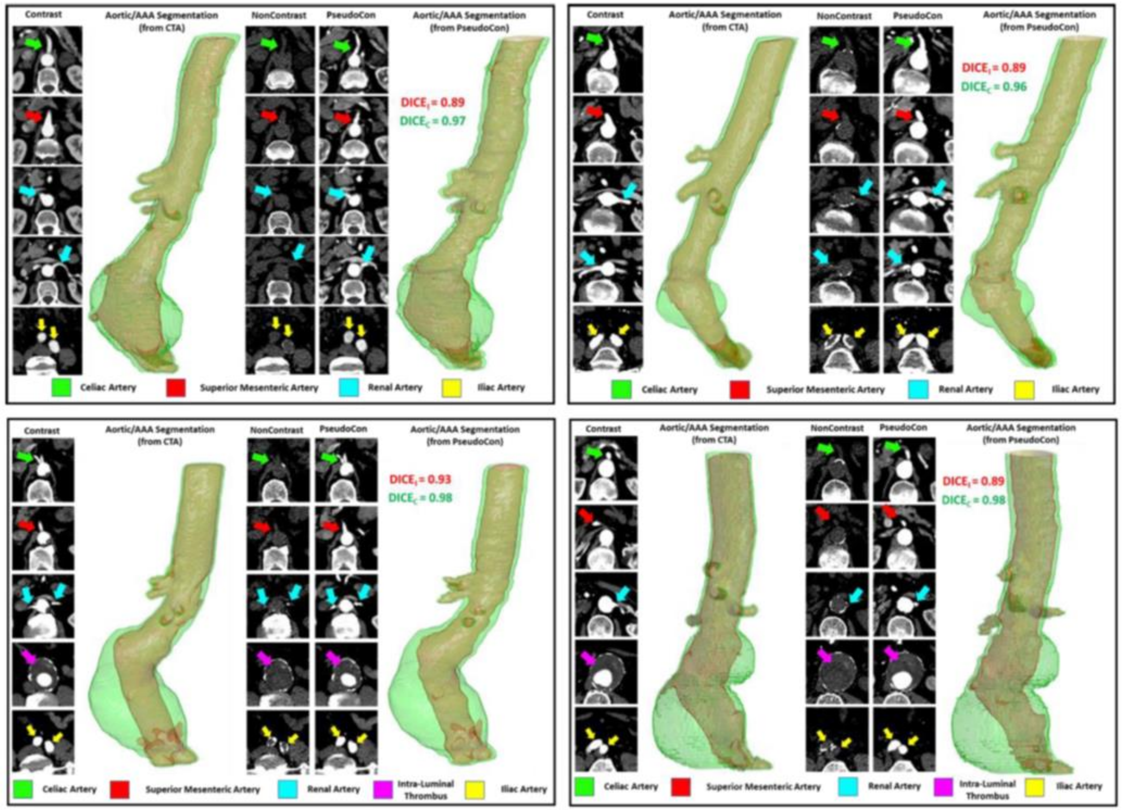
ORIGINAL ARTICLE: PDF ONLY

A Deep Learning Approach to Visualise Aortic Aneurysm Morphology without the Use of Intravenous Contrast Agents

Chandrashekar, Anirudh BE[*,‡]; Handa, Ashok MBBS, FRCS, MA[*,†]; Lapolla, Pierfrancesco[*]; Shivakumar, Natesh BSc, MBChB[*]; Uberoi, Raman MBBChir, MRCP, FRCR[‡]; Grau, Vicente PhD[§]; Lee, **Regent** MBBS MS, DPhil, FRCS[*,†]

Author Information

Annals of Surgery: March 04, 2021 - Volume - Issue -
doi: 10.1097/SLA.0000000000004835

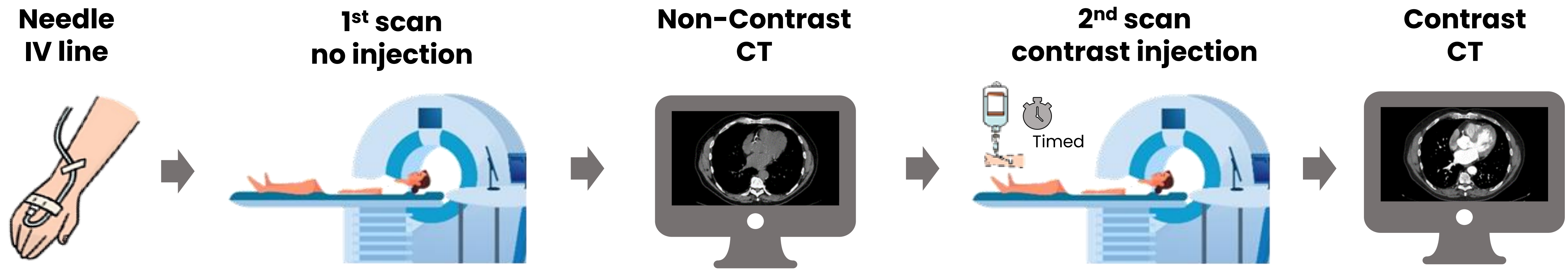


4. WO/2021/038202 COMPUTERISED TOMOGRAPHY IMAGE PROCESSING — WO - 04.03.2021

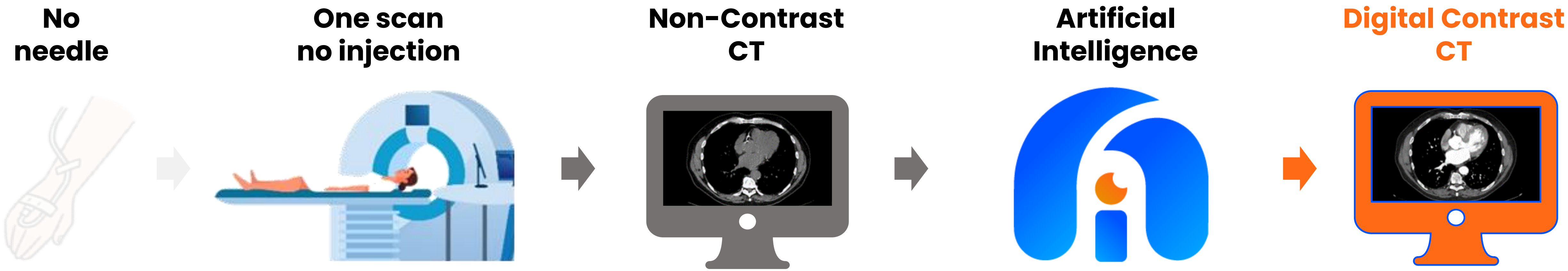
Int.Class G06T 7/00 **Appl.No** PCT/GB2020/052013 **Applicant** OXFORD UNIVERSITY INNOVATION LIMITED **Inventor** LEE, Regent

Methods for training an algorithm to identify structural anatomical features, for example of a blood vessel, in a non-contrast computed tomography (NCT) image are described herein. The algorithm may comprise an image segmentation algorithm, a random forest classifier, or a generative adversarial network in examples described herein. In one embodiment, a method comprises receiving a labelled training set for a machine learning image segmentation algorithm. The labelled training set comprising a plurality of NCT images, each NCT image of the plurality of NCT images showing a targeted region of a subject, the targeted region including at least one blood vessel. The labelled training set further comprises a corresponding plurality of segmentation masks, each segmentation mask labelling at least one structural feature of a blood vessel in a corresponding NCT image of the plurality of NCT images. The method further comprises training a machine learning image segmentation algorithm, using the plurality of NCT images and the corresponding plurality of segmentation masks, to learn features of the NCT images that correspond to structural features of the blood vessels labelled in the segmentation masks, and output a trained image segmentation model. The method further comprises outputting the trained image segmentation model usable for identifying structural features of a blood vessel in an NCT image. Further methods are described herein for identifying anatomical features from an NCT image, and for establishing training sets. Computing apparatuses and computer readable media are also described herein.

Conventional Patient Journey for a Contrast Enhanced CT



Patient Journey for a ‘CT Digital Contrast’



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THE LANCET
Digital Health

Editorial

Curbing the carbon footprint of health care

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Technology and innovation is a key theme of the 2023 UN Climate Change Conference, COP28, hoping to catalyse the development and deployment of climate solutions to drive down global temperatures and protect human health. The health-care sector contributes approximately 4·6% to global greenhouse gas (GHG) emissions. Will wider adoption of digital health technologies help mitigate this issue, or exacerbate it?

Around 1% of global GHG emissions is attributable to medical imaging, which is both resource-intensive and energy-intensive. Artificial intelligence (AI) applications in medical imaging have been transformative, from assisting breast cancer screening to computer-aided detection for tuberculosis, but there are concerns that AI

detected during colonoscopy should be resected and, if so, whether they should be retrieved for histopathological examination. Reducing the number of unnecessary resections and biopsies can further reduce the health-care sector's GHG emissions.

Reducing the number of in-person consultations is another effective means of lowering health-care emissions. Telemedicine has become a vital tool in the path towards more sustainable health care by reducing the need for patient and provider travel. Availability of virtual consultations has been shown to reduce GHG emissions of health-care systems, and is also associated with lower physician burnout, which might consequently improve the quality of patient care.

alengo/Getty Images

For more on **COP28** see https://www.cop28.com/en/

For the **2023 report of the *Lancet* Countdown** see **Countdown** 2023; published online Nov 14. https://doi.org/10.1016/S0140-6736(23)01859-7

For more on the **carbon costs of medical imaging** see J Clin Med 2023; 12: 215

For more on the **carbon**

Contrast CT and environmental impact

Over **180 million** contrast CT scans performed globally per year generating combined sizable carbon footprints

Single use packaging	Needle (steel)	Plastic waste	Energy consumption	Iodine in wastewater
42,000 tons	**900** tons	**90,000** tons	**150,000,000** kWh	**200,000** tons

Average CO_2 emission per CT scan is 9.2kg*!

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Source: Lancet Regional Health July 2022

Digital Contrast – Towards Sustainable and Climate Neutral Health Systems

With a target of reducing 30% of contrast CT scans

Digital Contrast can reduce CO_2 emission, per year

EU 300,000 tons
Global 6-900,000 tons
(↓ global iodine wastewater contamination by **70,000 tons**)

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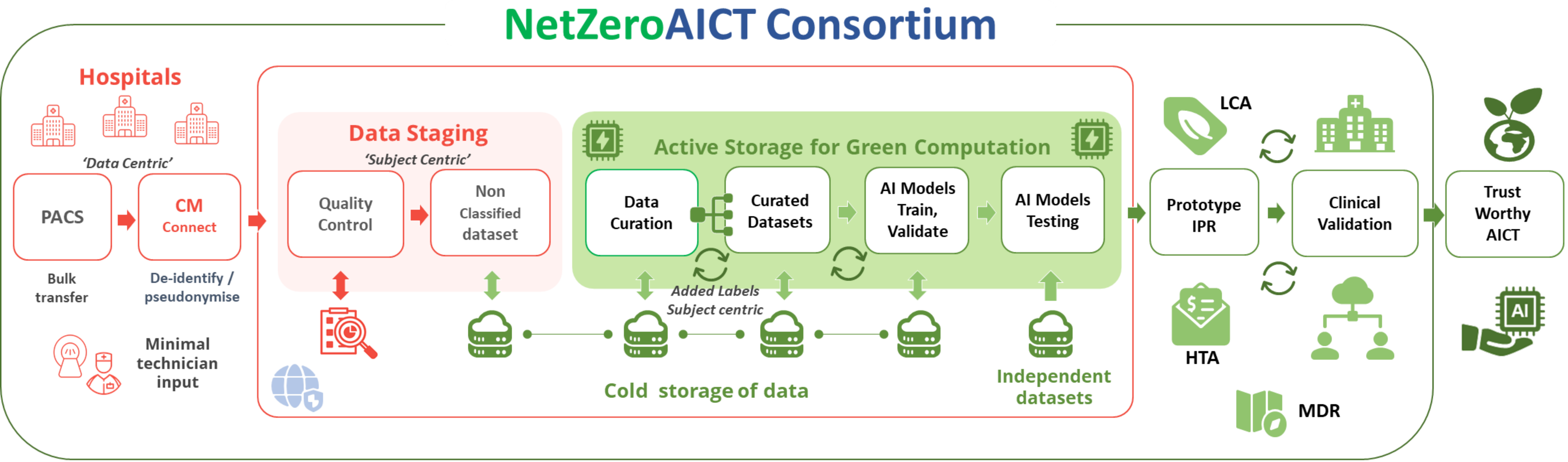

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- Legal Framework / GDPR
- Ethics / IRB approval
- Stakeholder involvement

Trustworthiness as a core mission

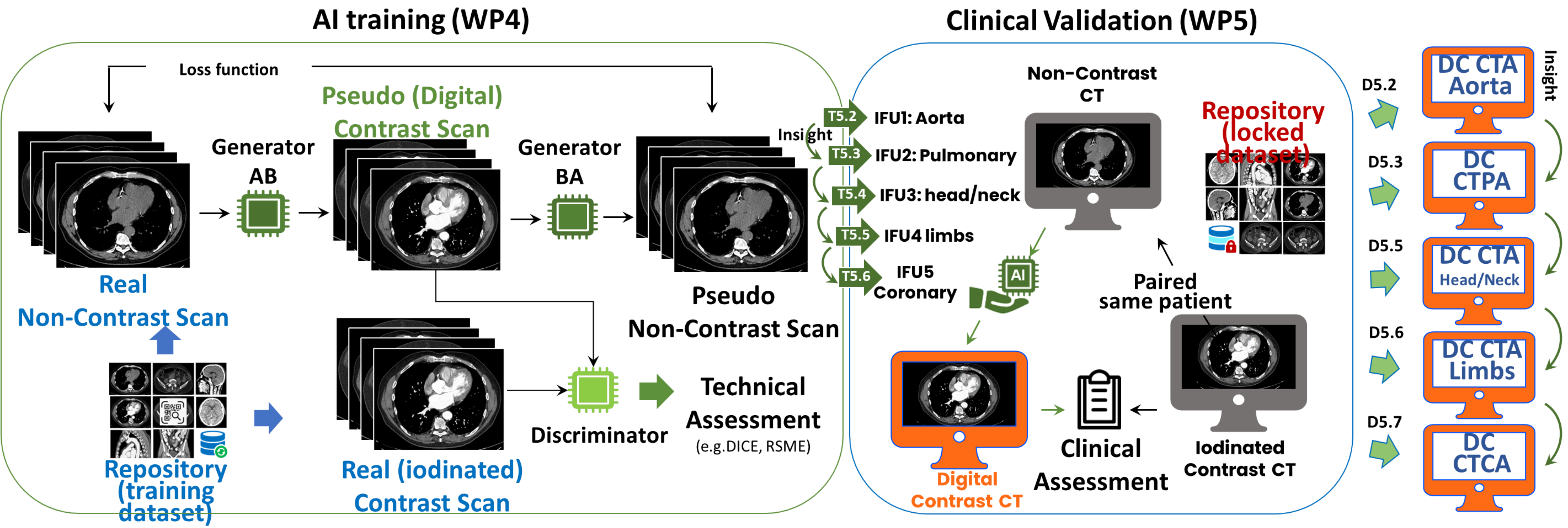
The most diverse dataset in a centralised CT Scan repository

(>1 million scans, 3 continents)

Pseudonymised scans
‘unsorted’

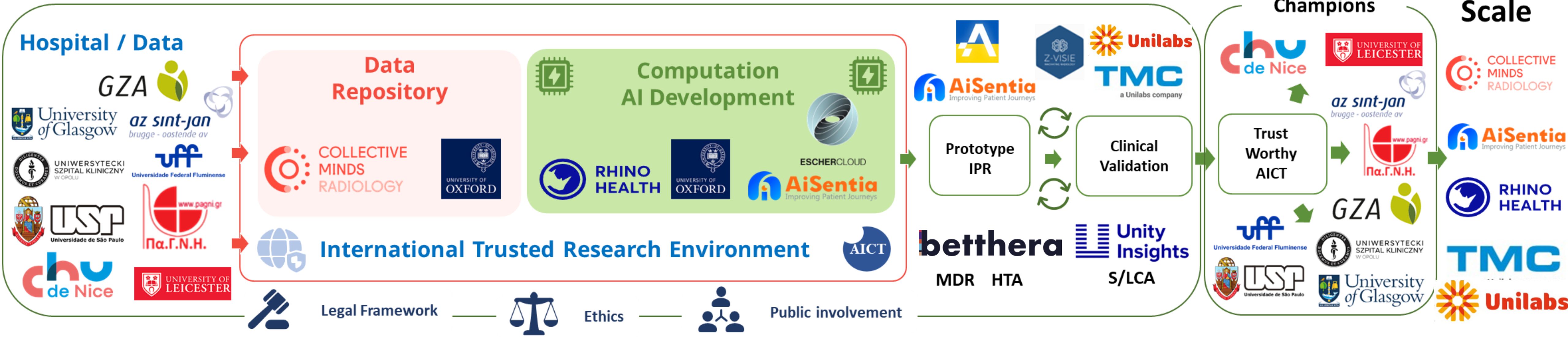
curated, catalogued, ‘research ready’

Train and validate CT angiogram applications



IFU = Indication for use

NetZeroAICT Value Chain



NetZeroAICT Consortium

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Improving Patient Journeys

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