

Project Title

Leveraging Endeavour AI to Eliminate Redundant CT Studies Performed

Project Lead and Members

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Organisation(s) Involved

National University Hospital

Healthcare Family Group(s) Involved in this Project

Allied Health

Applicable Specialty or Discipline

Diagnostic Radiography

Aims

1. To develop a code-based solution using the Endeavor AI (EAI) platform which can identify potential redundant CT requests on large volume data of incoming out patient CT requests.
2. To evaluate the accuracy and time saved using the code-based solution vs the existing process of vetting by radiographers & radiologists within the department.

Background

Redundant CT studies are a significant issue due to the fragmented specialized care patients receive, often leading to overlapping imaging studies by multiple specialists. The existing vetting process for CT scans is time-consuming, requiring manual checks by radiographers and radiologists.

Methods

1. Development of a rule-based code solution using the Endeavor AI platform (EAI) and TIBCO Spotfire software for real-time data analytics.
2. Integration of patient data from electronic health records (EHR) into the platform to create a dashboard solution that highlights redundant CT examinations.
3. Rule-based criteria for identifying redundancy tailored to different types of CT scans (e.g., CT Brain, CT Liver).
4. Automated identification of potential duplicate studies and visual assessment for clarification and prevention.

Results

1. Sensitivity and specificity improvements in the solution:
 - Version 1: Sensitivity 0.78, Specificity 0.98
 - Version 2: Sensitivity 0.91, Specificity 0.95
2. Positive Predictive Value (PPV) and Negative Predictive Value (NPV) outcomes:
 - Version 1: PPV 0.42, NPV 0.99
 - Version 2: PPV 0.18, NPV 0.99
3. Average of 87 CT request forms checked daily, with 8 highlighted for clarification.
4. 90% reduction in effort and time spent on vetting processes.
5. Implementation of the solution has led to reduced redundant CT scans, saving machine utilization time, scan slots, and staff manpower.

Lesson Learnt

Key lessons include the importance of interdisciplinary collaboration, the need for flexibility in solution development, and the value of ongoing stakeholder engagement. Challenges in data integration and code development highlighted the need for adaptable strategies and the potential for broader applications beyond radiology.

1. Customizable criteria for redundancy detection to meet department needs.
2. Scalability of the solution to include cross-modality redundancy (e.g., MRI, ultrasound).
3. Integration of additional EHR data for comprehensive scan vetting (e.g., renal function, pacemaker, metallic implants).

Additional Information

National Healthcare Innovation & Productivity (NHIP) 2024 – Best Practice (Automation, IT and Robotics category)

Conclusion

The Endeavour AI-based solution for eliminating redundant CT studies has demonstrated significant improvements in efficiency and accuracy. It provides a scalable and customizable approach to managing imaging requests, with potential applications across other imaging modalities. The implementation has led to substantial time and cost savings, improving the overall quality of care.

Project Category

Technology

Digital Health, Data Analytics, Artificial Intelligence

Keywords

Endeavour AI, Redundant CT Studies, Diagnostic Imaging, Healthcare Technology, Radiology, Efficiency

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LEVERAGING ENDEAVOUR AI TO ELIMINATE REDUNDANT CT STUDIES PERFORMED

A modern solution to reduce redundant CT studies performed in our institution

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BACKGROUND

Redundant CT examinations are an elephant in the room.

- A large contributor is the fragmented specialized care of our patients.
- Patients are often seen by multiple specialists who may order imaging studies with overlapping coverage and diagnostic ability thus creating redundancy.
- Scan requests are often not consolidated when patients are seen by different teams in the inpatient and outpatient settings.

An audit within our institution conducted over a 20-month period revealed up to 211 redundant CT examinations.

Performing redundant CTs results in:

1. Unnecessary cost and radiation to the patient
2. Machine utilization time and wasted scan slots
3. Waste of staff manpower to perform and interpret these scans.

DEVELOPING THE SOLUTION

- Endeavor AI platform (EAI) houses the TIBCO Spotfire software which allows real time data analytics.
- Patient data within the electronic health records (EHR) is streamed into the platform which allowed us to code a dashboard solution which visually highlights redundant CT examinations.
- Rule-based codes were written with varying criteria for each type of CT scan, for e.g. the redundancy criteria for CT Brain and CT Liver are different.
- By importing the scheduled lists of examinations from EHR, the dashboard solution instantaneously performs the rule-based identification of potential duplicate studies and provides a quick visual assessment of redundant CT requests.
- The department can then clarify the need of these studies and prevent them from happening thus saving scan slots, and patient dose and money.

EXISTING VETTING PROCESS

Outpatient setting

List of scheduled CT scans & all individual scan request forms are printed

Suitability for CT scan checks:

1. Checking of last performed CT scan date and scan type
2. Protocolling of the scan requests
3. Checking of latest renal function & other risk factors: asthma, drug allergies

Troubleshooting:

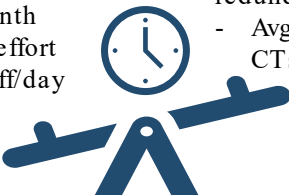
1. Clarification of redundant CT scan requests & cancellation
2. Prescription of appropriate pre-medication OR patient counselling
3. Request forms are individually signed off

Total time elapsed:
Avg. 2 hrs/day
Radiographer time

Total time elapsed:
Avg. 1 hr/day
Radiologist time

Manual checking of avg. of 2100 CT requests/month
- Opportunity cost of effort and time spent by staff/day

0.5% incidence of redundant CT requests
- Avg. of 11 redundant CT scans/month

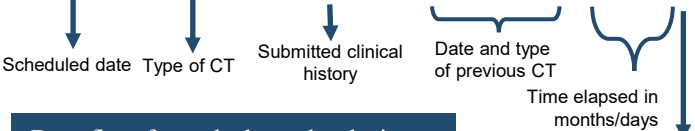


AIM

1. To develop a code-based solution using the Endeavor AI (EAI) platform which can identify potential redundant CT requests on large volume data of incoming outpatient CT requests.
2. To evaluate the accuracy and time saved using the code-based solution vs the existing process of vetting by radiographers & radiologists within the department.

THE SOLUTION SHOWCASE

Name	Appt	Investigation_name	reason_for_investi	examinati...	Investigation_imported	Mon...	Days...	Pote
TJ	6/28/2023	CT Thorax Abdomen and Pel...	Dysphagia for ix TRO malignancy	5/11/2023	CT Thorax Abdomen an...	1.58	48.09	YES
AI	6/28/2023	CT Thorax Abdomen and Pel...	Met lung cancer on ETOP trial, also on vorico...	5/17/2023	CT Thorax Abdomen an...	1.38	42.09	YES
QI	6/28/2023	CT Abdomen and Pelvis	Fever for investigation, left sided abdo pain T...	5/10/2023	CT Abdomen and Pelvis	1.61	49.23	YES
FC	6/28/2023	CT Urography	gross haematuria b/g RCC	5/30/2023	CT Urography	0.97	29.26	YES
W.	6/28/2023	CT Thorax Abdomen and Pel...	met's hilar cholangiocCA on cis/T51 trial, for d...	5/17/2023	CT Thorax Abdomen an...	1.38	41.96	YES
W.	6/28/2023	CT Abdomen and Pelvis	to rule out abscess/infection/for prognosis	6/12/2023	CT Thorax Abdomen an...	0.53	16.20	YES
W.	6/28/2023	CT Abdomen and Pelvis	uprending Bili; and ALP04 TRO biliary obstru...	6/23/2023	CT Thorax Abdomen an...	0.17	5.27	YES
LII	6/28/2023	CT Thorax Abdomen and Pel...	Abdo pain tro PO peritonitis with collection, b...	5/16/2023	CT Abdomen and Pelvis	1.42	43.00	YES
NI	6/28/2023	CT Thorax Abdomen and Pel...	met NSCLC	5/15/2023	CT Thorax Abdomen an...	0.43	13.07	YES
KC...	6/29/2023	CT Brain	vertiginous giddness with headache/neckpal...	4/30/2023	CT Brain	1.93	59.05	YES



Benefits of a code-based solution:

- Customizable to department needs and demands
- Criteria for redundancy can be modified easily
- Scalability to include cross modality redundancy
- Include other important EHR data for scans including renal function, pacemaker, metallic implants

RESULTS:
DOES THE SOLUTION WORK?

SOLUTION VS EXISTING PROCESS	Solution ver 1.	Solution ver. 2
Sensitivity	0.78	0.91
Specificity	0.98	0.95
Positive Predictive Value (PPV)	0.42	0.18
Negative Predictive Value (NPV)	0.99	0.99

90% reduction in effort and time

Avg. of 87 CT request forms for checking/day

Avg. of 8 highlighted CT request forms for clarification/day

CONCLUSION & APPLICATION

- Feedback from ground users and department heads was that the solution provides an acceptable level of sensitivity for daily use.
- Currently deployed in outpatient CT setting.

Similar solution is being developed for MRI vetting which can also detect metal implants/pacemakers.

Cross modality model/dashboard is being developed for US to mitigate redundant US examinations