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Silent Deployment of a Machine Learning Algorithm for Managing Real-World Head and Neck Surgical Oncology Referrals

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Introduction

- In the standard manual referral process, otolaryngology patients endure long wait times of >40 days for a new patient appointment.[1]
- Call centers have emerged to shorten patient wait times, but operators rely on complicated decision trees, leading to clinical errors of up to 56% of referrals being triaged inappropriately.[2]
- Head and neck cancer patients require both efficient and accurate triage with treatment delays worsening outcomes for cancer patients.[3]
- Machine learning is an emerging technology in clinical practice that may improve the efficiency of patient referral management.[4]

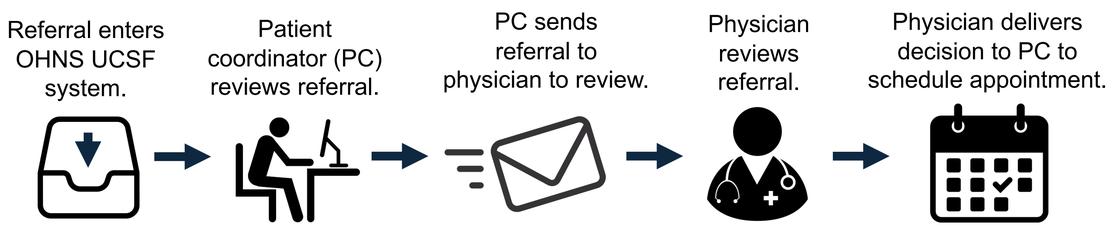
Objectives

- Silently pilot, deploy, and evaluate the efficacy of a triage machine learning algorithm at an academic head and neck cancer center
- Identify inefficiencies in the manual triage process that may be alleviated through a machine learning model triage assistant

Methods

- Surveys were distributed to practice coordinators and physicians to evaluate inefficiencies in current manual referral processing, using tools such as Likert-scale questionnaires.
- Between 12/10/2024-2/6/2025, 225 patients were referred to the UCSF Otolaryngology-Head and Neck Surgical Oncology Center.
- Patient clinical data were collected, including the initial referral packet, administrative communications, and all final clinical notes, imaging reports, and pathology reports.
  - Etiologies included suspected non-endocrine malignancies, benign lesions, and non-cancerous thyroid, salivary gland, and parathyroid pathologies.
- Referral packets were input into a deep learning algorithm (IIAM Corporation, San Francisco, CA) to triage and analyze referrals.

Figure 1. Workflow of manual referral process



Time to referral triage reflects time from when the referral enters the UCSF Otolaryngology-Head and Neck Surgical Oncology (OHNS) system to when the physician delivers a decision for a patient to schedule an appointment.

Results

Table 1. Patient Coordinator and Physician Survey Responses

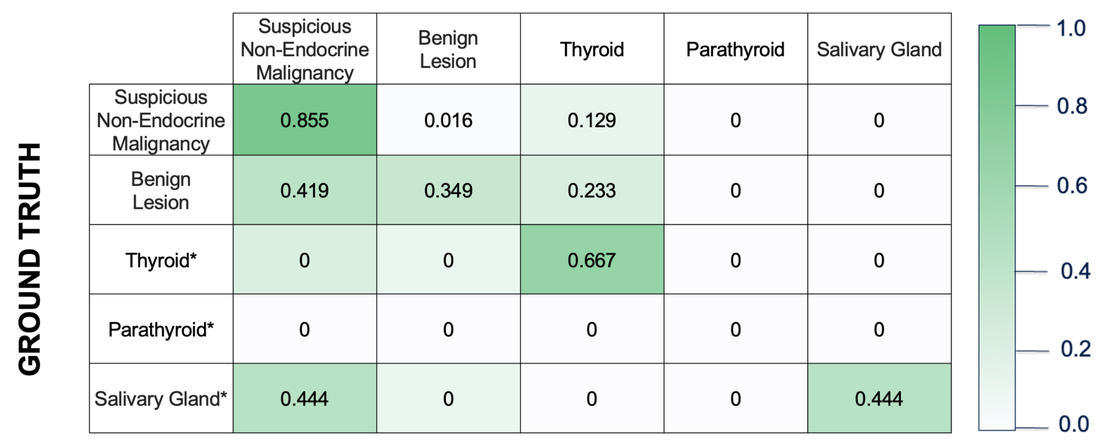
Parameter	Value (Mean ± SD or N(%))
Patient Coordinator Responses	2 (100.0%)
Physician Responses	6 (100.0%)
Patient Coordinator Responses	
Referrals processed per week	30.0 ± 0
Physician referral clarifications per week	15.0 ± 14.1
Physician response times (business days)	2.0 ± 1.4
Average burn out 1= not at all burnt out; 5= completely burnt out	3.0 ± 1.4
Physician Responses	
Average confidence regarding referral triage by patient coordinator 1= not at all confident; 5 = confident	2.8 ± 1.3
Average confidence regarding referral triage by call center 1= not at all confident; 5 = confident	1.8 ± 0.8
Average confidence regarding referral triage by patient self-schedule 1= not at all confident; 5 = confident	1.7 ± 0.8

Results Continued

Table 2. Patient Demographics and Referral Characteristics

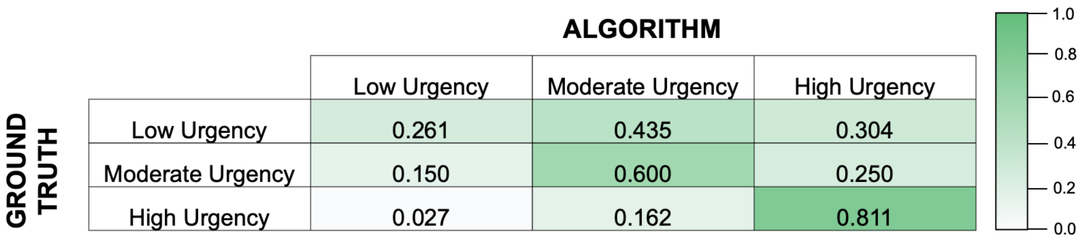
Parameter	Value (Mean ± SD or N(%))
Age	57.9 ± 18.2
Female	105 (49.1%)
Male	109 (50.9%)
Disease Etiology Documented on Referral	
Suspected Non-Endocrine Malignancy	117 (54.6%)
Benign Lesion	53 (24.8%)
Thyroid	35 (16.4%)
Salivary Gland	5 (2.3%)
Parathyroid	4 (1.9%)
Time	
Days from Referral Initiation to Referral Triage	3.7 ± 6.8
Days from Referral Resolution to Appointment	19.3 ± 18.8
Report Available on Referral	
Clinical Note	206 (96.3%)
Imaging	129 (60.3%)
Pathology	82 (38.3%)
Referral Processing Characteristics	
Required clarification from physician or APP	154 (72.0%)
Required additional documents from referring provider	22 (10.3%)
Inappropriate for head and neck cancer	11 (5.1%)

Figure 2. Confusion matrix for deep-learning algorithm disease etiology predictions versus ground truth



Based on final pathology reports, 85.5% (105/123) of suspicious non-endocrine malignancies were correctly flagged by the algorithm.

Figure 3. Confusion matrix for ground truth referral urgency results and algorithm referral urgency predictions



Based on independent physician assessment of final pathology reports, 81.1% (100/123) of high urgency lesions were correctly flagged by the algorithm.

Discussion

- The manual referral process took ~3.7 days to triage a referral packet, while the algorithm took <60 seconds to triage the same referral.
- Long referral processing times, a high proportion of referrals requiring physician review, and reports of patient coordinator burnout highlight the need for additional referral support.
- Given the algorithm's high accuracy in detecting suspicious non-endocrine malignancies and high-urgency lesions, a machine learning assistant could help flag urgent cases and reduce the coordinator's workload and increase productivity throughput.

Conclusion

- The algorithm was significantly faster than manual triage processes and demonstrated high accuracy in triaging high-urgency referrals.

References

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