Automated Auditing of Upper Endoscopy Procedure Times: A Temporal Multiclass Analysis

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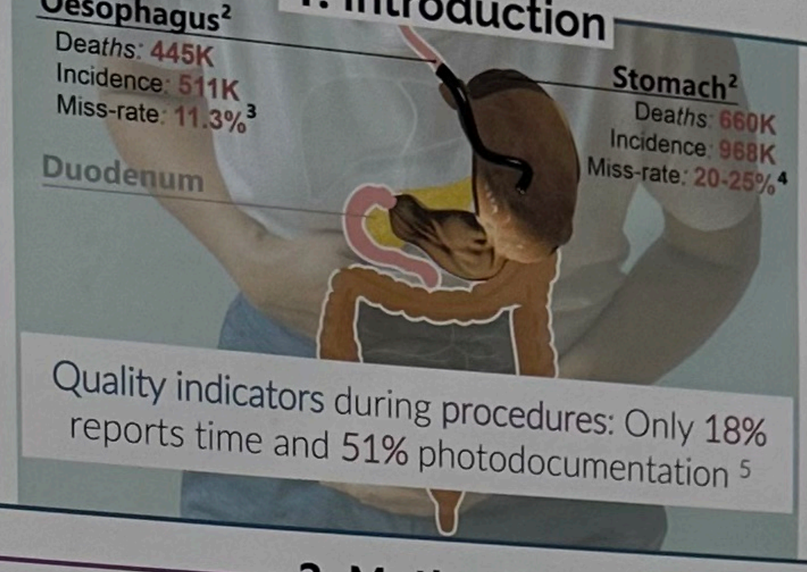
A. Clinical Motivation

Upper Endoscopy is the gold standard for early detection of upper gastrointestinal cancers, reducing their incidence and mortality by 23% [1].

High Miss-Rate of early and advanced cancers in upper GI.

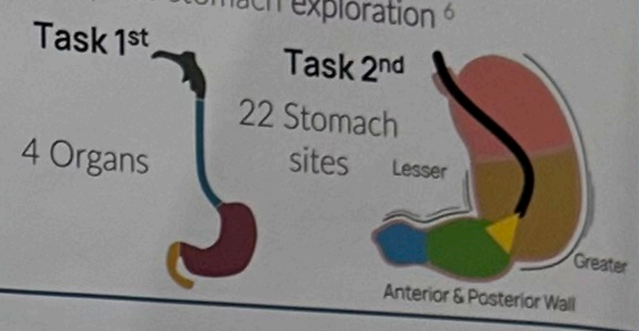
1. Introduction



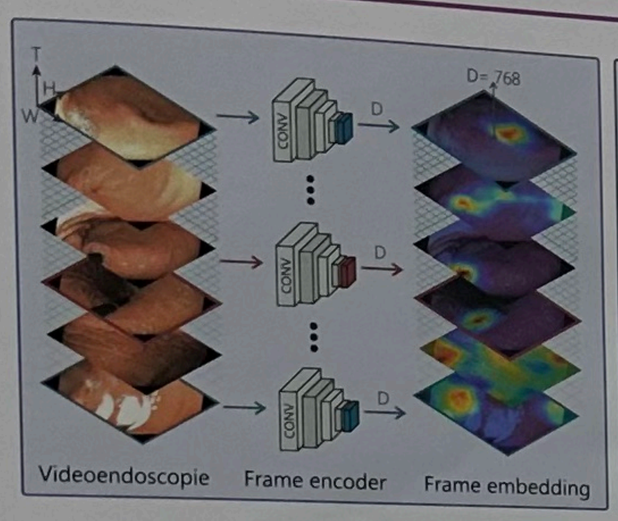
Quality indicators during procedures: Only 18% reports time and 51% photodocumentation [5]

B. Smart Endoscopy

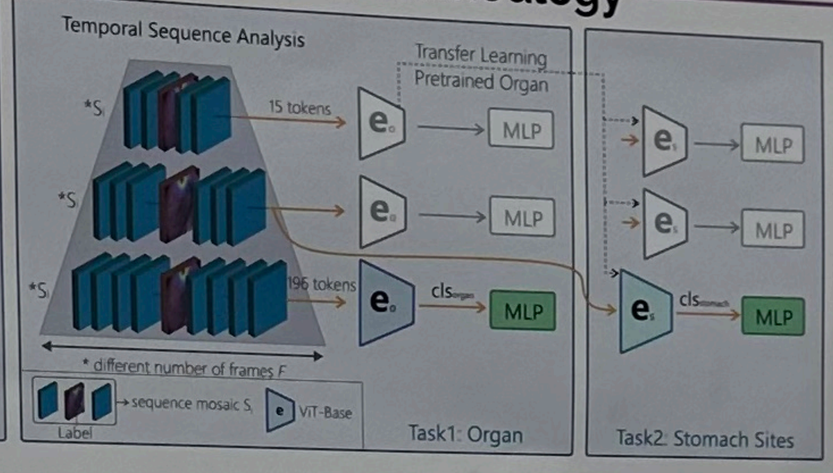
AI provides an automatic audit of Quality Indicators: minimum procedure time and complete stomach exploration [6]



2. Methodology



a) Multi-Frame Embedding



b) Temporal Attention Module

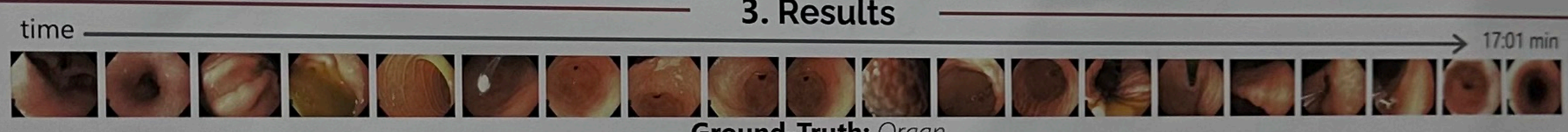
A. Parameters

CNN: Pretrained Endoscopy ConvNexT
ViT: Pretrained Vit-Base (~85.5 m)
Training: Warm-up, sequential finetuning
Temporal: Multiple windows (15 to 13 sec.)
Task: Report Quality Indicators 1st and 2nd

B. Datasets

GastroHUN: 233 videoendoscopies
Patients: 165 training (1,182M frames), 33 validation (~234K) and 35 test cases (~242K samples).

3. Results



Ground-Truth: *Organ*

Organ prediction: *Pretrained ViT temporal window 9.0 sec 1st*

Organ Classification 1st

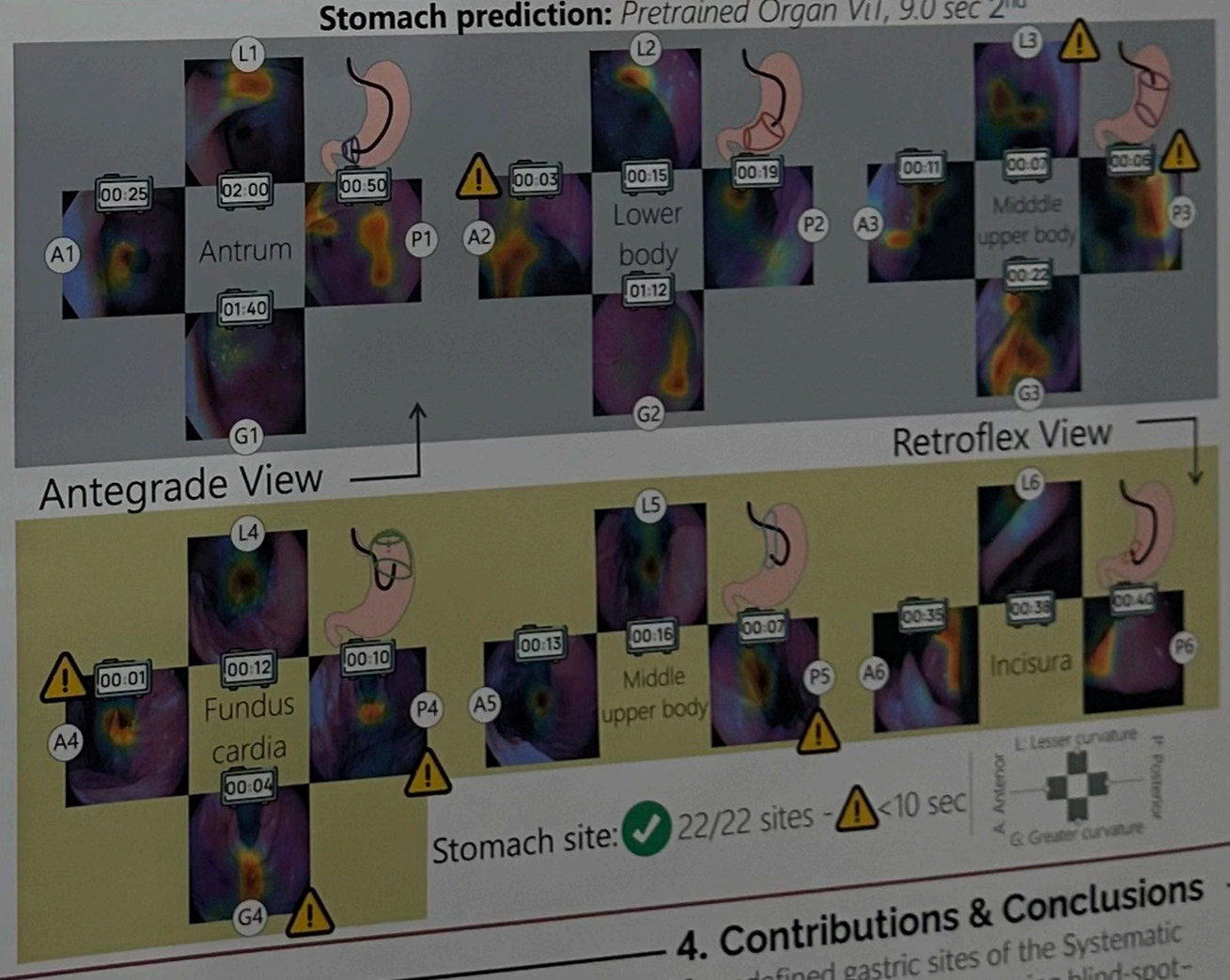
Time	Precision	F1 score	MCC
1 frame	64.55	71.98	70.38
1.0 sec	82.24	84.96	83.08
3.0 sec	89.74	89.14	87.85
5.0 sec	91.03	90.29	89.62
9.0 sec	**92.03**	**90.42**	**89.94**
13.1 sec	89.87	88.64	88.19

Integrating temporal data improves the precision and standardization of EGD quality assessment, reveals robust inter-frame correlations, and delivers consistent, expert-aligned predictions.

Stomach Classification 2nd

Time	Precision	F1 score	MCC
1.0 sec	83.38	81.62	82.45
3.0 sec	83.87	82.38	83.22
5.0 sec	86.02	84.96	86.04
7.0 sec	87.66	86.45	87.38
9.0 sec	**89.34**	**87.96**	**87.90**
10.0 sec	87.81	86.43	87.21

Stomach prediction: *Pretrained Organ ViT, 9.0 sec 2nd*



4. Contributions & Conclusions

We propose an automatic procedure-time audit covering the pharynx → duodenum 1st and 22 predefined gastric sites of the Systematic Screening Protocol for the Stomach 2nd. Sequence classification enables interpretable, time-based quality metrics. 1) Ensuring blind-spot-free inspection in upper endoscopy is key to reducing missed lesions; AI enables both procedure auditing and verification of compliance with standardized protocols. 2) Future work will involve validation in real clinical settings using our openly available platform.

References

[1] Chen R, et al. Effectiveness of one-time endoscopic screening programme in prevention of upper gastrointestinal cancer in china. Gut 2021 [2] Ferlay J, et al. Global cancer observatory: Cancer today. 2024 [3] Menon S, Trudgill N. How commonly is upper gastrointestinal cancer missed at endoscopy? A meta-analysis. Endosc Int Open 2014 [4] Kaise M. Advanced endoscopic imaging for early gastric cancer. Best Pract Res Clin Gastroenterol 2015 [5] Zagari RM, et al. Adherence to European Society of Gastrointestinal Endoscopy quality performance measures. Front Med 2022 [6] Yao K. The endoscopic diagnosis of early gastric cancer. Ann Gastroenterol 26:1