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Validation of EndoMIMYK Performance Metrics:
Correlation between Endoscopy Simulator Scores and GAGES Scores

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Introduction

Endoscopy skills for therapeutic and diagnostic procedures are essential and require a significant amount of time and hands-on training. Virtual reality simulators offer a promising way of training and evaluating these skills without patient contact. Global Assessment of Gastrointestinal Endoscopic Skills (GAGES) score is widely accepted as an objective measure of endoscopy skills.

Aim: To compare the EndoMIMYK simulator performance metrics and GAGES scores to validate the scoring mechanism of the EndoMIMYK simulator.

The study consisted of:

- Intubation
- Stomach Examination

Simulator

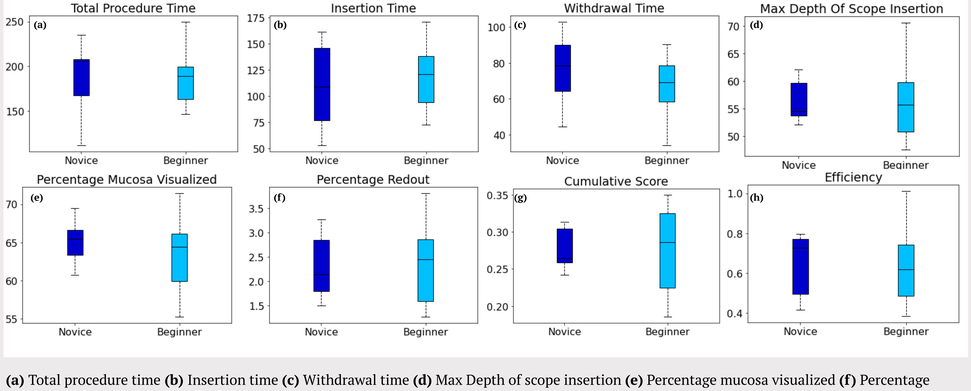
EndoMIMYK is a novel haptic simulation platform developed by Mimyk, Bangalore for the simulation of endoscopic procedures. The platform consists of a robotic patient and a simulation endoscope. The trainee performs endoscopy procedures on the robotic patient using the simulation endoscope. The simulation is rendered onto a screen that responds to the movements the trainee performs using the scope.



Statistical Analyses

The results from this study showed a non-parametric distribution. Hence, for each measured parameter, the subject groups were subjected to pairwise group comparisons using the Wilcoxon rank sum test (also called Mann-Whitney U test).
A p-value of less than 0.05 was deemed to be significant. A total of 21 doctors participated in the study which included 7 novices and 14 beginners.

Performance parameters

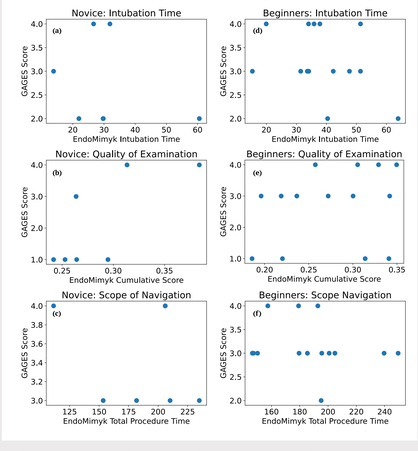


(a) Total procedure time **(b)** Insertion time **(c)** Withdrawal time **(d)** Max Depth of scope insertion **(e)** Percentage mucosa visualized **(f)** Percentage redouts **(g)** Cumulative score **(h)** Efficiency score

For novices (**dark blue**; n = 7), beginners (**sky blue**; n = 14).

For each 'box'; top, bottom and middle lines represent the 25th, 75th and 50th percentile respectively. The distance between the top and the bottom line is the interquartile range. Whiskers extend in either direction till 1.5 times the interquartile range.

Comparison of Endomimyk scores with GAGES scores



Left panel **(a, b and c)** shows the scatter plots of GAGES scores vs EndoMimyk scores for novices, while the right panel **(d, e and f)** shows scores for beginners.

Parameters	Correlation Coefficient	p-value
Intubation	-0.2668	0.5629
Scope Navigation	-0.2637	0.5675
Quality of Examination	0.7358	0.0593

Pearson correlation coefficients of corresponding GAGES scores vs EndoMimyk scores for novices.

Parameters	Correlation Coefficient	p-value
Intubation	-0.3547	0.2133
Scope Navigation	-0.1851	0.5263
Quality of Examination	0.2513	0.3859

Pearson correlation coefficients of corresponding GAGES scores vs EndoMimyk scores for Beginners.

The correlation analysis shows that GAGES 'intubation' and 'scope navigation' scores are negatively correlated with the corresponding EndoMimyk scores. This implies that when participants' 'intubation time' and 'total procedure time' decrease, GAGES 'intubation' and 'scope navigation' scores increase and vice versa.

Results

According to both simulator and GAGES scores, beginners performed marginally better than novices. Correlation coefficients for GAGES intubation score and simulator intubation time ($|r| = 0.2668$ for novices; $|r| = 0.3547$ for beginners); GAGES navigation score and simulator procedure time ($|r| = 0.2637$ for novices; $|r| = 0.1851$ for beginners); GAGES quality of examination score and simulator cumulative score ($|r| = 0.7358$ for novices; $|r| = 0.2513$ for beginners) were not statistically significant.

Conclusion

- We demonstrate that there is a correlation between the corresponding simulator and GAGES scores but because of insufficient sample sizes and class imbalance, the results are not statistically significant.
- Further validation studies with more sample sizes are needed to establish the validity of the EndoMIMYK scoring mechanism against the GAGES scale.