

Improved team communication in endoscopic procedures by digital enhanced telecommunication during the COVID-19 pandemic



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ABSTRACT

Background and study aims Unbiased communication is crucial for excellent teamwork in high-quality endoscopy. Personal protective equipment (PPE) (FFP-masks and face-shields) worn by endoscopists that are ubiquitous in the current COVID-19 pandemic strikingly impair communication. Digital enhancement approaches to maintain team communication, especially during complex endoscopic procedures, are urgently warranted.

Materials and methods A prospective, two-armed interventional study was performed at an endoscopy unit at a tertiary center in Germany. Two hundred and three endoscopic procedures with PPE se according to pandemic risk level were randomly assigned (1:1) to a group performed by an endoscopy team equipped with digital enhanced cordless telecommunication (DECT) or one without digital-enhanced communication. The primary outcome was the team-reported number of communication-associated events (CAEs) defined as misunderstandings that impaired workflow during endoscopic examination. Secondary outcomes included perceived voice and headphone quality and overall comfort with DECT during endoscopic work.

Results The use of DECT was associated with a significant reduction in communication-associated events in endoscopic procedures and overall, was perceived positively.

Conclusions Digital enhancement of communication is a promising and easy-to-establish tool for improving team communication quality in endoscopy.

Introduction

During the ongoing COVID-19 pandemic, endoscopy units and their staff are at increased risk of exposure to the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) via generation of aerosols from respiratory and gastrointestinal secretion

[1,2]. To address this risk, national and international societies have published recommendations for endoscopy units to mitigate infection risks, which include use of personal protective equipment (PPE) [3–5]. Unfortunately, both verbal and nonverbal communication are significantly impaired through use of protective masks [6–8]. Effective team work, as a part of endo-

scopic nontechnical skills (ENTS), is crucial to team performance and, ultimately, to patient outcomes [6, 9–11].

Development of new approaches to improve team communication has been accelerated by the COVID-19 pandemic in endoscopic units but is already advanced in surgical teams [12, 13]. Furthermore, with increasingly complex interventions in gastrointestinal endoscopy [14], the integration of innovative communication technologies will become even more important.

The aim of this study was to evaluate the impact of digitally enhanced team communication on endoscopic procedures in times during the COVID-19 pandemic and beyond.

Materials and methods

Study design

A prospective, randomized study was conducted at Ulm University hospital in Germany between November 2020 and January 2021. All endoscopic procedures were performed in the interdisciplinary endoscopy unit. Endoscopic procedures performed by a core team (one endoscopist and two nurses, or two endoscopists and one nurse) were enrolled. In case of hearing impairment, use of hearing aids or declined participation by team members, the respective examination was not included in the trial. Emergency endoscopies outside regular working hours were also not considered for the trial.

The study was approved by the institutional review board and ethics committee of the University of Ulm, Germany, and was registered at ClinicalTrials.gov (NCT04680858).

A table of random numbers was created (RandList, DatInf GmbH, Tuebingen, Germany) by the principal investigator. Two hundred and three endoscopic examinations were allocated (ratio 1:1) to one of the following two groups: control group in which the endoscopy team was equipped with COVID-19 protection equipment according to ESGE guideline (FFP3 face mask and face shield in case of COVID-19 positive patients) and an interventional group in which the endoscopy team was also equipped with DECT [3].

Adverse events (AEs) during examinations were recorded directly during endoscopic procedure. In any case, termination of DECT enhanced communication was possible, if necessary.

Base noise level was measured for each endoscopy room with a working Olympus Exera III processor, plugged-in endoscope, and suction pump (Medela, Switzerland) using sound level meter (Voltcraft, IEC 61672–1, Germany). A cordless DECT Duplex Headset Intercom Duo (Comhead, Germany) was used for digitally enhanced team communication. A central controller for wireless communication (Intercom Box) was installed in examination rooms. Wipe-disinfectable full duplex communication headsets with noise-cancelling microphones and individual volume adjustment were used (DW Pro2 Phone, Sennheiser, Germany) (► Fig. 1). Volume was set individually by the user. In addition, disposable mic protectors (HYM1000, 3M, the Netherlands) and single-use ear pads were used.

All endoscopic procedures were performed by experienced endoscopists and skilled nurses in a team of three. The team members changed on a weekly base according to working sche-



► **Fig. 1** a DECT Intercom Headset with FFP3 and face shield in use for COVID-19 high-risk examinations. b Digital enhanced team communication within colonoscopy, endoscopist (left front), assisting nurse (right) and sedation performed by nurse (back left). PPE with FFP2 mask, hair net, gown and gloves for moderate risk stratification. c (Left) Cordless DECT Intercom Headsets with microphones on cubic charging station, noise-cancelling microphones equipped with disposable mike protector. (Right) Controller for connected audio communication (Intercom Box)

dule. Sedation was performed by either an additional physician or a nurse skilled in administration of propofol sedation. Sedation of patients was performed using propofol according to the S3 guideline [15]. Demographic data from the teams, including age, professional experience, and gender, were collected. Single-use PPE was utilized in accordance with current consensus recommendations [3–5].

Data on type of examination and performed procedure, PPE, examination time, ASA-state, communication-associated events, rating of communication (NRS 0–10, 0=very poor, 10=very good), quantity of propofol used, and AEs and severe AEs were recorded.

The subjective grade of communication comfort during endoscopic work was assessed using a questionnaire administered to the participating endoscopists and nurses. Wearing comfort, voice quality, headphone quality, and overall impression were recorded (rated from 1=very good to 6=very poor).

The primary endpoint was the number of communication-associated events (CAE) during endoscopic procedure. CAE's were defined as follows: 1) acoustic misunderstanding which made a further explanation of the instruction necessary; 2) acoustic misunderstanding which leads to the wrong tool being handed to the endoscopist; 3) instruction not heard by the team, which must then be repeated; 4) instruction to which no response is given at all. CAE's were noted by a DECT-equipped study nurse with appropriate PPE who was not involved in endoscopic procedures.

Secondary endpoints included duration of examination, rate of AEs, severe AEs during endoscopic procedures, and subjec-

► **Table 1** Examination characteristics, patient risk stratification, and type of protective equipment.

Characteristics	Standard (n = 100)	With headset (n = 103)	P value
Gastroscopy			0.272
▪ Diagnostic	29	33	
▪ Therapeutic	16	8	
Colonoscopy			0.627
▪ Diagnostic	16	17	
▪ Therapeutic	16	13	
EUS			0.282
▪ Diagnostic	11	9	
▪ Therapeutic	3	8	
ERCP	9	15	0.573
Face mask			0.718
▪ FFP 2 (COVID-19 unclear/low risk)	96	100	
▪ FFP 3 + shield (COVID-19 positive/high risk)	4	3	
ASA			0.421
▪ I	16	9	
▪ II	57	65	
▪ III	24	27	
▪ IV	3	2	
Propofol, mg, mean±SD	177.6 ± 68.8	179.8 ± 71.9	0.789
Examination time, min, mean±SD	35.1 ± 23.4	34.0 ± 26.2	0.320

EUS, endoscopic ultrasound; ERCP, endoscopic retrograde cholangiopancreatography; FFP, filtering face piece; FFP3, filtering face piece plus shield worn in case of proven or highly suspected COVID-19 infection; ASA, American Society of Anesthesiologists.

tively perceived comfort of team members with DECT devices during procedures.

Based upon experience from internal quality control data, an average of 1.8 communication-associated events is observed per endoscopic examination during the COVID-19 pandemic. The rate of communication-associated events with DECT was expected to be reduced from 1.8 to 1.0. Thus, a sample size of 98 examinations in each group was calculated for a statistical power of 80% at a two-tailed significance level of 0.05. To compensate potential dropouts, a total sample size of 210 was determined. Statistical analysis was performed using SPSS Statistics 21 (IBM, USA). Chi-squared test, Fisher's exact test, Mann-Whitney U test, and correlation analysis were used wherever applicable. $P < 0.05$ indicated statistical significance.

Results

Overall, 203 eligible procedures were included in the study and randomized 1:1 to one of the two study groups (103 with DECT, 100 without DECT). Seven procedures were excluded because of technical defect (1) or altered core team composition (6).

Average baseline noise level for each examination room and room size are summarized in **Table S2**.

Examination characteristics are shown in ► **Table 1** and **Table S1**. No significant differences were found between the patients and procedures in the study group and control group in terms of ASA state ($P = 0.421$), type of examination and procedure performed ($P = 0.573$) and type of protective equipment ($P = 0.718$). In general, FFP3 face masks and face shields were only used for examinations of patients confirmed or highly likely to be COVID-19-positive (in total 7 endoscopic examinations, ► **Table 1**).

Ten endoscopists and 13 nurses participated in the study. Demographic data and work experience are summarized in ► **Table 2**.

Considering the primary endpoint, the occurrence of communication-associated events in total (184 vs. 66; $P < 0.001$) and per examination (0.6 ± 1.0 vs. 1.7 ± 1.8 ; $P < 0.001$) was significantly reduced using DECT devices (► **Table 3** and ► **Fig. 2**).

Furthermore, the different types of communication-associated events (need for repetitive request, delivery of the wrong tool, no answer after being verbally addressed) occurred

► **Table 2** Demographic characteristics and work experience of endoscopists and nurses.

Team characteristic	Endoscopist (n = 10)	Nurse (n = 13)	P value
Age, years, mean±SD	42.2±7.1	43.3±11.8	0.585
Age (range), years	33–55	26–62	
Experience (mean±SD), years	11.7±8.5	8.7±8.6	0.487
Experience (range), years	1–25	1–30	
Sex, n (%)			<0.001
▪ Male	9 (90)	1 (8)	
▪ Female	1 (10)	12 (92)	

SD, standard deviation.

► **Table 3** Communication-associated events and rating of communication.

Variable	Standard (n = 100)	With Headset (n = 103)	P value
Communication-associated events (total)	184	66	<0.001
▪ Demand	151	59	<0.001
▪ Wrong tool	22	6	<0.001
▪ No response	11	1	<0.001
Communication-associated events per examination, mean±SD	1.7±1.8	0.6±1.0	<0.001
Communication-associated events per minute, mean±SD	0.07±0.11	0.02±0.05	<0.001
Rating of communication, mean±SD	5.2±1.8	8.6±1.2	<0.001

SD, standard deviation.

significantly more frequent in the standard communication group (► **Table 3**).

Communication quality was rated significantly better in the DECT group (5.2±1.8 vs. 8.6±1.2; $P<0.001$) (► **Fig. 2** and ► **Table 3**).

However, there was no significant difference regarding the time of examination, propofol per examination, and occurrence of serious AEs. In total, only one serious AE was observed with no relation to the study conduct. Primary and secondary outcomes are summarized in ► **Table 1**, ► **Table 3**, and **Table S1**.

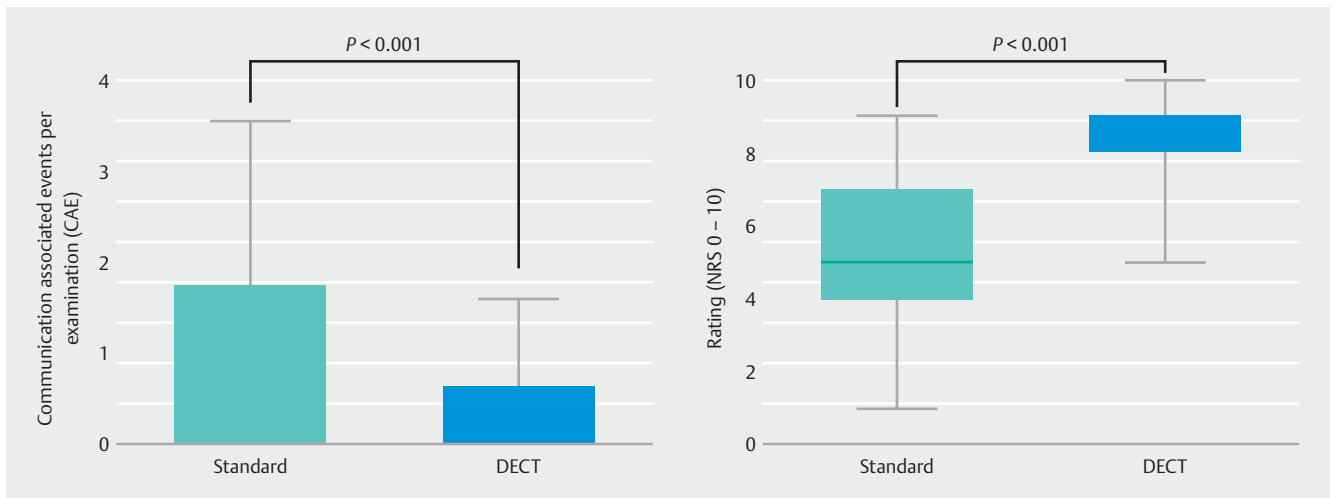
Speech and hearing quality, comfort, and overall satisfaction with DECT devices were positively rated by nurses and endoscopists. The results of the questionnaire are summarized in ► **Table 4** and **Table S3**.

Discussion

The present study demonstrates a positive impact of digitally enhanced communication on team communication during endoscopic procedures. According to our data, a lower rate of communication issues and a high level of contentedness with team communication using DECT communication was reported.

Although optimal team communication might be affected by multiple factors, it is closely associated with high-quality acoustics. In our study, digitally enhanced communication was effective in improving team communication. Given the fact that standard acoustic interaction is impaired by PPE in addition to background noise in the endoscopy unit, digital communication support is a potentially modifiable factor that can impact the quality of team communication not only during the COVID-19 pandemic. Especially challenging procedures in gastrointestinal endoscopy might benefit from enhanced communication regarding the development of increasingly complex intervention techniques [14]. Nevertheless, the multifactor genesis of impaired team communication must be stated: In addition to optimal acoustic conditions, human factors must be taken into consideration and further improvement in team communication may be achieved with structured communication training. Furthermore, the use of DECT device comes with its own challenges: Technical difficulties and loss of time due to necessary habituation period hamper improved work flow in endoscopy at the beginning.

Potential further future and post-COVID-19 applications might be the integration of a nurse outside the examination room to supply missing tools or an even closer connection in terms of education in endoscopy. Limitations on routine appli-



► **Fig. 2** (Left) Communication-associated events per examination with standard communication and with DECT enhanced communication. (Right) Rating of interpersonal communication with and without headset on a NRS (numeric rating scale) from 0 (very bad) to 10 (very good); DECT = Digital enhanced cordless telecommunication.

► **Table 4** Perceptions of wearing comfort, voice quality, headphone quality, and overall satisfaction among endoscopists and nurses.

DECT characteristic	Endoscopist (n = 10)	Nurse (n = 13)	P value
Wearing comfort, mean±SD	1.65 ± 0.61	1.70 ± 0.63	0.585
Voice quality, mean±SD	1.71 ± 0.59	1.70 ± 0.56	0.154
Headphone quality, mean±SD	1.65 ± 0.61	1.70 ± 0.63	0.160
Overall satisfaction, mean±SD	1.71 ± 0.69	1.65 ± 0.65	0.313

Ratings are based on a scale from 1 to 6, 1 = best perceived quality, 6 = worst perceived quality. SD, standard deviation.

cation of DECT in gastrointestinal endoscopy remain to be explored, especially considering the economic effort and the potential clinical benefit.

We acknowledge certain limitations of our study. First, because of its monocentric and pilot-trial design at a university hospital, general transferability of the data may be impaired. Future studies should demonstrate the impact of digitally enhanced communication in endoscopy and should elaborate on a general recommendation for communication for health care providers (HCP) in endoscopy. Second, only the core team (3 members) and the study nurse were equipped with DECT in this study. Whether it is beneficial to integrate more team members into the DECT workflow should be further evaluated in larger studies. Third, it must be acknowledged that this study was performed at the beginning of the second wave of the COVID-19 pandemic in Germany, during which PPE was more likely to be worn for upper and lower gastrointestinal endoscopy. This may limit its transferability in post-COVID gastrointestinal endoscopy. Nevertheless, it also should be stated that applications of enhanced team communication while using PPE will remain valid for treatment of patients with other infectious diseases and for communication without PPE. Fourth, the study was performed with Olympus EXERA III series whereas the new-

er X1-series might result in quieter surroundings. Furthermore, given how the study was designed, participant blinding was not possible, which could confer some systemic bias to the results.

Finally, it must be stated that no significant effect on examination time or occurrence of serious AEs was observed by using DECT device. Larger studies with more complex interventions may show these effects in the future. Furthermore, data on the development of serious AEs in patients were only collected directly during endoscopic procedures. There was no postinterventional observation of patient outcomes and incidence of complications after endoscopy. Therefore, we cannot state whether patients benefitted from improved team communication during the postinterventional course. Further studies are mandatory to investigate this issue over a longer investigation period.

Conclusions

In conclusion, our study demonstrated for the first time the impact of digitally enhanced telecommunication as an effective and well-accepted tool for improving the quality of team communication in endoscopy. Digital assisted communication, such as DECT systems, may help improve and maintain high-quality

team communication during increasingly complex endoscopic procedures.

Competing interests

The authors declare that they have no conflict of interest.

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