Nakhara: Journal of Environmental Design and Planning (2022)
Volume 21(1), Article 202
DOI: https://doi.org/10.54028/NJ202221202

The Design of Physical Components of Endoscopy Units: A Case Study of Four Major Public Hospitals in Thailand

Chatchai Wiriyakraikul, Wasita Amatyakul, Kawin Dhanakoses*

Faculty of Architecture, Chulalongkorn University, Thailand
* Corresponding e-mail: kawin.d@chula.ac.th

Received 2021-06-14; Revised 2022-01-06; Accepted 2022-02-03

ABSTRACT

Endoscopists and medical practitioners of the Thai Association of Gastrointestinal Endoscopy (TAGE) have raised critical concerns regarding vast variations in the design of endoscopy facilities. This study presents an overview of the design of gastrointestinal endoscopy units in Thailand. The case studies include six endoscopy units from four major public hospitals in Bangkok. The research methodology comprises three main parts. The first part is based on a literature review of international and local architectural design guidelines to understand and justify the research framework. The second part includes walk-through observations and documentation of the current condition. Finally, the obtained data were compared and analyzed using the framework derived from the literature review. The findings identified variations among case studies in three main aspects: (1) functional area requirements, (2) functional relationship and circulations for traffic flow, (3) detailed functional requirements. One of the causes of these design variations is related to the lack of local design guidelines. The findings support the need for design guideline establishment and implementation to ensure efficacy and safety, especially on the future adaptive reuse buildings that would turn into endoscopic units. Another noticeable finding is the circulation traffic flow planning of separation between dirty and clean corridors. Further research suggests investigating the potential and risk of implementing the non-separating corridors for more efficient use of space. The development of local design guidelines, including the three mentioned aspects with the adjustment to the local context, would be highly beneficial to the healthcare system.

Keywords: design, endoscopy unit, gastrointestinal endoscopy, design guidelines, hospital

INTRODUCTION

The demand for medical endoscopic procedures has gradually increased globally due to operational efficiency and minimally invasive interventions. The complexity of endoscopy services has become more significant, resulting in the need for purpose-specific facility design (Petersen & Ott, 2009). Endoscopists and medical practitioners of the Thai Association of Gastrointestinal Endoscopy (TAGE) have raised concerns about the variation in the design of endoscopy units, which could jeopardize the safety, efficiency, and quality of healthcare delivery. Generally, the endoscopy design would be standardized based on the design guidelines or a building code to ensure efficiency and safety. However, the frequent dissimilarity shown in this context raises the question of lacking local policy that would affect the endoscopy unit design. This apprehension has led to the importance of this study investigating the design of the gastrointestinal endoscopy department of four major public hospitals in Thailand to understand the current conditions and to compare to the international standard to identify the problems relating to planning medical endoscopic design.

The current stage of Thailand's endoscopy unit design guidelines

In Thailand, the design guidelines available to assist the design process and for better comprehension among project stakeholders are minimal. Members of TAGE recommended some important guidelines developed by medical practitioners, including the study from Guidelines for designing an endoscopy unit (report of the Dutch Society of hepatogastroenterology) (Mulder et al.,1997), Guidelines for designing a digestive disease endoscopy unit: Report of the World Endoscopy Organization (Mulder et al., 2013) and Petersen and Ott (2008), which are still not the local-based guidelines. The most common local reference was the study of Ratanachuake et al. (2010), providing vital information mainly from general practitioners' perspectives, including focusing on the patient care process, details of medical equipment and accessories. However, the guidelines on the design principles of the physical environment or the provision of information on technical requirements remain in the unknown realm.

International guidelines for designing an endoscopy unit

The design guidelines, which were commonly perceived in the process of developing endoscopy units in Thailand, can be divided into two main groups.

First, the design guidelines from the Center for Diseases Control and Prevention (Centers for Diseases Control and Prevention [CDC], 2009) and the Department of Veterans Affairs (Department of Veterans Affairs [VA], 2011) represent the design standards from internationally recognized organizations in the USA. The main objectives of their guidelines are to maximize the efficiency of the design process and to ensure a high safety level. The guidelines provide a comprehensive overview of general design considerations for service planning, space design criteria, space requirements, and detailed technical specifications. Moreover, the essential parts are to provide drawings, which are easy to understand, representing typical configurations for general technical guidance of crucial components of the unit.

Second, the design guidelines from the rest of the world - International Health Facilities Guidelines (International Health Facilities Guidelines [iHFG], 2014a, 2014b), The Endoscopy Governance Group for New Zealand (Endoscopy Governance Group for New Zealand [EGGNZ], 2017), and Australia Health Facilities Guidelines (Australasian Health Infrastructure Alliance [AHIA], 2018) were selected as representatives for the overview from a global perspective. iHFG guidelines were developed from collaboration among many countries and organizations such as India, Australia, and the United Kingdom by the Institute of Healthcare Engineering and Estates Management (IHEEM).

Framework for analyzing endoscopy unit design

The review of international design standards, guidelines, manuals, and journal articles relating to facility planning highlights three crucial aspects: (1) functional area requirements, (2) functional relationships and circulations for traffic flow, and (3) detailed functional requirements.

Functional area requirements

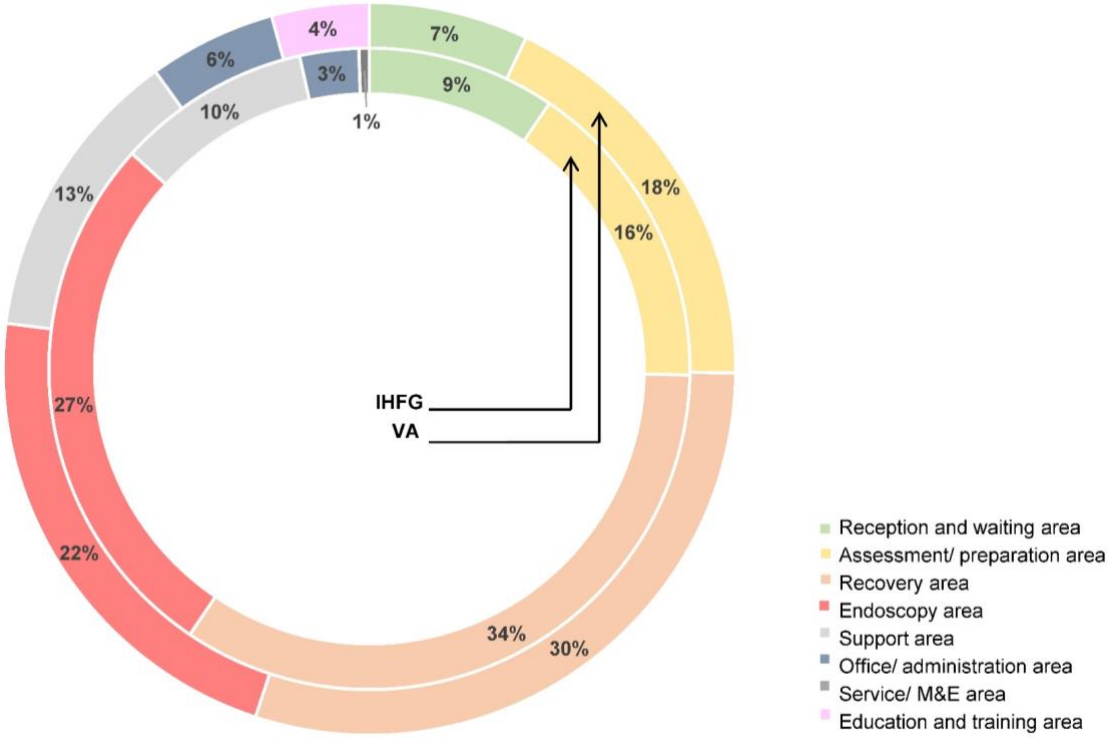
The gastrointestinal endoscopy unit consists of 8 main functional areas (VA, 2011; iHFG, 2014a). The research compares two design guidelines to define the baseline value. Both provide a different approach, calculating the space required for the endoscopy unit. To compare the allocation, the area requirements were adjusted and calculated based on the defined criteria for an equal number of endoscopy procedure rooms, as shown in Figure 1.

The design of endoscopy suites can be standardized into a module, starting with a minimum of two endoscopy rooms required. This two-unit combination enables parallel examinations of upper and lower endoscopy, while a three-room endoscopy module is suitable for accommodating 3,000 endoscopies per year (Mulder et al., 2013). For designing larger modules, an increment of two is suggested for operational efficiency. Therefore, larger modules may consist of an even number of room endoscopy suites, as shown in Figure 2.

It is noteworthy to mention that several international design guidelines provide recommendations on each functional area's sizes and general requirements (VA, 2011; iHFG, 2014a), but there are some differences in the amount, size, and some specific needs, which vary depending on cultural context and healthcare facilities standard in each country.

Figure 1

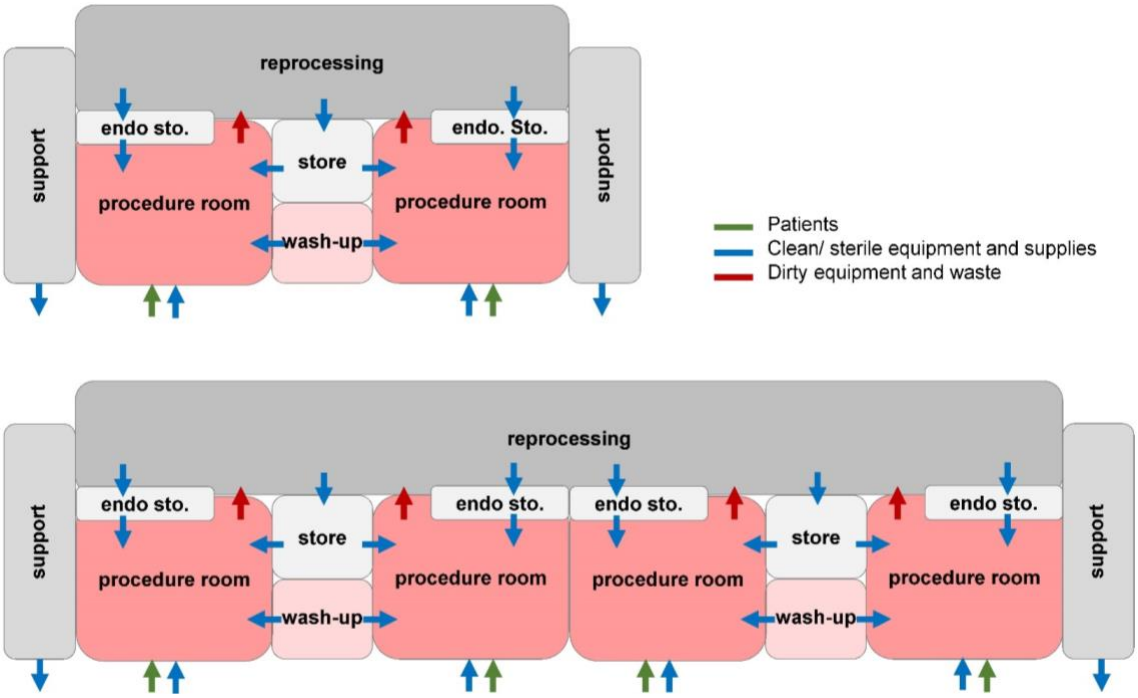
The proportion of each functional area compared between two international design guidelines



Note. This figure demonstrates differences in the space allocation of each functional area, The data for iHFG is from International Health Facility Guidelines by iHFG, 2014a. The information for VA is from Design Guide: Digestive Diseases-Endoscopy Service by VA, 2011.

Figure 2

The relationship diagram within endoscopy units of various module size



Note. This figure shows the smallest unit recommendation and the planning for growth by utilizing "modular" adapted from International Health Facility Guidelines by iHFG, 2014a and Design Guide: Digestive Diseases-Endoscopy Service by VA, 2011.

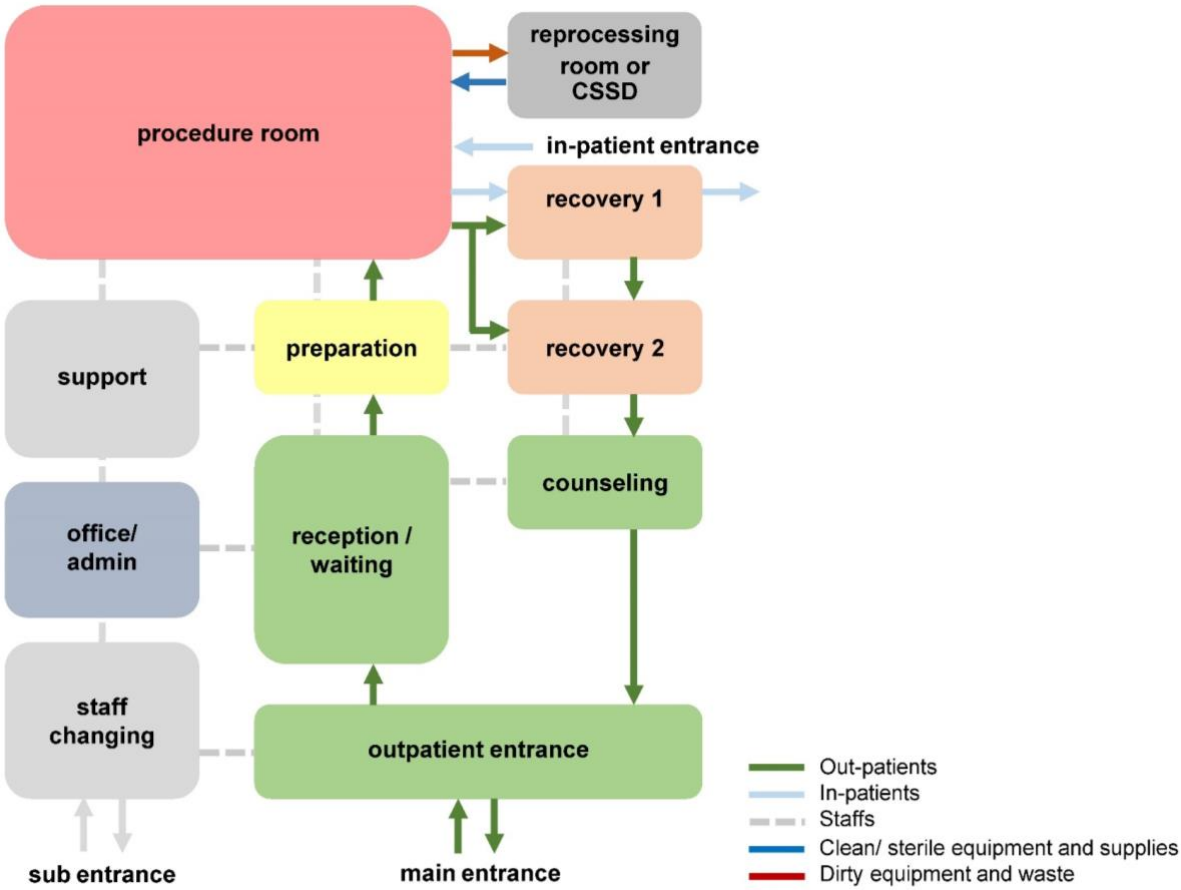
Functional relationship and circulation traffic flow

Figure 3 illustrates the recommended configurations of important functional areas. Each functional area is connected through circulations or corridors, which are suggested to be separated between patients, medical staff, and medical equipment. The key consideration for designing circulation paths is accessibility, efficiency, and safety for the medical process. The circulation paths within endoscopic facilities involve three main flows: patients, medical staff, medical equipment, and other medical supplies. The essential design requirements for circulation planning include the separation of clean-dirty corridors and workflow for infection control (iHFG, 2014a), the separation of patients and service flows (VA, 2011; Mulder et al., 2013), the separation between awaiting and treated patients (Mulder et al., 2013). Therefore, at least two separate corridors should be within an endoscopic facility.

For the patient-related path, the width of the corridor should be at least 2.20 to 2.40m. Alternatively, it should be wide enough for stretchers to turn around (Department of Veterans Affairs [VA] & Veterans Health Administration [VHA], 2021; iHFG, 2014a). The flow of patients should be controlled to avoid confusion caused by the cross-circulation of pre-post procedure patients and in-out patients. For the non-patient-related path, the width should be at least 1.50m. The traffic flow of medical services and equipment must be restricted to be a dirty-to-clean workflow, and the travel distance should be minimized for operational efficiency (Mulder et al., 2013).

Figure 3

Functional relationships diagram of an endoscopy unit



Note. It was adapted from Part B: Health Facility Briefing and Planning by Australasian Health Infrastructure Alliance [AHIA], 2016; Endoscopy Standards for Individual Colonoscopists Performing Bowel Cancer Screening in New Zealand by EGGNZ, 2017; Endoscopy Department Graphic Standards Programming and Schematic Design by Herman Miller for Health Care, 1999; International Health Facility Guidelines by iHFG, 2014a; Design and Construction Division by Ministry of Public Health (Thailand), 2015; Guidelines for designing a digestive disease endoscopy unit: Report of the World Endoscopy Organization by Mulder, et al., 2013; Guidelines for designing an endoscopy unit (Report of the Dutch Society of Hepato-gastroenterology) by Mulder, et al., 1997; Design and management of gastrointestinal endoscopy units by Petersen & Ott, 2008; Endoscopy Unit, Equipment, Accessories, and Reprocessing Process by Ratanachuake, et al., 2010.

Detailed functional requirements

International design guidelines emphasize specifying detailed functional requirements to ensure the practicality of the design, as the procedure room and reprocessing area are the core areas of endoscopic facilities. The summarized dimension is shown in Table 1.

Endoscopy procedure room

For accessibility, the design of the endoscopy room should provide a minimum of 2 access points for the separation flow of clean and dirty supplies. Double doors or sliding doors with vision panels should reach a minimum of 1.20m, which is clearance for door openings. The materials used for the doors are supposed to be durable, lightweight, and easy maintenance. Window openings for endoscopy rooms are not suggested except for glazed windowpanes of the adjunct control room for endoscopy rooms with

fluoroscope because the illuminance level of the room must be fully controlled during the endoscopic procedure. The room occupancy indicator light and hazard symbol of radiation source must be installed in front of the procedure rooms for safety purposes. Built-in furniture of the workstations and loose furniture should be provided according to the need of endoscopists or the standard operating procedures of each facility. Building structures and engineering systems, especially for electrical, communication, HVAC, and medical gas systems, should be designed according to international design standards (VA, 2011) and regulations and fully integrated into the architectural designs.

Reprocessing room

For the reprocessing room, the key concept is to separate the contaminated (dirty) area and the clean or sterile area, which means a dirty-to-clean workflow must be applied (Association of periOperative Registered Nurses [AORN], 2016; Ratanachuake et al., 2010; Scottish Government Health and Social Care Directorate [SEHD], 2006). Endoscopes and accessories must be pre-cleaned at the point of use and transported in a closed container to the decontamination area. An automatic endoscope washer-disinfector should apply the leak testing process before undergoing the cleaning and high-level disinfection process. Finally, the endoscopes must be sterilized and stored in sterile storage cabinets until they are ready for use (AORN, 2016).

The size of the reprocessing area should not be smaller than 8 m², the room width should not be less than 2.50m with a minimum ceiling height of 3.00m. As suggested in the endoscopy rooms, similar architectural finishes should be applied. The clearance of the door openings should not be less than 0.95 m.

Furthermore, the design of the window openings for the use of daylight and natural ventilation is highly suggested. The built-in furniture of workstations and loose furniture should be designed to support each facility's reprocessing process. Building systems such as electrical, sanitary, HVAC, and emergency systems must be provided sufficiently.

Table 1

The standard size of endoscopy rooms and reprocessing rooms recommended

Room type	Width (m.)	Length (m.)	Height (m.)	Size (m^2.)
Endoscopy procedure room	4.20 - 6.00	5.70 – 6.30	3.00	25.00 – 36.00
Endoscopy room with X-ray	4.90 - 7.00	6.00 - 6.70	3.00	33.00 – 42.00
Reprocessing room	>3.00	>2.60	3.00	8.00 – 40.00

Note. This table summarizes the size of endoscopy rooms. Endoscopy rooms with X-ray and reprocessing rooms are recommended by reviewed guidelines. Data are from Mulder, et al., 1997; Herman Miller for Health Care, 1999; Petersen & Ott, 2008; VA, 2011; Mulder, et al., 2013; iHFG, 2014a, 2014b; AHIA, 2016; EGGNZ, 2017; SEHD, 2006; AORN, 2016; VA, 2011.

METHODOLOGY

Framework development

This empirical research obtained detailed information about architectural design, planning, and space utilization from six case studies. The case studies were suggested and selected by endoscopists and medical practitioners who are the board members of TAGE, including six endoscopy units from four major public hospitals in Thailand. The process provides an overview of existing local and international design guidelines. The guidelines were obtained through recommendations from members of TAGE, followed by an extensive search for publications from reliable sources including, academic journal articles, design manuals, guidelines, and standards published by internationally recognized organizations.

Data collection from case studies

The investigations of the physical environment were conducted by walk-through observations, together with the head of the department. Space dimensions, utilization, and workflow were obtained and analyzed using architectural drawings combined with information obtained from interviews and observations during visits at each facility. The collected data focus on two main parts: (1) General information, providing a further understanding of each case background; (2) Detailed physical component information, based on the three aspects resulting from the literature review step.

Analyzed data to identify the characteristic case studies

This process was analyzed with all the information obtained from the selected case studies and compared with the summarized data gathered on the framework development process as (1) functional area requirements, (2) functional relationships and circulations for traffic flow, (3) detailed functional requirements. The raw data was interpreted into charts and tables to point out the differences between each case and international design guideline. The conclusion of an overview design and the analysis of the research findings were summarized and will be further utilized as the foundation for developing gastrointestinal endoscopy unit guidelines in Thailand, especially for planning and designing.

RESEARCH FINDINGS

General information of the case studies

The size of the six selected endoscopy units ranges from 510 - 1,670 m², with the circulation area accounting for 24% - 37% of the total unit area. There are two cases, ENDO 02 and 04, where existing building structures were not initially designed to accommodate endoscopic facilities. The proportion between the total area of the unit per one procedure room varied from 128 - 433 m², as detailed in Table 2.

Table 2

Comparison of general information among six case studies

Case studies	Years of use	Functional planning	No. of procedure rooms	Area			Total m²/ procedure room
				Total area	Functional area *(%)*	Circulation area *(%)*	
ENDO 01	4	Original	11	1,670 m²	1,123 m² (67%)	547 m² (33%)	152
ENDO 02	6	Adaptive reuse	3	1,300 m²	814 m² (63%)	486 m² (37%)	433
ENDO 03	8	Original	8	1,273 m²	891 m² (70%)	382 m² (30%)	159
ENDO 04	11	Adaptive reuse	4	510 m²	388 m² (76%)	122 m² (24%)	128
ENDO 05	13	Original	9	1,367 m²	955 m² (70%)	412 m² (30%)	152
ENDO 06	6	Original	6	875 m²	663 m² (76%)	212 m² (24%)	146

Note. The data are derived from existing case studies.

Detailed physical component information of the case studies

Functional area requirements

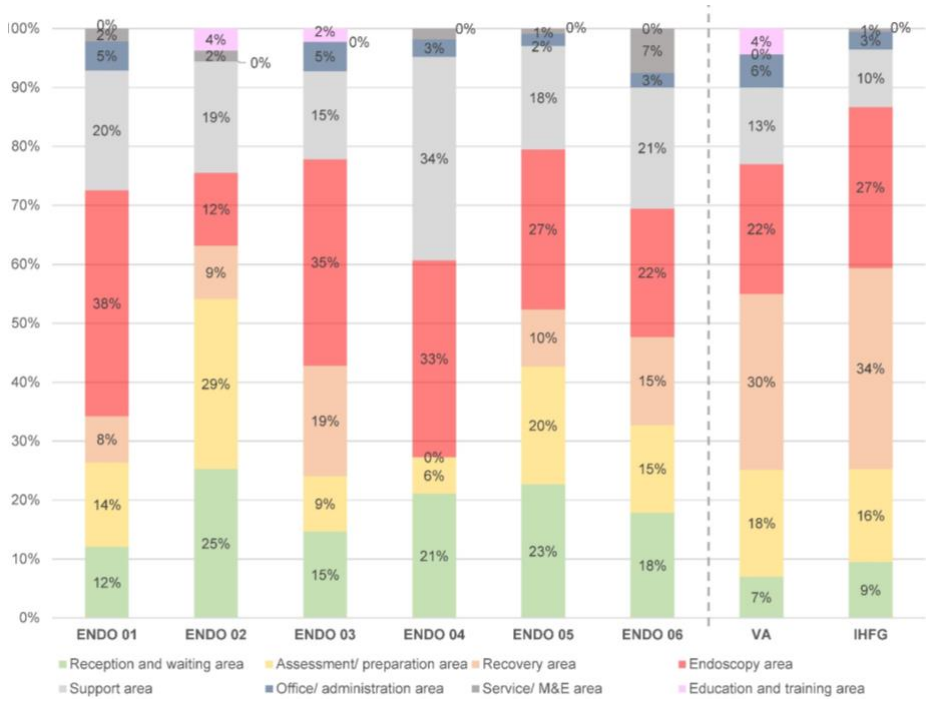
The findings show that all six case studies possessed 7 to 8 functional areas which complied with international design guidelines. However, some areas overlapped between two or more functional areas to economize the space. For example, in ENDO 04, the preparation area is shared with the recovery area. In ENDO 02, the office and administration area are located at the reception counter in the reception and waiting area. Figure 4 illustrates the comparison between functional areas in case studies and international guidelines. All endoscopy units from the case studies possessed vastly greater proportions of reception and waiting areas, while the preparation and patients' recovery areas were much smaller. These gaps in functional areas and specific requirements could result from the difference between local context, design criteria, and workplace culture.

Functional relationship and circulation for traffic flow

The finding shows similarities in the arrangement of the functional relationship among the cases that were initially planned or built as endoscopic facilities. The space utilization diagram of ENDO01 (Figure 5) demonstrates the clear separation between clean and soiled corridors, which is similar to the spatial configuration of surgical suites. A contradictory approach on circulation for traffic flow within the department could be found on ENDO06. Figure 6 shows an alternative system, where the main circulations within the unit are combined, which is against several guidelines' suggestions. This combined circulation has the more significant potential to save spaces. Nonetheless, the comparison in other important aspects regarding hygienic issues, infection control, operation efficiency, and users' satisfaction need to be further explored.

Figure 4

Comparison of functional area proportion between the different case studies and international guidelines



Note. The figure shows significant variations of space allocation among case studies and differences in existing local buildings and international standards (VA, 2011; iHFG, 2014a).

Figure 5

Floor plans showing space utilization and circulation flow of ENDO01

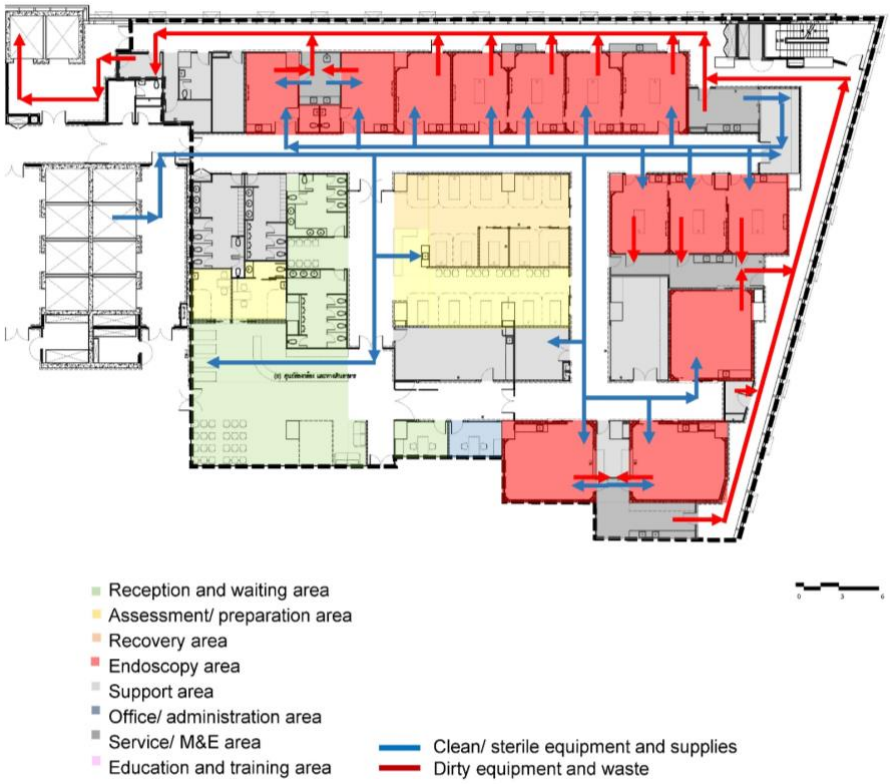
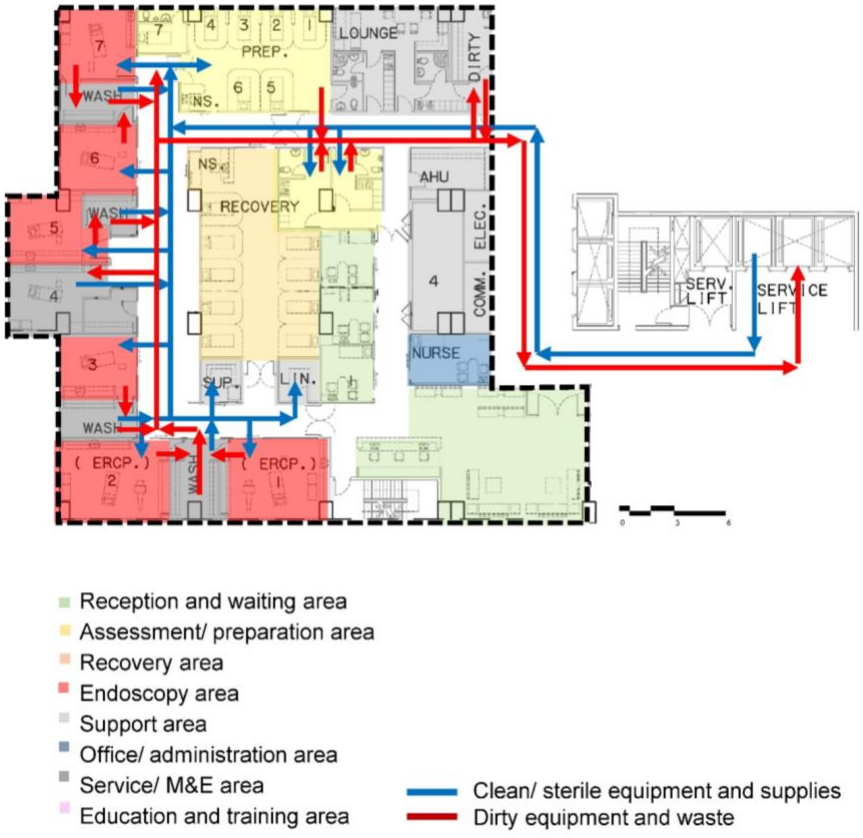


Figure 6

Floor plans showing space utilization and circulation flow of ENDO06



In the case studies, the width of the patient-related corridors ranged between 2.10 and 3.70m compared to 2.20 and 2.40m, as suggested on the guidelines, and between 1.50 and 2.50m for staff and services, respectively. The clean and dirty corridors were not always separated, and the dirty-to-clean workflow was not entirely applicable. Therefore, cross-circulations of the flow of patients, medical staff, and services could be found. In front of the procedure rooms, the alcoves provided efficient storage spaces for trolleys and emergency medical carts. They served as a safety clearance area for opening doors that would not interrupt the main circulation adjacent to the procedure rooms.

Detailed functional requirements

Endoscopy procedure rooms and reprocessing areas are the crucial elements of the endoscopy unit. The rooms require specific equipment, interior finishing, and clearance. From cases, the dimensions shift from the international guideline, especially on the width of ENDO 04 case is inadequate for the equipment to operate thoroughly. The case studies found two types of endoscopy rooms: endoscopy rooms and endoscopy rooms with X-ray/ fluoroscopy. The room dimensions and circulation flow details are shown in Figures 7 and 8.

Figure 7

Floor plans of endoscopy rooms from the case studies

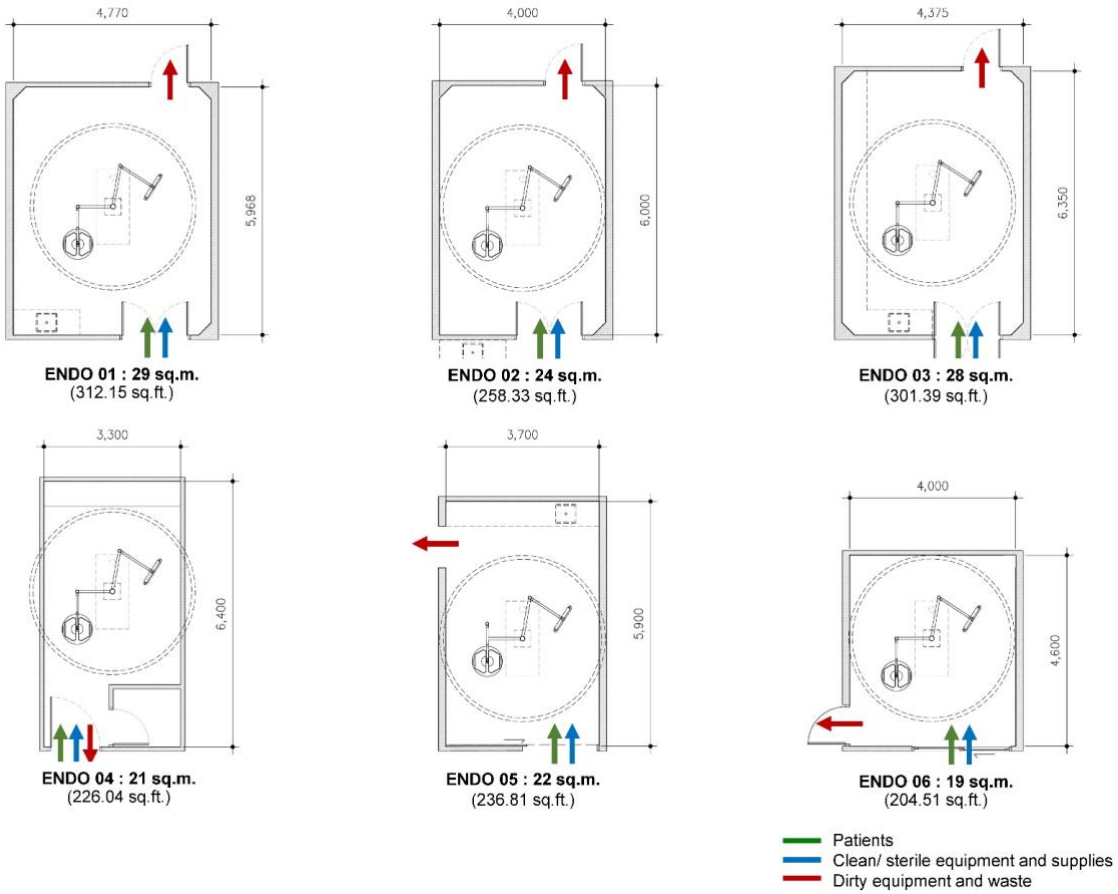
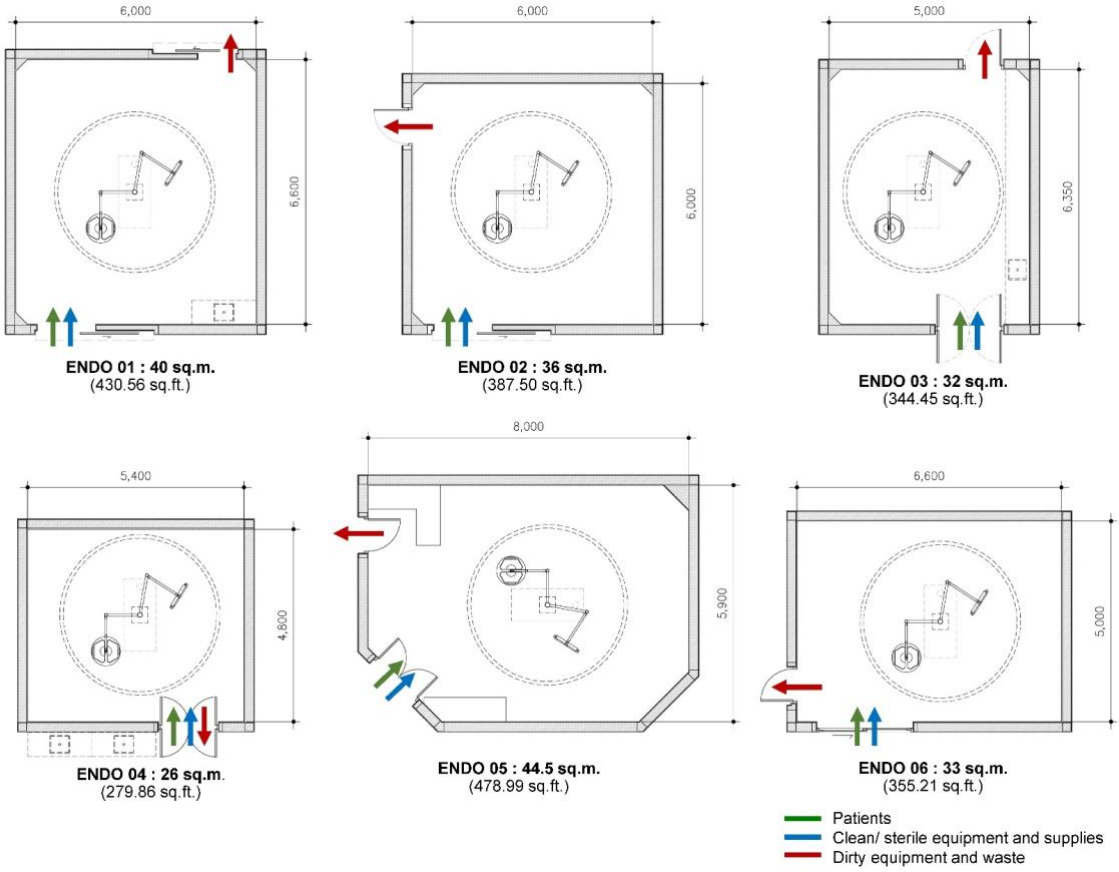


Figure 8

Floor plans of endoscopy rooms with X-ray/ fluoroscopy from the case studies



DISCUSSION

The first part of this section will discuss some critical points relating to three aspects of endoscopic facility planning. The latter feature will discuss the key considerations in the local design guidelines.

Differences in functional area allocations

Regarding the functional area allocations, the comparison between the case studies shows two case studies worth mentioning: ENDO 02 and ENDO 4. As seen on the proportional comparison of functional areas (Figure 4), these two outliers reveal unique functional area allocations, including a sizeable preparation area in ENDO 02 and an unusual portion of supporting area without any recovery area provided in ENDO 04. These findings suggest further investigation into the relationship between the existing constraints of the physical environment and the planning of endoscopy units, especially in the case of adaptive reuse, which is the functional planning type of both cases.

Moreover, noticeable differences can be found when comparing the proportion of functional areas between the case studies and the international design guidelines. The case studies tend to allocate a greater proportion to reception and waiting areas, while international design guidelines provide sizeable assessment/ preparation and recovery areas. This finding indicates the need to investigate further the actual activities and space utilization of endoscopy units in Thailand, where differences in cultural context and healthcare system could be an influential factor.

Table 3

Minimum room dimensions of endoscopy rooms recommendation in Thailand

Room type	Width (m.)	Length (m.)	Height (m.)	Size (m^2)
Endoscopy room	>4.20	>5.70	>3.00	>25.00
Endoscopy room with X-ray	>5.00	>6.00	>3.00	>33.00
Reprocessing room	>2.50	>3.00	>3.00	>8.00

Differences in circulation for traffic flow

The literature review presents the concept of providing a clear separation of clean and dirty corridors as an essential principle for efficient and safe endoscopy services. In contrast, the findings reveal cases with the non-separation of clean and dirty corridors, which could occur because the clear-separation concept of flow is sometimes not applicable, especially in building refurbishment cases.

However, the non-separation of clean and dirty corridors presents possibilities in a space-saving design, since the hygienic requirements of the procedure rooms are different from the design of surgical suites. Further research regarding the management of non-separation corridors could expand the understanding of the endoscopy units.

Differences in detailed functional requirements

Comparing the size of the endoscopy room from the findings shows the critical point on the room width as ENDO 04 room would not allow the equipment to operate fully, and ENDO 05-06 reaches a minimum line that could hinder the operation safety. The endoscopy rooms do not meet the international standard size in most cases. Even though these rooms are currently used and operable, the findings to the recommended standards could lead to the recommendations for the size of the endoscopy rooms in Thailand, as shown in table 3.

Further key considerations in physical component design

The findings indicate the noticeable results on the adaptive reuse type, which was the most contrasting number from the international standards to be found. The future guidelines should also include an architectural design concept that supports flexibility and adaptability. This is because the expansion of endoscopy units and the change in technology and equipment could affect the space utilization, the structural load of existing building structures, and building systems. Moreover, the building system such as lighting, HVAC, sanitary systems should be included in the design requirements to secure the room's functionality and practical usage.

CONCLUSION

The lack of comprehensive local design guidelines for establishing gastrointestinal endoscopy units could be the main reason causing variations in the physical environment among endoscopy units in hospitals. Although Thai endoscopists and practitioners have developed some guidelines, architectural design and planning details have been rarely discussed or forced to be implemented.

When comparing case studies and international design guidelines, the findings indicate differences in the planning approach in three major aspects: functional area allocations, functional relationship diagram and circulation flow, and detailed functional requirements.

In the functional area allocations aspect, endoscopic facilities in Thailand tend to share space within other functional areas with a vague boundary between recovery areas, office administration, service support, and educational areas. The proportional areas in case studies distribute less to the patient-related facilities: waiting, assessment, and recovery areas than the international standard do. These differences in area proportion and specific requirements could result from the local context and environment criteria such as laws and regulations, users' behavior, patient care procedures, and workplace culture. Therefore, acquiring detailed functional requirements and constant participation from all stakeholders along the planning process is crucial for local optimal area distribution in an endoscopy unit design.

Another core concept of planning a functional relationship diagram and circulation flows, defined by international standards included in this research, emphasized the importance of clear separation between clean and dirty corridors for efficient and safe endoscopy services. However, implementing this concept seems challenging in most cases and sometimes not applicable in actual operation, especially in refurbishment cases. Because of restrictions from existing building structures and mechanical and engineering systems, nevertheless, the contradictory findings of this non-distinctive, clean-dirty path in some case studies have raised some areas for which further research could further explore.

For the detailed functional requirements, in most cases, the size of the endoscopy procedure rooms does not meet the requirements recommended by the international design guidelines. This matter could be a result of specific programming requirements or constraints of each development. For instance, in the case of building refurbishment, the design constraints could result from the building structures or the floorplate shapes and sizes of the existing buildings, which were initially designed to accommodate in-patient wards. Therefore, this stresses the need to establish local design standards to justify the minimum criteria that would not compromise the safety and efficacy of healthcare operations.

The findings portrayed the general view of six case studies from four public hospitals in Thailand and compared the current conditions to the international standards. The issues which could lead to facility improvement were identified. Establishing and implementing detailed local design guidelines into practice would be the key to enhancing the design of healthcare facilities to better facilitate the healthcare practice in the future.

SUGGESTIONS FOR FUTURE RESEARCH

The outcome of this research could be compiled as a database for developing guidelines for designing an endoscopy unit in Thailand. Facility management teams, designers, and stakeholders could use the guidelines as a reference for planning, design, construction, and facility management during occupancy to accelerate building efficiency and diminish the risk of jeopardizing the user's safety. However, this database should be continuously updated and revised to ensure its effectiveness and practicality before implementation. Finally, expanding and collaborating with neighboring countries to explore a broader context, aiming to understand the overview of private and public hospitals, could further develop the regional design standard.

DISCLOSURES AND ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to Assoc. Prof. Pradermchai Kongkam, M.D., and Assoc. Prof. M.L. Taya Kitiyakara, M.D., Assist. Prof. Piyapan Prueksapanich, M.D. and the endoscopists and medical doctors of the Thai Association of Gastrointestinal Endoscopy (TAGE) for their initiation of the projects and input at multiple stages throughout this research.

REFERENCES

Association of periOperative Registered Nurses. (2016). *AORN guideline for processing flexible endoscopes. https://aornguidelines.org/guidelines/content?sectionid=173735349&view=book*

Australasian Health Infrastructure Alliance. (2016). *Part B: Health facility briefing and planning | AusHFG*. Healthfacilityguidelines. https://healthfacilityguidelines.com.au/part/part-b-health-facility-briefing-and-planning-0

Australasian Health Infrastructure Alliance. (2018). *Part C: Design for access, mobility, safety and security | AusHFG*. Healthfacilityguidelines. https://www.healthfacilityguidelines.com.au/part/part-c-design-access-mobility-safety-and-security

Centers for Disease Control and Prevention, Department of Health and Human Services. (2009). *Control guidance sheet 406–endoscopy suite architectural design*. https://www.cdc.gov/niosh/docket/archive/pdfs/NIOSH-159/0159-020109-Sheet406.pdf

Department of Veterans Affairs, Office of Construction & Facilities Management. (2011). *Design guide: Digestive diseases-endoscopy Service*. The Office of Construction & Facilities Management. https://www.cfm.va.gov/til/dGuide/dgDigestiveEndoscopy.pdf

Department of Veterans Affairs & Veterans Health Administration. (2021). *PG-18-9: Space planning criteria*. The Office of Construction & Facilities Management. https://www.cfm.va.gov/til/space/SPchapter287.pdf

Endoscopy Governance Group for New Zealand. (2017). *Endoscopy standards for individual colonoscopists performing bowel cancer screening in New Zealand*. https://eggnz.endoscopyquality.co.nz/assets/Uploads/EGGNZ-Endoscopy-Standards-for-Individual-Colonoscopists-Performing-Bowel-Cancer-Screening-in-New-Zealand-Final-v3.0.pdf

Herman Miller for Health Care. (1999). *Endoscopy department graphic standards programming and schematic design*. Chandler Business Interiors. http://www.cbifurniture.com/sw/swchannel/images/ProductCatalog/ProductPage/File/endoscopy.pdf

International Health Facility Guidelines. (2014a). *International health facility guidelines: Part B health facility briefing & design*. https://healthfacilityguidelines.com/ViewPDF/ViewIndexPDF/iHFG_part_b_endoscopy_unit

International Health Facility Guidelines. (2014b). *Endoscopy procedure room - room layout sheet*. https://healthfacilityguidelines.com/ViewPDF/ViewStandardCompnentPDF/endp-i/endp-i

Ministry of Public Health (Thailand), Design and Construction Division. (2015). *Building and environment design guidelines of health care facilities: X-ray*. https://hss.moph.go.th/fileupload_doc_slider/2016-11-16--167.pdf

Mulder, C. J. J., Jacobs, M. A. J. M., Leicester, R. J., Reddy, D. N., Shepherd, L. E. A., Axon, A. T., & Waye, J. D. (2013). Guidelines for designing a digestive disease endoscopy unit: Report of the World Endoscopy Organization. *Digestive Endoscopy*, *25*(4), 365–375. https://doi.org/10.1111/den.12126

Mulder, C.J.J., Tan A.C.I.T.L., & Huibregtse, K. (1997). Guidelines for designing an endoscopy unit (report of the Dutch Society of hepatogastroenterology). In G.N.J. Tytgat & C.J.J. Mulder (Eds.) *Procedures in Hepatogastroenterology* (2nd ed., pp. 485-494). Springer Science+Business Media Dordrecht. https://doi.org/10.1007/978-94-011-5702-5_38

Petersen, B., & Ott, B. (2009). Design and management of gastrointestinal endoscopy units. In P. B. Cotton (Ed.), *Advanced Digestive Endoscopy: Practice and Safety* (pp. 3–32). Blackwell Publishing Ltd. https://doi.org/10.1002/9781444300260.ch2

Ratanachuake, T., Chanthakhan, V., & Salarak, D. (2010). Endoscopy unit, equipment, accessories, and reprocessing process. In S. Phanpimanmas & T. Ratanachuake (Eds.), *Practical ERCP* (pp. 1–34). http://thaitage.org/source/content-file/content-file-id-17.zip

Scottish Government Health and Social Care Directorate. (2006). *Chief Medical Office* (*CMO) letter 04*. Scottish Executive Health Department (SEHD). https://www.sehd.scot.nhs.uk/cmo/CMO(2006)04.pdf