A Health Mobile Application for Self-Care of Colostomy Patients

Elahe Jozpoor[1] Monireh Tahvildarzadeh[2] Azam Sadat Hoseini[1] Mohammad Kazem Shahmoradi[3] Mohammad Almasian[4] Hamid Moghaddasi[1]

[1] Department of Health Information Technology, School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[2] Department of Health Information Technology, Lorestan University of Medical Sciences, Khoramabad, Iran
[3] Department of General Surgery, School of Medicine, Lorestan University of Medical Sciences, Khorramabad, Iran
[4] Department of English Language, School of Medicine, Lorestan University of Medical Sciences, Khorramabad, Iran

Address for correspondence Hamid Moghaddasi, Department of Health Information Technology, School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran (e-mail: moghaddasi@sbmu.ac.ir).

J Coloproctol 2024;44(1):e9–e16.

Abstract

Introduction and Objective In most cases, due to the failure of nonsurgical methods in the treatment of diseases related to the colon, it is necessary to perform colostomy as the main treatment method. However, this surgery can cause a wide range of physical, social, and psychological problems in patients. Therefore, in order to prevent and treat the complications of colostomy, it is necessary to adopt measures in the field of self-care and continuous education for patients to control the complications of the disease, seek treatment, and experience improvements in their quality of life . Additionally, considering the role of mobile health (mHealth) applications in facilitating continuous and effective training, and improving self-care for these patients, the aim of the present study was to design and evaluate an mHealth application for self-care of colostomy patients.

Materials and Methods In the present applied research, first the functional requirements of the software were determined considering the self-care requirements of colostomy patients. Then, the software was designed based on object-oriented analysis, and according to it, the application was coded in Java and developed in the Android Studio environment. Finally, to evaluate the software, the opinions and comments of 5 gastroenterologists and 10 adult colostomy patients in the age range between 27 and 64 years who had at least a high school diploma were used as the basis of judgment at this stage. The instruments used in the evaluation included a checklist, derived from three standard questionnaires (the System Usability Scale [SUS], the mHealth App Usability Questionnaire [MAUQ], and the User Version of the Mobile Application Rating Scale [uMARS]) to measure the user-friendliness indicator, and a researcher-made checklist to measure the performance indicator of the various services provided.

Keywords
- mobile health
- mHealth
- self-care
- colostomy
- stoma

received
September 14, 2023
accepted after revision
January 10, 2024

DOI https://doi.org/10.1055/s-0044-1779604.
ISSN 2237-9363.

Thieme Revinter Publicações Ltda., Rua do Matoso 170, Rio de Janeiro, RJ, CEP 20270-135, Brazil

Results The services of the software developed include the provision of medical information and self-care instructions regarding colostomy surgery, as well as alerts for the user to schedule an appointment with a doctor and the time to take medications. Based on the results of the evaluation stage, the users were generally satisfied with the interface, services, and general features of the software. In general, the software was evaluated at the "acceptable" level, with a rate of 85%.

Discussion and Conclusion Based on the findings of the current research, the software developed can be significantly effective in facilitating the education of colostomy patients and improving their self-care. Proper and continuous self-care and education for colostomy patients is necessary to prevent and control complications resulting from surgery and to improve their quality of life. Therefore, in addition to patients, all health care staff, organizations, and associations which support colostomy patients can also use this software to educate patients and improve the care provided to them.

Introduction

A colostomy is a surgical procedure in which one side of the large intestine or part of it is removed through an opening in the abdominal wall (called a stoma). In this operation, the stool is emptied through a side route and the stoma, instead of the colon and rectum of the patient, into a bag connected to the abdomen.[1–3] Nowadays, due to the increase in diseases related to the colon and the failure of nonsurgical methods in relieving the severe symptoms of colon diseases, colostomy may be necessary to treat complications and improve the quality of life (QoL) of patients. Approximately 60% to 70% of patients with inflammatory bowel disease (ulcerative colitis and Crohn disease) will need this surgery, and among colon diseases, colorectal cancer is the most common cause of colostomy.[1] Despite all the current medical advances, colostomy is still one of the main treatments for many patients with colon cancer.[4] Based on figures reported by the World Health Organization (WHO) in 2020, colorectal cancer ranks third among the 10 most prevalent cancers, and presents the second highest mortality rate among men and women worldwide.[5] It is worth noting that the number of patients who need a colostomy increases every year; in the United States, for example, $\sim$ 100 thousand patients need this surgery every year.[1] The international statistical information concerning colostomy has not yet been determined and published accurately. About 102 thousand residents of England and $\sim$ 100 thousand residents of Germany undergo colostomy each year.[6]

Precise statistical information is not available on the number of ostomy patients in Iran; however, according to the Iranian Ostomy Association, about 30 thousand ostomy patients live in Iran, 70% of whom have undergone colostomy, 20%, ileostomy, and 10%, urostomy, with the total number of ostomy patients increasing every year.[7] Colostomy can lead to a wide range of physical, psychological, and social problems for the patients. Given the significance of the problems and complications that can arise after surgery, self-care and patient education play important roles in ameliorating complications and improving adjustment and QoL. Therefore, access to a comprehensive and appropriate educational program can facilitate self-care, reduce complications from surgery, and improve the QoL of colostomy patients.[8,9] Self-care, as defined by the WHO, refers to the ability of individuals, families, and societies to improve health conditions, and prevent and deal with diseases, which can be achieved with the support of health care staff, or without their presence. Self-care involves many aspects and activities, including health and hygiene (public and individual), nutrition, lifestyle (exercise and sports, leisure time activities etc.), environmental factors (living conditions, social habits etc.), and socioeconomic factors.[10] Public guidelines and statements, including the joint position statement of the American Society of Colorectal Surgeons, the Wound Nurses Society, and the guidelines for the care and management of ostomy published in 2009 by the Ontario Nursing Association, have all emphasized ostomy patient education and the education of their relatives and family members to prevent the possible complications of ostomy, especially during the preoperative period. Additionally, the guidelines recommend that patient education should continue postoperatively and even after discharge from the hospital.[11–16] Thus, it seems absolutely necessary that measures should be taken regarding self-care, continuing patient education, complication management and control, treatment, and improvements in the QoL of colostomy patients.[8] In this regard, patients should be taught about stoma care, care for the skin around the stoma, the type and characteristics of secretions from the stoma (unusual color, amount, viscosity, and smell), how to empty and change the ostomy pouching system, how to change the bag and put it in place, how to rinse and cleanse the intestines, how to modify the diet, as well as about the effects of ostomy on sexual activity.[1,17,18] A study[19] conducted in Canada has shown that mental disorders, anxiety, depression, and attention disorders can worsen the physical condition of these patients. Hence, ostomy patients need to receive constant counselling services for their psychological

needs to detect and address any problems.[20] Some problems, such as flatulence and excrement leakage, can be embarrassing for these patients, leading to further intensification of mental disorders, depression, anxiety, and isolation. Therefore, patients should be educated about how to expel gas from the colostomy site noiselessly, and how to alter their diets to minimize flatulence. Additionally, patients should receive precise instructions about the proper size of the colostomy bag opening, how to take care of it, and when to change it to minimize excrement leakage from the colostomy site.[9] Improvements in the QoL of patients with a stoma is the responsibility of all health care personnel, including nurses, and they must know that knowledge and skills regarding pre- and postoperative self-care play an important role in enhancing the QoL of colostomy patients.[20] To achieve favorable results in terms of patient self-care, appropriate instruments and solutions – such as information technology and digital learning environments[21]–should be used to facilitate and promote patient education. Patient education using electronic devices is a novel method that can convey educational concepts and materials simply, widely, and intriguingly by making use of texts, sounds and voice, pictures and images, and movies and animations and can be used and published on a large scale.[22] In recent years, developments in information and communication technologies along with the widespread availability of smartphones and internet connectivity that can be accessed at any time play a key role in providing modern health care solutions.[23] Currently, there are mobile health (mHealth) applications with many different functions in the field of health care, which are often used as educational tools, to simplify patient self-care, and to provide proper information together with educational films and content about diseases and disorders.[24] On the other hand, the widespread use of cell phones creates new paths to overcome the various barriers to coping behaviors and to the maintenance of self-care behaviors.[25] Advances in cell phone technology has created many opportunities to promote the health and well-being of patients.[26] Smartphones can assist in the management of medical conditions without direct monitoring by health care staff, which can enhance the QoL of patients, reduce costs, decrease hospital stay and re-hospitalizations, and, ultimately, empower the patients.[27] Applications available on smartphones can enable nurses to remind patients through short message service (SMS) after the in-person sessions, and also motivate the patients to carry out the assigned tasks. Hence, smartphones eliminate the limitations regarding the access to mental health services and improve patient self-care.[28] Moreover, patients who experience surgical complications and seek solutions may face difficulties in countries with inadequate numbers of health care centers and personnel. For instance, when patients are affected by peristomal dermatitis, they do not usually know which products they should use to treat it. On the other hand, lack of timely access to health care and delayed treatment can intensify complications, adversely affecting the patient physically, socially, and psychologically. Thus, mHealth applications have become an important option by reducing the time needed to educate the patients and their families about stomas and lifestyle changes.[29–31]

Therefore, it is crucial to make sure that patients have access to continuing education, and that their self-care skills improve. To achieve this purpose, it seems necessary to develop highly useful mHealth applications to improve the self-care required in the management of this medical condition. Despite the numerous problems and complications faced by colostomy patients, few studies have been conducted on the use of mobile applications in colostomy patient self-care, and the functionalities of smart phones have not been fully put to use in this field. Hence, considering the important points that were mentioned about the use of cell phones in facilitating patient education and self-care, the current study aimed to design and evaluate an mHealth application to improve the self-care of colostomy patients.

Materials and Methods

The current applied research was conducted in 2 main stages in 2022 and 2023.

First Stage: Development of the mHealth Software

First, articles, books, and global health websites were studied and analyzed to better understand the self-care needs of colostomy patients. Then, the functional requirements of the colostomy self-care software were determined, including the conveyance of comprehensive and understandable medical information and scientific content about colostomies, the provision of the necessary training and instructions related to the self-care of colostomy patients, and the display of warnings to remind patients to visit the doctor and when to take medicines based on the information collected. After the establishment of the functional requirements, a conceptual model of the software was designed based on object-oriented analysis and on the visual paradigm programing environment, which included the functional model, the structural model, and the behavioral model. Finally, the conceptual model was coded and developed using the Java programming language in the Android Studio environment. Then, it was tested and debugged in terms of execution accuracy.

Second Stage: Evaluation of the mHealth Software

After the development stage, the software was made available to 10 adult colostomy patients in the age range between 27 and 64 years, with at least a high school diploma, who owned smartphones running the Android operating system. To evaluate the user interface, the services, and general features, the software was also made available to five gastroenterologists.

- **Data collection instrument:** Evaluation data was collected using a checklist including 26 questions in 2 general categories. A combination of 3 standard questionnaires (the System Usability Scale [SUS], the mHealth App usability questionnaire [MAUQ], and the User Version of the Mobile Application Rating Scale [uMARS]) was used to design 15 questions related to usability criteria.[32–35] Eleven questions related to the services and general features of the software were designed by the research team based on the features of the software.

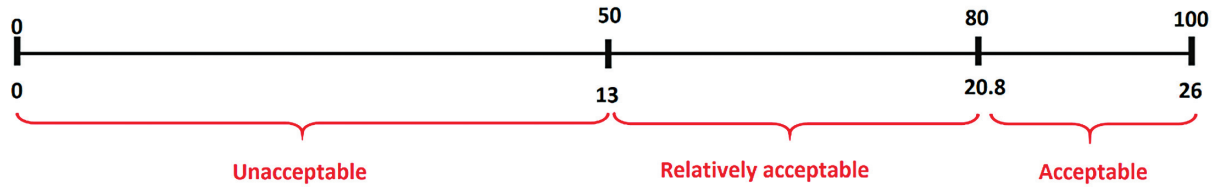

Fig. 1 Total evaluation scale.

- **Methods of data analysis:** All items on the checklist had the same weight. Regarding the questions, each affirmative ('yes') answer was assigned a score of one point, and a score of zero was assigned to each negative ('no') answer. Additionally, three scales were designed to analyze the results obtained from the checklist as follows:
  1. **Total evaluation scale**: Three intervals were considered in the design of this scale: unacceptable (score ranging from 0 to 13), relatively acceptable (score ranging from 13 to 20.8), and acceptable (score ranging from 20.8 to 26) (►**Fig. 1**).
  2. **User-friendliness indicator scale**: In this scale, three intervals were also considered: unacceptable (score ranging from 0 to 7.5), relatively acceptable (score ranging from 7.5 to 12), and acceptable (score ranging from 12 to 15) (►**Fig. 2**).
  3. **Performance indicator scale for the types of services provided by the software**: As the previous two, this scale is also based on three intervals: unacceptable (score ranging from 0 to 5.5), relatively acceptable (score ranging from 5.5 to 8.8), and acceptable (score ranging from 8.8 to 11) (►**Fig. 3**).

Moreover, in each scale, if the sum of the points was in the unacceptable range, the section related to that range in the software would be revised, and after the necessary corrections, the checklist was provided to the user again until an acceptable result was obtained. This situation did not occur during the present research, and the checklist was not provided to the user for revision.

Results

Findings on Software Development

The functional requirements and services provided in the colostomy self-care software were determined based on a review of the literature. The main services provided include the conveyance of medical knowledge, self-care instructions, and alerts for when the user should consult with a doctor and take medications. The first part is related to medical knowledge, including familiarity with the colostomy surgery, the management of its gastrointestinal complications, and the performance of daily activities with the stoma. The second part is related to teaching self-care instructions, including how to change and empty the bag, how to wash the bowel, skin care of the area of the stoma, motivational materials, and an introduction to health insurance providers and the ostomy associations of Iran. In this section, all the necessary training related to the self-care instructions along with educational materials, as well as images and educational videos were provided to the user. By selecting each section and opening the corresponding page, the user can view the step-by-step tutorials with images and texts at the end, and also view the related video tutorial. Moreover, all the content of the first and second parts were compiled based on authoritative texts and authoritative global websites and were provided to the user in a simple and understandable way. In the third part, the user enters the information related to medicines and doctor appointments, and the software can remind and warn the user of the appropriate time and date to take the medicines and about their appointments with the doctor.

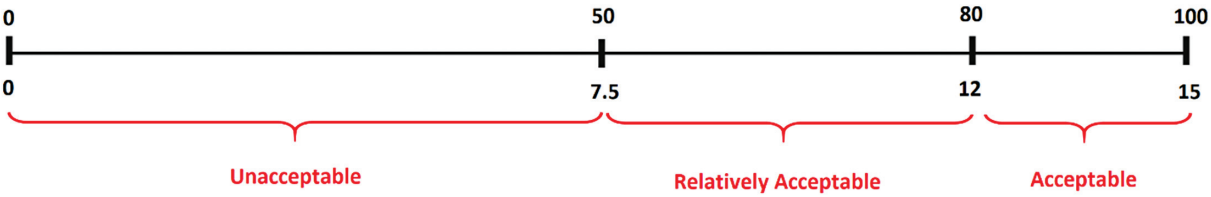

Fig. 2 User-friendliness indicator scale.

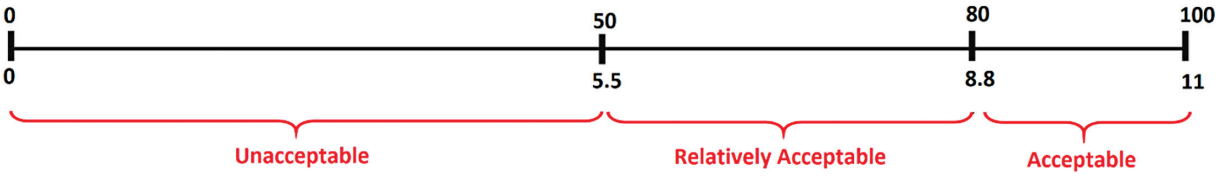

Fig. 3 Performance indicator scale for the services provided by the software.

Table 1 Frequency distribution of the demographic characteristics of the patients participating in the software evaluation

Row	Variable		Frequency	
			n	Percentage
1	Gender	Male	7	70%
		Female	3	30%
2	Level of schooling	Below high school	0	0%
		High school	1	10%
		Bachelor's degree	6	60%
		Master's degree	3	30%
		Ph.D.	0	0%
3	Age (in years)	< 27	0	0%
		27–30	3	30%
		30–40	4	40%
		40–50	2	20%
		50–64	1	10%
		> 64	0	0%

Findings of the Evaluation of the Software

The software was evaluated by 10 colostomy patients and 5 gastroenterologists. ►**Table 1** presents the frequency distribution of patient demographics, including age, gender, and level of schooling. ►**Table 2** summarizes the responses of the patients to items related to the evaluation of the user interface, which indicate that they were satisfied with it (87%). ►**Table 3** shows the opinions of gastroenterologists about the services and general features of the software, which indicate that they found them satisfactory (81%). ►**Table 4** presents a summary of the opinions of the patients about the services and general features of the software, which indicate that 85% of them were satisfied. Therefore, based on the results of the evaluations of the user interface and the services and general features of the software, and with the average total score obtained from them, the level of user satisfaction with the software was of 85%, which places the software at an acceptable level.

Discussion and Conclusion

The statistical results of previous studies show that mobile-based software can play an effective role in facilitating education and improving the self-care of colostomy patients.

Table 2 Scores and their frequency distributions assigned by patients in the evaluation of the user interface of the colostomy self-care software

Response Checklist items		Yes (1)	No (0)	Score	Percentage
Software user interface (the appearance of the software)	1. Is the introductory screen of the application indicative of the main purpose of the software in terms of logo and title?	8	2	8	80%
	2. Can you easily input information into the application, including reminders, registration etc.?[32]	9	1	9	90%
	3. Is the appearance of the software characteristics (colors, menus, images, and icons) good?[32]	8	2	8	80%
	4. Are the layout, size of buttons, icons, menus, and content on the screen appropriate and relevant?[32]	9	1	9	90%
	5. Is it possible to quit the application in each section?	10	0	10	100%
	6. Is it possible to return to the main page in all parts of the software?	10	0	10	100%
	7. Is the navigation menu (direction buttons such as return, home page, exit etc.) stable when moving between application pages?[34]	10	0	10	100%
	8. Does the title bar on different pages indicate the use of that page?	7	3	7	70%
	9. Is the content of the software appropriate in terms of font, resolution and size, and is it easily visible?	8	2	8	80%
	10. Are different components of the program in coordination? (Brock, 1996)	8	2	8	80%
	11. Do the different components of the program (buttons, menus etc.) work accurately and quickly?[32]	9	1	9	90%
	12. Can you easily use all the features of the program through the user interface?[34]	10	0	10	100%
	13. Can the software be used easily? (Brock, 1996)	8	2	8	80%
	14. Does the application have all the features and services you expect?[34]	7	3	7	70%
	15. Would you like to use this software again?[34]	10	0	10	100%
	Mean percentage				87%

Table 3 Frequency distribution and scores assigned by experts regarding the evaluation of the services and general features of the colostomy self-care software

Response Question			Yes (1)	No (0)	Score	Percentage
Services and general features of the software	Alerts and reminders	1. Are the tasks, including recording, editing, and deleting information in the reminders management section, including warning to take medicines and visit a doctor, carried out easily?	4	1	4	80%
		2. Are warning messages displayed in the right place on the screen?	3	2	3	60%
		3. Are alert and reminder messages clear and understandable for the patients?	4	1	4	80%
		4. Are alert and reminder operations performed accurately in the software?	3	2	3	60%
	Educational content	5. Are educational materials and self-care recommendations and their subcategories classified correctly and can you easily find the materials you need?	3	2	3	60%
		6. Are the recommendations and educational content in the software simple and understandable?	4	1	4	80%
		7. Are the educational content and self-care recommendations appropriate to the self-care goals of colostomy patients?	5	0	5	100%
		8. In general, is the educational content provided in the software, including medical knowledge and self-care recommendations through videos and images, sufficient and appropriate to the needs of patients?	4	1	4	80%
		9. Are all videos, images, and sounds of good quality?	5	0	5	100%
		10. In general, can the educational content of the software help improve the care provided to colostomy patients?	5	0	5	100%
		11. In your opinion, is this application satisfactory overall?	5	0	5	100%
Mean percentage						81%

Additionally, the effects of the use of mobile-based educational software on factors such as QoL, reduction of postoperative complications, and the facilitation of patient self-care have been investigated, with statistically significant results.[36–39] Therefore, in the present research, a software was designed and developed to improve the self-care of colostomy patients. All the services provided in the software are in line with the self-care goals of colostomy patients.

In their study, Kim et al.[40] discussed the provision of educational information as one of the important services offered by mHealth software, which can positively affect the self-care of patients. Moreover, Grainne et al.,[41] who examined mHealth applications in the management of chronic wounds, showed that the provision medical information and educational tips is an important feature of mobile-based software that can be effective in the self-management of chronic wounds. To achieve this goal, the provision of medical information related to the colostomy surgery and self-care instructions to patients in a simple and understandable manner were considered the main services offered by the software developed in the present study. All medical and educational content in the application was based on scientific texts, and it was supervised by the experts of the research team to help users improve their self-care.

Yin et al.[42] examined the effectiveness of electronic health applications to improve knowledge, QoL, and disease management among inflammatory bowel patients. The reminder system in mHealth software is considered an important factor for adherence to treatment and to improve patient self-care. In this regard, providing reminders and alerts to take drugs and consult with a doctor was another service that was implemented in the software developed in the current study.

The results of the present study show that the average percentage of user satisfaction with the interface was of 87%, which shows attests to its proper and principled design . According to the responses of the users, all parts of the software could be easily accessed, and the main operations could be easily run. In addition, the rate of 85% of positive evaluation of the services and general features of the software shows that all the services provided are in accordance with the basic needs of the users. Finally, the average total score of the two evaluated sections showed that the rate of user satisfaction was of 85%, suggesting that users were satisfied with the visual and graphic features, the medical

Table 4 Frequency distribution and scores assigned by patients about the evaluation of the services and general features of the colostomy self-care software

Responses Question			Yes (1)	No (0)	Score	Percentage
Services and features of the software	Alerts and reminders	1. Can you easily record, edit, and delete information in the reminder management section, including warnings to take medications and visit a doctor?	7	3	7	70%
		2. Are warning messages displayed in the right place on the screen?	8	2	8	80%
		3. Are alerts and reminders clear and understandable for patients?	7	3	7	70%
		4. Are alert and reminder operations performed accurately and on time in the software?	8	2	8	80%
	Educational content of the software	5. Are educational materials and self-care advice and their subcategories classified correctly, and can you easily find the materials you need?	8	2	8	80%
		6. Are the advice and educational content simple and understandable?	9	1	9	90%
		7. Are the educational content and self-care advice appropriate to the self-care goals of colostomy patients?	10	0	10	100%
		8. In general, is the educational content of the software, including medical knowledge and self-care advice taught through videos and pictures, sufficient and appropriate to the needs of patients?	7	3	7	70%
		9. Are videos, images, and sounds of good quality?	10	0	10	100%
		10. In general, is the educational content of the software useful to improve the care of patients with colostomy?	10	0	10	100%
		11. Is this application generally satisfactory?	10	0	10	100%
	Mean percentage					85%

and educational content, the warnings and reminders, and that the software developed is at an acceptable level.

It is worth noting that in countries like Turkey, Brazil, and the United States, software similar to the application produced in the present study has been produced with the aim of providing knowledge and information to colostomy patients. However, none of them include a medication reminder service for patients[36–38] such as the one provided in the software produced in the present study. Considering that, before the present study, there was no such software in the Iranian society, and its use can facilitate education, increase awareness, and improve the health and self-care of colostomy patients.

Suggestions

Based on the findings of the current research, we recommend that health care organizations support the production of self-care software to improve the care provided to patients. Additionally, considering the problems that colostomy patients face postoperatively and the fact that their treatment should be pursued on an ongoing basis, the software developed in the present study can be essential in the achievement of these goals. On the other hand, the mobile-based software developed in the present study could be used in countries that face a shortage of stoma therapy centers and stoma care nurses. Additionally, by using said software, the problems of forgetting the provided training could be solved. Finally, we recommend that all medical staff use the software produced in the present study to improve patient self-care to provide patients with easy and continuous access to necessary training and reduce learning time, and to make it available to all patients under their care and encourage them to use it.

Funding
The authors declare that they have received no funding from agencies in the public, private or non-profit sectors for the conduction of the present research.

Conflict of Interests
The authors have no conflict of interests to declare.

Acknowledgments
The authors would like to express their gratitude to all individuals who participated in the present study by completing the evaluation checklist.

References

1 Hinkle JL, Cheever KH. Brunner and Suddarth's textbook of medical-surgical nursing. Wolters Kluwer India Pvt Ltd; 2018
2 The National Health Service (NHS) 2020. Available on: https://www.nhs.uk/search/results?q=colostomy

3 MedlinePlus Medical Encyclopedia. 2021. Available on: https://medlineplus.gov/ency/article/002942.htm
4 Naseh L, Rafii F, Moghadasi J, Yousefi F. Quality of Life and its Dimensions in Ostomates. Journal of Clinical Nursing and Ostomates. Journal of Clinical Nursing and Midwifery 2012;1(01): 10–22
5 World Health Organization (WHO) 2020. Available on: https://gco.iarc.fr/today/home
6 Shahidi S, Farajniya S. The Design and Validation of Spiritual outlook Measurement Questionnaire. Ravanshenasi Va Din. 2012; 5(03):97–115
7 Parchami IM, Ahmadi Z. Effect of telephone counselling (telenursing) on the quality of life of the patients with colostomy. 2016:123–130
8 Ahmadi F, Aghabarari M, Mohammadi E, Hajizadeh E, Farahani A. Physical, spiritual, psychological and social dimensions of quality of life in breast cancer women receiving chemotherapy. Nurs Res 2006;3:55–65
9 HawksJ. H. Medical-surgicalnursingclinicalmanagementforpositiveoutcomes. Saunders/Elsevier; 2009
10 World Health Organization (WHO) 2021. Available on: https://www.who.int/reproductivehealth/self-care-interventions/definitions/en/
11 Pittman J, Bakas T, Ellett M, Sloan R, Rawl SM. Psychometric evaluation of the ostomy complication severity index. J Wound Ostomy Continence Nurs 2014;41(02):147–157
12 RNAO Supporting Adults who Anticipate or Live with an Ostomy 2019. Available on: https://rnao.ca/bpg/guidelines/ostomy
13 Mahoney MF. Preoperative preparation of patients undergoing a fecal or urinary diversion. In: Carmel JE, Colwell JC, Goldberg MT, editors. Wound, Ostomy and Continence Nurses Society. Core Curriculum: Ostomy Management USA: Kluwer; 2016:99–112
14 Colwell JC. Postoperative nursing assessment management. In: Carmel JE, Colwell JC, Goldberg MT, editors. Wound, Ostomy and Continence Nurses Society. Core Curriculum: Ostomy Management USA: Wolters Kluwer; 2016:113–119
15 Grant M, McCorkle R, Hornbrook MC, Wendel CS, Krouse R. Development of a chronic care ostomy self-management program. J Cancer Educ 2013;28(01):70–78
16 Miller D, Pearsall E, Johnston D, Frecea M, McKenzie MOntario Provincial ERAS Enterostomal Therapy Nurse Network. Executive Summary: enhanced recovery after surgery best practice guideline for care of patients with a fecal diversion. J Wound Ostomy Continence Nurs 2017;44(01):74–77
17 Lynn P. Taylor's clinical nursing skills: a nursing process approach. Lippincott & Wilkins; 2018
18 Canobbio MM. Mosby's handbook of patient teaching. Vol. 13; Elsevier Health Sciences; 2017
19 Wasio VH. Psychological distress and physical symptom experience in post-surgical colorectal cancer patients. [Dissertation]. Manitoba: University of Manitoba; 2005
20 Black PK. Psychological, sexual and cultural issues for patients with a stoma. Br J Nurs 2004;13(12):692–697
21 Gordon EJ, Prohaska TR, Gallant M, Siminoff LA. Self-care strategies and barriers among kidney transplant recipients: a qualitative study. Chronic Illn 2009;5(02):75–91
22 Huang JP, Hsia MC, Linge Y. A comparison of multimedia to improve knowledge, control, and self-care among people with diabetes in Taiwan. Public Health Nurs 2009;26(04):3173–28
23 Silva BMC, Rodrigues JJ, de la Torre Díez I, López-Coronado M, Saleem K. Mobile-health: A review of current state in 2015. J Biomed Inform 2015;56:265–272
24 Choi J, Cho Y, Woo H. mHealth approaches in managing skin cancer: Systematic review of evidence-based research using integrative mapping. Journal of Medical Internet Research mHealth and uHealth. 2018
25 Kirwan M. Developing and evaluating smartphone applications to improve health behaviours and chronic disease self-management [dissertation]. Queensland: Central Queensland University; 2012
26 Farshidi D, Craft N, Ochoa MT. Mobile teledermatology: As doctors and patients are increasingly mobile, technology keeps us connected. Skinmed 2011;9(04):231–238
27 Nasi G, Cucciniello M, Guerrazzi C. The role of mobile technologies in health care processes: the case of cancer supportive care. J Med Internet Res 2015;17(02):e26
28 Luxton DD, McCann RA, Bush NE, Mishkind MC, Reger GM. mHealth for mental health: Integrating smartphone technology in behavioral healthcare. Prof Psychol Res Pr 2017;42(06): 505–512
29 Crawford D, Texter T, Hurt K, VanAelst R, Glaza L, Vander Laan KJ. Traditional nurse instruction versus 2 session nurse instruction plus DVD for teaching ostomy care: a multisite randomized controlled trial. J Wound Ostomy Continence Nurs 2012;39 (05):529–537
30 Olla P. ve, Shimskey C. mHealth taxonomy: a literature survey of mobile health applications. Health Technol (Berl) 2015;4(04): 299–308
31 Menzi N, Önal N, Çalışkan E. Mobil teknolojilerin eğitim amaçlı kullanımına yönelik akademisyen görüşlerinin teknoloji kabul modeli çerçevesinde incelenmesi. Ege Eğitim Dergisi. 2012;13 (01):40–55
32 Stoyanov SR, Hides L, Kavanagh DJ, Wilson H. Mobile Application Rating Scale: User Version (uMARS). (appears in: Development and Validation of the User Version of the Mobile Application Rating Scale (uMARS).) Copyright: Creative Commons License. 2016
33 Brooke J. SUS-A quick and dirty usability scale. Usability evaluation in industry 1996; 189(194), 4–7
34 Zhou L, Bao J, Setiawan IM. A, Saptono A, Parmanto B. The mHealth App Usability Questionnaire (MAUQ): development and validation study. JMIR Mhealth Uhealth 2019
35 Mustafa N, Safii NS, Jaffar A, et al. Malay Version of the mHealth App Usability Questionnaire (M-MAUQ): Translation, Adaptation, and Validation Study. JMIR Mhealth Uhealth 2021;9(02):e24457
36 Yigitoglu ET, Sendir M. Mobile Application in Stoma Care Education: STOMA-M. J Educ Res Nurs 2021;18(02):210–216
37 Cardoso IA, et al. A new APP for prevention and treatment of complications of intestinal peristomal skin. J Coloproctol (Rio J) 2020;40:120–128
38 Morss-Walton PC, Yi JZ, Gunning ME, McGee JS. Ostomy 101 for dermatologists: Managing peristomal skin diseases. Dermatol Ther 2021;34(05):e15069
39 Qing-qing W, Zhao J, Huo X, et al. Effects of a home care mobile app on the outcomes of discharged patients with a stoma: A randomised controlled trial. J Clin Nurs 2018;•••:3592–3602
40 Kim BY, Park KJ, Ryoo SB, et al. Effects of a mobile educational program for colorectal cancer patients undergoing the enhanced recovery after surgery. Open Nurs J 2018;12:142–154
41 Grainne V, Geraldine P, Eustace-Cook J, Byrne G. Use of mHealth apps by nurses in the management of chronic wounds: a scoping review protocol. JBI Evid Synth 2021;19(10):2783–2789
42 Yin AL, Hachuel D, Pollak JP, Scherl EJ, Estrin D. Digital health apps in the clinical care of inflammatory bowel disease: scoping review. J Med Internet Res 2019;21(08):e14630