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**Recent changes and improvements in multidisciplinary perioperative management from a nutritional perspective: Dental specialty should be considered important**

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## **Abstract**

### *Purpose of review*

Recently, multidisciplinary strategies on accelerated recovery postoperatively have been provided, and management of the perioperative period has changed and improved dramatically. We summarize the enhanced recovery after surgery (ERAS®) protocol and its outcomes from a nutritional perspective. We established the perioperative management center (PERiO), much of whose work contents conform to ERAS®, but intensive dental staff involvement is characteristic. We also summarize its outcomes.

### *Recent findings*

ERAS® is a multimodal perioperative care pathway designed to achieve early recovery for patients undergoing a major surgery. Nutrition is a key pillar for patient-care. Throughout the perioperative period, oral nutrition is suggested as well as possible. Good outcomes have been reported by a meta-analysis of randomized controlled trials. However, dental staff are not regarded as part of the professional team. PERiO reported good outcomes of care bundles and suggested the importance of dental staff contribution. The Japanese social insurance system began to cover involvements of dental staff for perioperative oral management since 2012. Analysis of the nationwide administrative claims database in Japan concluded that preoperative oral care by a dentist significantly reduced postoperative complications in patients undergoing cancer surgery.

### *Summary*

Currently, dental staff are not regarded as key professionals of ERAS®, although dental staff can contribute to good outcomes in the perioperative period and PERiO, and consequently the Japanese universal health insurance coverage system covering involvements of dental staff for perioperative oral management showed good outcomes. Therefore, further clinical studies involving the dental specialty should be considered important for perioperative management from nutritional perspectives.

### **Key words**

perioperative management; nutrition; dental; oral management

## Introduction

For the last several decades, many multidisciplinary strategies on accelerated recovery postoperatively have been provided worldwide, and management in the perioperative period has changed and improved dramatically. Attempts to create a perioperative multidisciplinary rehabilitation program began in the late 1990s, and its usefulness has been provided names such as “fast-track program,” “fast-track surgery,” “enforced multimodal rehabilitation program,” “enhanced recovery program,” “accelerated rehabilitation care.” The enhanced recovery after surgery (ERAS®) protocol, originating in the ERAS group organized by the European Society for Clinical Nutrition and Metabolism (ESPEN) in 2001, also is representative of multidisciplinary strategies on accelerated recovery postoperatively. The ERAS group consists of facility representatives from the five countries (Denmark, the Netherlands, Norway, Scotland, and Sweden) and introduced the ERAS® protocol for colon resection in 2004 as ESPEN Highlight News. In the following year, it was announced as a consensus review in the official journal of the ESPEN [1]. The ERAS® protocol is the term used by the strong influential society ESPEN; hence, its impact is enormous in that the meaning of the ERAS® protocol expressed the aforementioned concept for general surgery in other areas, not just for colon resection.

In the ERAS® protocol, oral nutrition intake during the perioperative period has a fundamental role among the main factors of accelerated recovery postoperatively, avoiding starvation conditions as much as possible throughout the perioperative period. Pre- and early post-oral nutrition intake is practiced even after surgery. Therefore, dental staff could contribute due to their specialty, but they are not included in the original multidisciplinary approach.

Okayama University Hospital established a perioperative management center (PERiO) in 2008, with much of the work content conforming to ERAS® [2]. However, it is characteristic for dental staff to intensively participate in the multidisciplinary approach to perioperative management [3].

In this report, recent changes and improvements in perioperative management, especially from a nutritional perspective in ERAS, are summarized first, followed by introduction of our perioperative management protocol with intensive participation of dental staff and its effect. We discuss the importance of the dental staff contribution to this field.

## **Recent changes and improvements in perioperative management, especially from a nutritional perspective in ERAS®**

ERAS® is a multimodal perioperative care pathway designed to achieve early recovery for patients undergoing a major surgery. The main elements of the ERAS® protocol are shown in Figure 1, which is based on a multimodal program with optimal pain relief, stress reduction with regional anesthesia, early enteral nutrition, and early mobilization [1]. Then, guidelines for several surgeries, such as gynecologic/oncology surgery [4, 5], gastrointestinal surgery [6, 7], gastrectomy [8], radical cystectomy for bladder cancer [9], pancreaticoduodenectomy [10, 11], elective colonic surgery [12, 13], elective rectal/pelvic surgery [14, 15], bariatric surgery [16], liver surgery [17], major head and neck cancer surgery [18], breast reconstruction [19], esophagectomy [20], lung surgery [21], and elective colorectal surgery [22], were presented and updated (available on the ERAS Society web site at <http://erassociety.org/guidelines/list-of-guidelines/>, accessed on January 1, 2019). These provided programs do not rely on new drugs and/or hardware but are provided from devising existing methods from evidence-based viewpoints. The endpoints are to (1) improve safety, (2) shorten of hospital days, and (3) reduce medical expense. To achieve the programs, multidisciplinary cooperation is necessary. All medical staff must understand the program and aim for patient-centered medical care. Many good outcomes have been reported worldwide. Greco et al.[23] have reported the following outcomes in a meta-analysis of randomized controlled trials: (1) ERAS programs allow patients to recover much faster postoperatively, and this reduces the hospital stay by approximately 30% or more than 2 days after major abdominal surgery; (2) Despite earlier discharge from the hospital, the rate of readmissions did not increase; and (3) ERAS reduced major complications after abdominal surgery by as much as 40%. In particular, noncardiac complications, such as those from the lungs and cardiovascular systems, were markedly reduced.

As shown in the main elements of the ERAS® protocol in Figure 1-A, nutrition is a key pillar. For example, guidelines recently published for elective colorectal surgery (2018), which is a large volume for each ERAS item within the ERAS® protocol, presented the following recommendations from a nutritional perspective [22]:

➤ *Preoperative nutritional care:*

*Preoperative routine nutritional assessment offers the opportunity to correct malnutrition and should be offered. Preoperatively, patients at risk of malnutrition should receive nutritional treatment preferably using the oral route for a period of at least 7-10 days.*

- *Preoperative fasting and carbohydrate loading:*  
*Patients undergoing elective colorectal surgery should be allowed to eat up until 6 h and take clear fluids including CHO drinks, up until 2 h before initiation of anesthesia. Patients with delayed gastric emptying and emergency patients should remain fasted overnight or 6 h before surgery. No recommendation can be given for the use of CHO in patients with diabetes.*
- *Postoperative nutritional care:*  
*Most patients can and should be offered food and oral nutrition supplementation (ONS) from the day of surgery. Perioperative immunonutrition in malnourished patients is beneficial in colorectal cancer surgery.*

### **Perioperative management with intensive dental staff participation: PERiO at Okayama University Hospital, Japan**

Along with streaming of a worldwide revolution in perioperative management, we established PERiO in 2008 to maintain safe, authentic, and high-quality perioperative management [3]. PERiO consists of anesthesiologists, surgeons, dentists/dental hygienists/ dental technicians, nurses, physical therapists, pharmacists, dieticians, and medical engineers (Figure. 1-B) [3]. ERAS® began with relatively less invasive colon cancer surgery aiming at strengthening recovery postoperatively, while PERiO was begun for relatively invasive respiratory and esophageal cancer surgeries aimed at suppressing complications [2]. As a result, much work content in PERiO conforms with ERAS® [2]. However, PERiO characteristically includes dental staff, while ERAS® does not, despite emphasizing the importance of multidisciplinary strategies.

Dentists, dental hygienists, and dental technicians perform preoperative management aimed at (1) preventing acute odontogenic pain caused by pulpitis and/or acute odontogenic infection during the perioperative period, (2) enabling patients to achieve oral nutrition/ingestion by dental treatment, (3) preventing dental injury during orotracheal intubation, (4) preventing postoperative pneumonia by keeping oral hygiene, and (5) enabling safe oral nutrition by appropriate eating/swallowing functional evaluation and rehabilitation.

Shimoda et al.[24] have investigated the impact of PERiO on the clinical outcomes of 127 elderly patients who underwent thoracic surgery for resection of non-small cell lung cancer. Radical operations were performed significantly more

frequently after than before PERiO introduction, whereas the postoperative complication rates were similar [24]. The duration of postoperative hospitalization was reduced, and the hospital surplus increased after PERiO introduction [24]. Yasuhara et al.[3] have investigated neurosurgical patients and noted that the PERiO system decreased the duration from admission to surgery. However, there was no significant difference in the complication rate or incidence of unexpected cancellation of surgery between the PERiO and non- PERiO systems to provide high-quality medical service, although the system should be improved so as to reduce the burden on medical staff [3]. Because perioperative management with PERiO constitutes a multidisciplinary care bundle approach, it is difficult to determine the effects of dental staff contribution only. However, Yamanaka et al.[25] have reported on an esophageal cancer surgery patient without occlusal support who gained body weight after treatment of dentures. Furthermore, dental status, especially with dental occlusal support, had a positive association with prognostic nutritional index (PNI) in patients with esophageal cancer who underwent esophagectomy (Yamanaka et al. submitted for publication). In 1984, Onodera et al.[26] have proposed that the linear predictive model relating the risk of operative complication and/or mortality to nutritional status is given by the relationship:  $PNI = 10 \times \text{serum albumin level (Alb) (g/dl)} + 0.005 \times \text{total lymphocytes count (TLC)/mm}^3$  in peripheral blood. PNI is simple to calculate, easy to interpret, and has been widely used to assess the preoperative immunologic and nutritional status of patients undergoing digestive surgery [27-29]. Our finding suggested that poor dental occlusal support might cause immunological and nutritional problems, leading to higher surgical risk and lower survival.

The Japanese social insurance system, which provides universal health insurance coverage (all Japanese citizens are provided with care and treatment at any time and place of their choice, regardless of the type of facility [public or private], level of care and as in- or outpatients; the fundamental idea of this system is free access to high-quality health care [30]), started to cover involvements of dental staff for perioperative oral management since 2012. Dental involvement in PERiO was a reference model to establish the system of Japanese health insurance coverage. Ishimaru et al. [31] have recently analyzed the nationwide administrative claims database in Japan. Patients were identified who underwent resection of head and neck, esophageal, gastric, colorectal, lung or liver cancer between May 2012 and December 2015 [31]. Of 509,179 patients studied, 81,632 (16.0%) received preoperative oral care from a dentist. A total of 15,724 patients (3.09%) had postoperative pneumonia and 1734 (0.34%) died within 30 days postoperatively. After adjustment for potential

confounding factors, preoperative oral care by a dentist was significantly associated with a decrease in postoperative pneumonia (3.28% vs. 3.76%; risk difference, 0.48 [95% confidence interval, -0.64% to -0.32%]) and all-cause mortality within 30 days of surgery (0.30% vs. 0.42%; risk difference, -0.12 [-0.17% to -0.07%]) [31]. They concluded that preoperative oral care by a dentist significantly reduced postoperative complications in patients who underwent cancer surgery [31]. Their discussion was focused on oral hygiene because one of its primary outcomes was postoperative pneumonia. However, preoperative oral care by dentists would include eating/swallowing functional perspective, leading to nutritional support, and it might contribute to a significant outcome because of better nutritional condition.

**Further clinics and studies involving dental specialty should be considered important in perioperative management from a nutritional perspective**

ERAS® introduces itself for patients on its website as follows. The protocol items are developed and run by a team of key professionals, including surgeons, anesthetists, nurses, dieticians, physiotherapists, and others, and they jointly keep control over the entire patient journey and continuously audit the treatment (available in the public domain at <http://erassociety.org/patients/>, accessed on January 1, 2019). ERAS focuses on the relatively early phase postoperatively; therefore, its nutritional support is mainly indicated by doctors and dietitians. However, it is obviously better that the fundamental oral condition enabling oral nutrition is managed by dental staff. Dentists with the specialty of eating/swallowing functional evaluation contribute to the early postoperative phase directly according to its specialty. Further clinical studies and research involving dental specialty should be considered important in perioperative management from a nutritional perspective. We are currently performing a study on association between dental occlusal support and recovery after esophageal cancer surgery, and it seems to show significant relationship. Such studies conducted in a single institute could have some impact; however, the number of subjects would be limited generally. Studies that can provide high evidence level such as a randomized controlled trial are difficult to conduct because dental intervention must have benefit theoretically, and negative control, which not provided dental intervention, could not be set ethically. Therefore, well-designed multicenter studies to evaluate relationships between the degree of dental intervention and benefits in perioperative outcomes are essential. Although this report is mainly given from a nutritional perspective, dental



staff can also contribute to preventing postoperative infections, such as pneumonia and/or surgical site infection (in the case when the surgical site is near the oral cavity). Furthermore, improving and maintaining oral functions contribute to better quality of life for patients in the mid- to long-term postoperative period after discharge.

Currently, contribution to general health by maintaining oral health is a significant theme of dentistry, such as the effects of periodontal treatment on the metabolic control of diabetes, which has been studied extensively. Now, it seems that the barrier between dental and medical staff is beginning to disappear in the field of perioperative management, enabling better medical treatment, such as our PERiO and consequently Japanese universal health insurance coverage. For surgical patients to live well and maintain health in their community, dental staff participate not only in medical surgery adaptation but also in decision-making for operations from the view point of postoperative life and support the patients to actively take care of their health through the perioperative period. The dental staff at hospitals as well as at dental clinics contributing to community health care have important roles.

## **Conclusion**

Recent changes and improvements in perioperative management methods, especially in nutritional perspectives in the multidisciplinary team approach of ERAS®, emphasize the importance of nutritional management in the perioperative period and lead to good outcomes. Currently, dental staff are not regarded as key professionals of ERAS®, while they can contribute to good outcomes in the perioperative period. Our PERiO and consequently the Japanese universal health insurance coverage system covering involvements of dental staff for perioperative oral management showed good outcomes. Contribution to not only oral health but also general health through oral managements/treatments is currently a significant theme of dentistry. Therefore, more clinics and further studies involving dental specialty should be considered important in perioperative management from a nutritional perspective.

## **Conflict of Interest**

We have no conflicts of interest to declare.

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## References

Papers of particular interest, published recently, have been highlighted as:

\* Of importance

\*\* Of major importance

1. Fearon KC, Ljungqvist O, Von Meyenfeldt M, Revhaug A, Dejong CH, Lassen K et al. Enhanced recovery after surgery: a consensus review of clinical care for patients undergoing colonic resection. *Clin Nutr.* 2005;24(3):466-77. doi:10.1016/j.clnu.2005.02.002.
2. Shirakawa Y. [Perioperative Team Cooperation in Okayama University Hospital]. *Nihon Geka Gakkai Zasshi.* 2017;118(2):149-54.
- 3.\* Yasuhara T, Hishikawa T, Agari T, Kurozumi K, Ichikawa T, Kameda M et al. Perioperative Management Center (PERIO) for Neurosurgical Patients. *Neurol Med Chir (Tokyo).* 2016;56(9):574-9. doi:10.2176/nmc.oa.2016-0085. **A characteristic perioperative management center in which dental staff intensively participate is introduced.**
4. Nelson G, Altman AD, Nick A, Meyer LA, Ramirez PT, Achantari C et al. Guidelines for pre- and intra-operative care in gynecologic/oncology surgery: Enhanced Recovery After Surgery (ERAS(R)) Society recommendations--Part I. *Gynecol Oncol.* 2016;140(2):313-22. doi:10.1016/j.ygyno.2015.11.015.
5. Nelson G, Altman AD, Nick A, Meyer LA, Ramirez PT, Achantari C et al. Guidelines for postoperative care in gynecologic/oncology surgery: Enhanced Recovery After Surgery (ERAS(R)) Society recommendations--Part II. *Gynecol Oncol.* 2016;140(2):323-32. doi:10.1016/j.ygyno.2015.12.019.
6. Scott MJ, Baldini G, Fearon KC, Feldheiser A, Feldman LS, Gan TJ et al. Enhanced Recovery After Surgery (ERAS) for gastrointestinal surgery, part 1: pathophysiological considerations. *Acta Anaesthesiol Scand.* 2015;59(10):1212-31. doi:10.1111/aas.12601.
7. Feldheiser A, Aziz O, Baldini G, Cox BP, Fearon KC, Feldman LS et al. Enhanced Recovery After Surgery (ERAS) for gastrointestinal surgery, part 2: consensus statement for anaesthesia practice. *Acta Anaesthesiol Scand.* 2016;60(3):289-334. doi:10.1111/aas.12651.
8. Mortensen K, Nilsson M, Slim K, Schafer M, Mariette C, Braga M et al. Consensus guidelines for enhanced recovery after gastrectomy: Enhanced Recovery After Surgery (ERAS(R)) Society recommendations. *Br J Surg.* 2014;101(10):1209-29. doi:10.1002/bjs.9582.
9. Cerantola Y, Valerio M, Persson B, Jichlinski P, Ljungqvist O, Hubner M et al. Guidelines for perioperative care after radical cystectomy for bladder cancer: Enhanced Recovery

- After Surgery (ERAS((R))) society recommendations. *Clin Nutr.* 2013;32(6):879-87. doi:10.1016/j.clnu.2013.09.014.
10. Lassen K, Coolsen MM, Slim K, Carli F, de Aguilar-Nascimento JE, Schafer M et al. Guidelines for perioperative care for pancreaticoduodenectomy: Enhanced Recovery After Surgery (ERAS(R)) Society recommendations. *Clin Nutr.* 2012;31(6):817-30. doi:10.1016/j.clnu.2012.08.011.
  11. Lassen K, Coolsen MM, Slim K, Carli F, de Aguilar-Nascimento JE, Schafer M et al. Guidelines for perioperative care for pancreaticoduodenectomy: Enhanced Recovery After Surgery (ERAS(R)) Society recommendations. *World J Surg.* 2013;37(2):240-58. doi:10.1007/s00268-012-1771-1.
  12. Gustafsson UO, Scott MJ, Schwenk W, Demartines N, Roulin D, Francis N et al. Guidelines for perioperative care in elective colonic surgery: Enhanced Recovery After Surgery (ERAS(R)) Society recommendations. *Clin Nutr.* 2012;31(6):783-800. doi:10.1016/j.clnu.2012.08.013.
  13. Gustafsson UO, Scott MJ, Schwenk W, Demartines N, Roulin D, Francis N et al. Guidelines for perioperative care in elective colonic surgery: Enhanced Recovery After Surgery (ERAS((R))) Society recommendations. *World J Surg.* 2013;37(2):259-84. doi:10.1007/s00268-012-1772-0.
  14. Nygren J, Thacker J, Carli F, Fearon KC, Norderval S, Lobo DN et al. Guidelines for perioperative care in elective rectal/pelvic surgery: Enhanced Recovery After Surgery (ERAS(R)) Society recommendations. *Clin Nutr.* 2012;31(6):801-16. doi:10.1016/j.clnu.2012.08.012.
  15. Nygren J, Thacker J, Carli F, Fearon KC, Norderval S, Lobo DN et al. Guidelines for perioperative care in elective rectal/pelvic surgery: Enhanced Recovery After Surgery (ERAS((R))) Society recommendations. *World J Surg.* 2013;37(2):285-305. doi:10.1007/s00268-012-1787-6.
  16. Thorell A, MacCormick AD, Awad S, Reynolds N, Roulin D, Demartines N et al. Guidelines for Perioperative Care in Bariatric Surgery: Enhanced Recovery After Surgery (ERAS) Society Recommendations. *World J Surg.* 2016;40(9):2065-83. doi:10.1007/s00268-016-3492-3.
  17. Melloul E, Hubner M, Scott M, Snowden C, Prentis J, Dejong CH et al. Guidelines for Perioperative Care for Liver Surgery: Enhanced Recovery After Surgery (ERAS) Society Recommendations. *World J Surg.* 2016;40(10):2425-40. doi:10.1007/s00268-016-3700-1.
  18. Dort JC, Farwell DG, Findlay M, Huber GF, Kerr P, Shea-Budgell MA et al. Optimal Perioperative Care in Major Head and Neck Cancer Surgery With Free Flap Reconstruction: A Consensus Review and Recommendations From the Enhanced

- Recovery After Surgery Society. *JAMA Otolaryngol Head Neck Surg.* 2017;143(3):292-303. doi:10.1001/jamaoto.2016.2981.
19. Temple-Oberle C, Shea-Budgell MA, Tan M, Semple JL, Schrag C, Barreto M et al. Consensus Review of Optimal Perioperative Care in Breast Reconstruction: Enhanced Recovery after Surgery (ERAS) Society Recommendations. *Plast Reconstr Surg.* 2017;139(5):1056e-71e. doi:10.1097/PRS.0000000000003242.
  20. Low DE, Allum W, De Manzoni G, Ferri L, Immanuel A, Kuppusamy M et al. Guidelines for Perioperative Care in Esophagectomy: Enhanced Recovery After Surgery (ERAS((R))) Society Recommendations. *World J Surg.* 2018. doi:10.1007/s00268-018-4786-4.
  21. Batchelor TJP, Rasburn NJ, Abdelnour-Berchtold E, Brunelli A, Cerfolio RJ, Gonzalez M et al. Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS(R)) Society and the European Society of Thoracic Surgeons (ESTS). *Eur J Cardiothorac Surg.* 2019;55(1):91-115. doi:10.1093/ejcts/ezy301.
  - 22\*\*. Gustafsson UO, Scott MJ, Hubner M, Nygren J, Demartines N, Francis N et al. Guidelines for Perioperative Care in Elective Colorectal Surgery: Enhanced Recovery After Surgery (ERAS((R))) Society Recommendations: 2018. *World J Surg.* 2018. doi:10.1007/s00268-018-4844-y. **One of the ERAS® guidelines recently published for elective colorectal surgery. Importance of oral nutrition is presented.**
  23. Greco M, Capretti G, Beretta L, Gemma M, Pecorelli N, Braga M. Enhanced recovery program in colorectal surgery: a meta-analysis of randomized controlled trials. *World J Surg.* 2014;38(6):1531-41. doi:10.1007/s00268-013-2416-8.
  24. Shimoda A, Soh J, Ashiba T, Murata N, Fukuda T, Kobayashi M et al. [Cross-sectoral Approach of a Perioperative Management Center for General Thoracic Surgery]. *Kyobu Geka.* 2016;69(1):20-4.
  25. Yamanaka R, Soga Y, Minakuchi M, Nawachi K, Maruyama T, Kuboki T et al. Occlusion and weight change in a patient after esophagectomy: success derived from restoration of occlusal support. *Int J Prosthodont.* 2013;26(6):574-6. doi:10.11607/ijp.3622.
  26. Onodera T, Goseki N, Kosaki G. [Prognostic nutritional index in gastrointestinal surgery of malnourished cancer patients]. *Nihon Geka Gakkai Zasshi.* 1984;85(9):1001-5.
  27. Hirahara N, Tajima Y, Fujii Y, Yamamoto T, Hyakudomi R, Taniura T et al. Preoperative Prognostic Nutritional Index Predicts Long-term Outcome in Gastric Cancer: A Propensity Score-matched Analysis. *Anticancer Res.* 2018;38(8):4735-46. doi:10.21873/anticancer.12781.
  28. Cui P, Pang Q, Wang Y, Qian Z, Hu X, Wang W et al. Nutritional prognostic scores in

patients with hilar cholangiocarcinoma treated by percutaneous transhepatic biliary stenting combined with 125I seed intracavitary irradiation: A retrospective observational study. *Medicine (Baltimore)*. 2018;97(22):e11000. doi:10.1097/MD.00000000000011000.

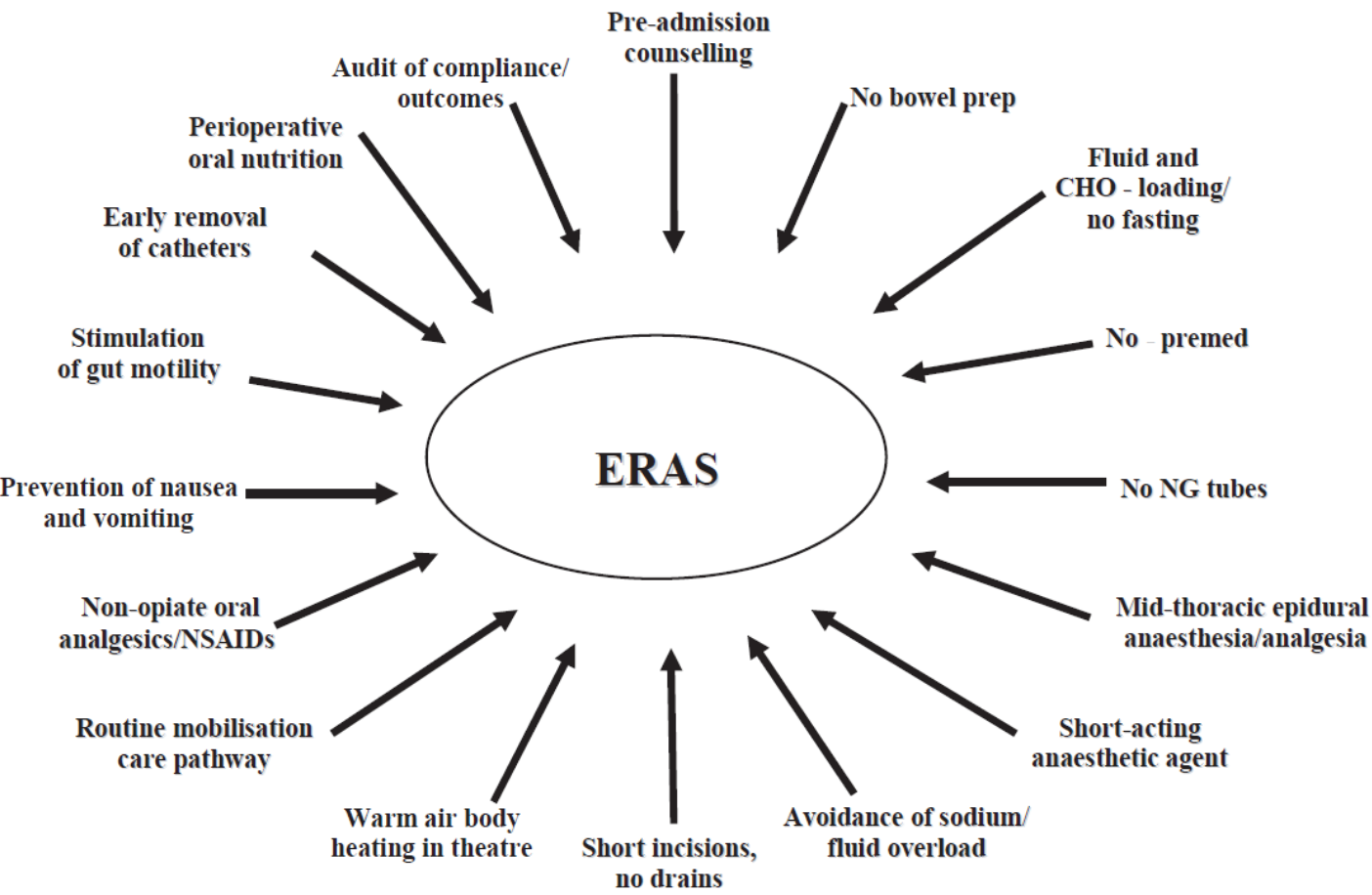
29. Okugawa Y, Toiyama Y, Oki S, Ide S, Yamamoto A, Ichikawa T et al. Feasibility of Assessing Prognostic Nutrition Index in Patients With Rectal Cancer Who Receive Preoperative Chemoradiotherapy. *JPEN J Parenter Enteral Nutr*. 2018;42(6):998-1007. doi:10.1002/jpen.1041.
30. Sasaki T, Izawa M, Okada Y. Current trends in health insurance systems: OECD countries vs. Japan. *Neurol Med Chir (Tokyo)*. 2015;55(4):267-75. doi:10.2176/nmc.ra.2014-0317.
- 31\*. Ishimaru M, Matsui H, Ono S, Hagiwara Y, Morita K, Yasunaga H. Preoperative oral care and effect on postoperative complications after major cancer surgery. *Br J Surg*. 2018;105(12):1688-96. doi:10.1002/bjs.10915. **Analyzed the nationwide administrative claims database in Japan, and concluded that preoperative oral care by a dentist significantly reduced postoperative complications in patients who underwent cancer surgery.**

## Figure legend

**Figure 1.** Concepts of multidisciplinary perioperative management. A) Main elements of ERAS® protocols (reproduced from [1]). ERAS® is based on a multimodal program with optimal pain relief, stress reduction with regional anesthesia, early enteral nutrition, and early mobilization. Nutrition is a key pillar of the cares. Throughout the perioperative period, oral nutrition is suggested as well as possible. Dental staff could contribute due to their specialty, but they are not included in the original multidisciplinary approach. B) Medical professionals constituting PERiO. PERiO consists of anesthesiologists, surgeons, dentists/ dental hygienists/ dental technicians, nurses, physical therapists, pharmacists, dieticians, and medical engineers. Much of the work content conforms to ERAS®. However, it is characteristic for dental staff to intensively participate in the multidisciplinary approach for perioperative management.

Figure. 1

A)



B)

