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TITLE:

The Dyspepsia Educational Tool as a Novel Aid in Dyspepsia Management

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KEYWORDS:

dyspepsia, patient education, E-learning, medical overuse, shared decision making, multimedia

SUMMARY:

This protocol describes the development process of a digital dyspepsia educational tool. Assessment of unmet needs and literature, content development, and building of the tool are presented. The methodology can be used as a guide for future development of digital educational tools.

ABSTRACT:

Digital educational tools have a well-established role in current healthcare. In particular, disorders that are managed non-pharmacologically benefit from this development, as it enables patient engagement in self-management. Dyspepsia is a condition thought to arise from gastric and duodenal perturbations, brain-gut axis disturbances, and dietary factors. Behavioral interventions are a major part of dyspepsia treatment, hence patient engagement and motivation through education is essential. Protocols that describe the development process of such educational tools are scarce. We provide a methodology describing development of a dyspepsia educational tool. Assessment of users' needs is the first step, followed by a literature search. The content is developed based on the main themes and entered into a content management system, to build the program. Final adjustments are made after a pilot test of the tool. The presented protocol can be used as a guide for development of a digital dyspepsia educational tool or as a tool for similar situations.

INTRODUCTION:

Patient education is an important component of healthcare, enabling active engagement of patients in responsible management of their health[1]. To improve efficacy and appropriate use of healthcare resources, contemporary and disease-specific measures are needed to facilitate patient engagement.

Nowadays, digital tools increasingly replace paper versions of patient education, benefiting from their sustainability, effective distribution, and potential to visualize information. For chronic illnesses that lack curative treatment and biological substrate, education is essential for motivation of patients to engage in self-management[2,3]. Dyspepsia is a condition that often causes long-term complaints. Exact origin of symptoms remains unclear, although evidence indicates three main pathophysiological mechanisms, including 1) hypersensitivity to gastric distension, 2) impaired gastric accommodation, causing inadequate distension in reaction to a meal, and 3) delayed gastric emptying[4]. Additionally, duodenal perturbations, brain-gut disturbances, and dietary factors have been suggested to play a role[5]. Main symptoms comprise post-prandial fullness, epigastric pain, early satiety, and epigastric burning. Upper gastrointestinal (GI) endoscopy in dyspeptic patients reveals no cause of symptoms in over 70%; these cases are referred to as functional dyspepsia. Pharmacological treatment options for dyspepsia are limited, often inciting patients to resolve to complementary and alternative therapies[6,7]. Quality of life in dyspepsia patients is often reduced as dyspepsia is associated with concomitant issues, such as impaired sleep quality and loss of work productivity[8]. Dyspepsia management benefits from active patient engagement, as behavioral interventions are a main component of dyspepsia treatment[9,10]. These interventions require a significant effort from patients, which may be facilitated by personalized and interactive support.

Correct management of dyspepsia is essential to improve healthcare outcomes and prevent overuse of medical resources. Upper gastrointestinal (GI) endoscopy for dyspepsia is a well-known form of overuse as its diagnostic yield is limited[11]. Several methods have been proposed to reduce the number of upper GI endoscopies, mostly focused on physician education or drug-based symptom reduction[12]. Uncertainty about the cause of dyspepsia is often unsatisfactory for patients, and diagnostic tests may be performed in excess as a consequence. Consequently, education of patients about pathogenesis, treatment options, and conservative management would be an effective strategy to reduce the number of upper GI endoscopies.

While digital tools potentially provide an excellent platform for patient education, several functionalities of a digital tool are required, in order to maximize patient adoption and subsequent patient engagement in disease management[13]. The expected success of digital education mainly depends on its development process and measures taken to optimize information transfer. However, development processes of digital educational tools are infrequently published, impairing reproduction, progression, and evaluation of the validity and safety[1,14].

There is need for a detailed description and evaluation of development of a patient-centered digital educational tool. We describe the development of our dyspepsia educational tool, to serve as a template for future educational tool development.

PROTOCOL:

All procedures described in this protocol were approved by the Radboud university medical center Institutional Review Board (file no. 2016-3074).

1. Preliminary research

1.1. Focus groups to assess unmet needs in dyspepsia management

1.1.1. Create a structure for a focus group with dyspeptic patients and with general practitioners.

1.1.2. Conduct a focus group. Keep conducting additional focus groups until saturation of information is reached.

NOTE: For this study two focus groups were conducted.

1.1.2.1. Recruit participants from patient organization platforms and the gastroenterology outpatient clinic.

1.1.2.2. Recruit general practitioners through local general practitioner networks.

1.1.2.3. Provide all participants with a patient information form, explaining the concept and goal of the focus group. Do not present the questions of the focus group in the information form.

1.1.2.4. Obtain written informed consent from all participants.

NOTE: Informed consent was obtained from all participants in this study.

1.1.2.5. Conduct the focus groups with two researchers. Appoint a moderator and an observer. As a moderator, emphasize that there are no wrong answers, ensure all participants have the opportunity to express their views, and monitor the time. As an observer, observe and take notes of the group dynamics and body language of participants.

1.1.2.6. Start the recording of the session using a voice recorder.

1.1.2.7. Present each question to the group and encourage discussion about varying views. Ask the following questions; 'Could you describe the symptoms you feel?', 'How do the symptoms influence your day-to-day life?', 'What measures have you taken yourself to relieve your symptoms?', 'Where did you get most information about your disease?', and 'Which elements lacked in the management of your disease?'.

1.1.2.8. Transcribe the voice recording. Process the focus groups and interviews using the qualitative data analysis software (e.g., ATLAS.ti version 8.3.16).

1.1.2.9. Highlight and connect topics and views that overlap. Use the observer notes for interpretation of discussion and opposite views of participants.

1.1.2.10. Extract the main themes resulting from the focus group to form the structure of the tool.

1.2. Existing scientific evidence

1.2.1. Based on the main outlines that resulted from assessment of needs, make an overview of the topics that should be supported by literature. Examples are pathophysiology of dyspepsia, dietary interventions, pharmacological treatment, and (the value of) diagnostics.

1.2.2. Use the online databases Medline and EMBASE to search for recent literature. To build a search, MeSH terms (Medline) or Emtree terms (EMBASE) should be combined with free text words.

1.2.3. Select the most relevant articles to use as scientific background in the tool.

1.2.4. Find local and national guidelines related to dyspepsia management. Make a selection of recommendations most relevant to the target audience.

1.2.5. Summarize existing national patient information on dyspepsia. Use approved primary and secondary care information, as well as government supported web-based information.

2. Content development

2.1. Software development partner

2.1.1. Select a partner for software production to involve in the development. Make a selection based on available products, such as 3D visualization, video recording, user friendly content management system, and possibilities to do adjustments after pilot test.

NOTE: For this study, Medify Media B.V. was contracted for software development.

2.2. Organization of data

2.2.1. Combine all collected data in one file and merge related topics. Create a clear overview of all items that should be addressed in the tool.

2.2.2. Categorize the information into manageable chapters.

2.2.3. Organize the items into a logical flow that will be maintained in the tool, for example by drawing up a flowchart illustrating the flow and content of each chapter and interconnection between chapters.

2.2.4. Organize the chapters in a nonlinear structure, allowing completion of chapters in random order.

2.3. Process session

2.3.1. Organize a process session with all stakeholders, including involved researchers, doctors, software developers, and visual designers.

2.3.2. Within the process session, identify all elements that can be visualized through real-life videos or animation or should appear as text.

2.4. Creation of content

2.4.1. Start every chapter with an overview of the chapter, introduce important items and terms.

2.4.2. At the end of every chapter, give a chapter summary. Refrain from giving redundant information that may distract attention.

2.4.3. Highlight essential information using bullet points and/or bold text.

2.4.4. Use plain language writing when writing texts.

2.4.4.1. Clearly consider the target audience and write from that perspective.

2.4.4.2. Maintain a 7^{th} to 8^{th} grade reading level.

2.4.4.3. Use active rather than passive sentences, writing in a conversational style, including the frequent use of questions and personal pronouns (e.g., 'do you regularly feel full after a normal sized meal? Try to avoid fatty foods.', rather than 'if a full feeling after a normal sized meal is regularly encountered, avoiding fatty foods may be tried.').

2.4.4.4. Limit the amount of text per paragraph to a maximum of 10 sentences.

2.4.5. For the videos:

2.4.5.1. Make a list of people needed for the real-life videos (e.g., patients, doctors, dieticians).

2.4.5.2. Write detailed scripts and log files for all videos.

2.4.5.3. Select an entourage for shooting of the videos, appropriate to the subject of the video, and with reduced noise level.

2.4.6. For 3D visualization of elements of the content:

2.4.6.1. Use visual references for each step of the desired 3D animation.

2.4.6.2. Split animations into clips of 8−12 s. Before and after a clip, provide text blocks with information about the clip.

3. Building the digital educational tool

3.1. Add all the content to a content management system to adjust the order and appearance.

NOTE: In this study, the Medify B.V. content management system was used.

3.2. Add all the text and the videos to panels. Choose a background image or a 3D visualization. Add customized questionnaires.

3.3. Check whether everything is correctly incorporated in the tool.

3.4. When all content is built into the content management system, create a pilot version of the educational tool.

4. User experience and validation

4.1. Administer the pilot educational tool to two patients and two general practitioners and ask for feedback on lay-out, content, and user friendliness.

4.2. Adjust the tool based on the test comments.

4.3. Validate the efficacy and usability of the educational tool in a randomized controlled trial.

REPRESENTATIVE RESULTS:

Results of focus groups

Five patients, recruited through patient networks (n = 2) or at the outpatient clinic (n = 3), were invited to join a focus group. All focus group patients were diagnosed with dyspepsia based on the opinion of a gastroenterologist. Characteristics of included patients are presented in **Table 1**.

Most participants agreed that uncertainty about the cause and origin of symptoms is a major issue. Participants agreed that it would have helped if they had received more information, such as prevalence of dyspepsia. Symptoms were related to diet for nearly all patients. Extensive dietary advice was missed by several participants. Two views on upper GI endoscopies were expressed; most considered upper GI endoscopies useful to rule out serious disease and reduce worries, and few thought upper GI endoscopies would be redundant for their symptoms. Sources of information used by participants were private web-pages, online patient networks, general practitioners, dieticians, and friends and family with similar complaints.

Five general practitioners agreed to participate in the focus group. All were currently practice-based in the Nijmegen (the Netherlands) area. Main issues participants encountered with dyspeptic patients were fear of disease (patients as well as doctors), and uncertainty about cause and origin of symptoms. All agreed they have a desire to offer patients ‘something’, but that options are limited. Often, upper GI endoscopy is used as a step in the management process, even though no abnormalities are expected. Arguments

were reassurance, and use as a 'final part' of the management process. Experiences with the effect of acid-reducing drugs were varied.

Themes extracted from both focus groups were 1) reassurance; 2) pathophysiology of dyspepsia; 3) prevalence, symptoms, and prognosis of dyspepsia; 4) lifestyle interventions; 5) availability and value of therapy and diagnostics; 6) psychosocial factors in dyspepsia; and 7) experiences of other dyspeptic patients with symptoms and treatments. For all themes literature searches were performed and data obtained was distributed across five chapters. Every chapter was arranged with an overview of the content, followed by multimedia information, and final summary statement. All text blocks were given a title representing the core message of the text below. Text blocks were organized to appear at alternating locations on the screen, creating a dynamic flow. If applicable, illustrations were inserted as a background. Within each chapter, several self-tests were incorporated. The self-tests contained three to four questions and answers. Videos were kept to a minimum length, with a maximum of one minute.

Overview of the digital dyspepsia educational tool per chapter

Chapter 1. Upper gastrointestinal endoscopy for dyspepsia.

Chapter 1 provides information on prevalence and different types of symptoms. The prevalence is explained through 3D animation (**Figure 1**) and text. Reassurance about the usually benign nature of symptoms and acknowledgement of the impact on quality of life is given in several short text blocks. The value and capabilities of upper GI endoscopy is explained in text, and 3D animation illustrates an endoscopy procedure (**Figure 2**). Outcomes of upper GI endoscopy are depicted in a pie chart. The chapter concludes with several experiences of patients with dyspepsia, one of which includes a video clip of a patient.

Chapter 2. Information about symptoms and potential causes

In chapter 2, normal gastric function is explained. In a video, a gastroenterologist elucidates on this function. After the video, 3D animation (**Figure 3**), accompanied by text, depicts the anatomy of the stomach and natural food processing in the stomach. After this natural function, it is explained how several disturbances of the stomach can cause symptoms. These are alternatingly explained in text and background illustration (**Figure 4**), or text and 3D animation (**Figure 5**).

Chapter 3. Symptoms due to inflammation of the stomach

The third chapter starts with a video of a gastroenterologist explaining gastric inflammation (**Figure 6**). 3D animations (**Figure 7**) and text illustrate how alcohol, medication, smoking, and Helicobacter pylori affect the stomach.

Chapter 4. What measures can you take against the symptoms?

In chapter 4, the role of diet is explained. A hyperlink to a food diary is provided (**Figure 8**). In this diary, patients are encouraged to keep track of their diet and report their complaints. A

dietician gives dietary advice in two videos, including a list of foods known to cause symptoms. The text explains how stress reduction may reduce symptoms and which role a therapist can play. The relevance of general health is explained, including a healthy weight, regular physical activity, and sufficient sleep.

Chapter 5. What can the doctor do to mitigate symptoms?

In chapter 5, the pharmacological mechanisms of proton pump inhibitors, histamin2-receptor antagonists, and anti-acids are illustrated by 3D animations (**Figure 9**), accompanied by text. It is also explained in text that several other drugs exist, such as prokinetics and antidepressants, although indications are more stringent. In text, information is also given about which therapists the general practitioner can potentially refer to, i.e., a dietician, psychologist, or a therapist focusing on stress reduction.

FIGURE AND TABLE LEGENDS:

Figure 1: 3D illustration of dyspepsia prevalence. As dyspepsia prevalence is 40%, 4 out of 10 people are highlighted.

Figure 2: 3D animation of endoscopy procedure. The endoscope passes through the esophagus and stomach, displayed transparently.

Figure 3: 3D animation of natural food processing. Food enters the stomach and the stomach contracts for food processing. Gastric acid is present in the stomach.

Figure 4: Text block and background illustration of gastric irritants. A text block explains the effect of spicy food. The background image shows a variety of spices.

Figure 5: 3D animation of natural gastric function disturbance. Stress, shown as blue lines, influences the stomach, by delaying gastric emptying. This is depicted by food stagnated in the stomach.

Figure 6: Video of a gastroenterologist explaining inflammation of the stomach. In a video, a gastroenterologist explains how several factors can irritate the stomach. In text, a summary of the explanation is given.

Figure 7: 3D animation of mucosal damage in the stomach. Several ulcers are shown in the gastric mucosa.

Figure 8: Food diary. In a food diary, patients can fill in day, time of food consumption, description of the food, amount of food, description of symptoms, duration of symptoms, measures taken against symptoms, and whether measures were effective.

Figure 9: 3D animation of pharmacological mechanism of anti-acids. A broken-down tablet is shown to reach the gastric lining.

Table 1: Characteristics of (patient) focus group participants. Five patients were invited to a focus group to assess unmet needs in dyspepsia management.

DISCUSSION:

The digital dyspepsia educational tool, developed using the abovementioned protocol, is a novel multimedia educational tool to assist patients and physicians in management of dyspepsia. This tool may be deployed to stimulate patient engagement, and improve health outcomes while curtailing inappropriate use of medical resources.

A similar procedure has been described for development of a fibromyalgia app[15]. As with dyspepsia, management of fibromyalgia focuses initially on non-pharmacological therapy, emphasizing the importance of patient engagement. Preliminary research for this app used a different approach, and was based on semi-structured interviews rather than focus groups. As a result, there is a risk of missing information through discussion. Questions for interviews for the fibromyalgia app were based on a literature search. Our literature search was based on focus group results, and themes were not restricted by availability of literature. Similar to our educational tool, patients and clinicians were involved in development of the tool. Involving clinicians is important for validity and safety of the tool[14,16]. This is not always the case as a review of 112 available digital tools for chronic respiratory diseases revealed that only 18% of the apps involved medical staff in the development process[14].

Using multimedia for educational purposes has a substantial advantage over information in printed text, as information can be delivered interactively and visualized in detail. When applied inappropriately, multimedia education also has several pitfalls. Principles for the design of multimedia instruction have been described, including pitfalls and correct application of multimedia[17]. Main principles for effective multimedia education are 'reduction of extraneous processing', i.e., minimizing stimulants distracting focus; 'managing essential processing', i.e., guiding learners through complex and large quantities of information; and 'fostering generative processing', i.e., stimulating learners to process the presented information. In the dyspepsia educational tool, a selection of these principles is implemented. First, extraneous processing was reduced by only displaying essential information, highlighting important information, and adding frequent overviews. Secondly, essential processing was managed by refraining from showing text during animations, to avoid split attentions. Also, animations were segmented, rather than continuous. Subsequent information could be accessed through a 'next-button', enabling users to control the pace of information processing[18]. Chapters were available in random order, allowing for selecting or bypassing information, based on patients' own needs. While this also imposes the risk that potentially relevant information is missed, it is an important component that contributed to user satisfaction. Lastly, generative processing was fostered by alternately using text, videos, and 3D animations. Text was written according to the personalization principle, entailing the use of a conversational writing style, with frequent use of personal pronouns.

In addition to the multimedia principles, interactivity was found to be positively correlated with learner performance[19]. In our protocol, interactivity was introduced by intermittently posing questions reflecting on the content, with direct feedback on the answers.

This protocol also has several limitations. No strict guidelines exist for focus group size, but six to eight participants allow for sufficient varying opinions and equal speaking chance, without the risk of group formation[20]. We included five participants for both focus groups, imposing a risk of achieving limited overview of perspectives. In addition, while a single focus group exercise provides important information, optimal assessment of unmet needs is done by conducting focus groups until information saturation is achieved. Collecting information from a broader range of stakeholders through focus groups, i.e., gastroenterologists, may also be an asset. Furthermore, a still greater element of interactivity could be introduced to further stimulate patient engagement, such as direct or indirect contact with a healthcare provider or peers, or adding a game aspect. Lastly, the information provided was equal for all patients. Patient adoption may have been further enhanced by using pre-entered symptoms to create personalized information and feedback.

Validation of the educational tool is in progress. Currently, a trial is being conducted with the dyspepsia educational tool for validation, and to determine whether it can be used to prevent inappropriate upper GI endoscopies (ClinicalTrials.gov Identifier NCT03205319).

In this study, we presented and evaluated a protocol for development of a dyspepsia educational tool. This protocol can be adopted to create similar dyspepsia tools, as well as tools for diseases with a similar management strategy, in order to improve health outcomes and efficient use of healthcare.

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DISCLOSURES:

The authors have nothing to disclose.

REFERENCES:

1. Barello, S. et al. eHealth for Patient Engagement: A Systematic Review. *Frontiers in Psychology.* **6**, 2013, (2015).
2. Halpert, A. Irritable Bowel Syndrome: Patient-Provider Interaction and Patient Education. *Journal of Clinical Medicine.* **7** (1), (2018).
3. Schulz, P. J., Rubinelli, S., Zufferey, M. C., Hartung, U. Coping With Chronic Lower Back Pain: Designing and Testing the Online Tool ONESELF. *Journal of Computer-Mediated Communication.* **15** (4), 625-645 (2010).
4. Tack, J., Bisschops, R., Sarnelli, G. Pathophysiology and treatment of functional dyspepsia. *Gastroenterology.* **127** (4), 1239-1255 (2004).
5. Talley, N. J. Functional dyspepsia: new insights into pathogenesis and therapy. *Korean Journal of Internal Medicine.* **31** (3), 444-456 (2016).
6. Chiarioni, G., Pesce, M., Fantin, A., Sarnelli, G. Complementary and alternative treatment in functional dyspepsia. *United European Gastroenterology Journal.* **6** (1), 5-12 (2018).

7. Ford, A. C., Marwaha, A., Lim, A., Moayyedi, P. What is the prevalence of clinically significant endoscopic findings in subjects with dyspepsia? Systematic review and meta-analysis. *Clinical Gastroenterology and Hepatology.* **8** (10), 830-837.e2 (2010).
8. Matsuzaki, J. et al. Burden of impaired sleep quality on work productivity in functional dyspepsia. *United European Gastroenterology Journal.* **6** (3), 398-406 (2018).
9. Keefer, L., Palsson, O. S., Pandolfino, J. E. Best Practice Update: Incorporating Psychogastroenterology Into Management of Digestive Disorders. *Gastroenterology.* **154** (5), 1249-1257 (2018).
10. Feinle-Bisset, C., Azpiroz, F. Dietary and lifestyle factors in functional dyspepsia. *Nature Reviews Gastroenterology & Hepatology.* **10** (3), 150-157 (2013).
11. Manes, G., Balzano, A., Marone, P., Lioniello, M., Mosca, S. Appropriateness and diagnostic yield of upper gastrointestinal endoscopy in an open-access endoscopy system: a prospective observational study based on the Maastricht guidelines. *Alimentary Pharmacology & Therapeutics.* **16** (1), 105-110 (2002).
12. de Jong, J. J., Lantinga, M. A., Drenth, J. P. Prevention of overuse: A view on upper gastrointestinal endoscopy. *World Journal of Gastroenterology.* **25** (2), 178-189 (2019).
13. Baldwin, J. L., Singh, H., Sittig, D. F., Giardina, T. D. Patient portals and health apps: Pitfalls, promises, and what one might learn from the other. *Healthcare (Amsterdam).* **5** (3), 81-85 (2017).
14. Sleurs, K. et al. Mobile health tools for the management of chronic respiratory diseases. *Allergy.* 10.1111/all.13720, (2019).
15. Yuan, S. L. K., Marques, A. P. Development of ProFibro - a mobile application to promote self-care in patients with fibromyalgia. *Physiotherapy.* **104** (3), 311-317 (2018).
16. Huckvale, K., Morrison, C., Ouyang, J., Ghaghda, A., Car, J. The evolution of mobile apps for asthma: an updated systematic assessment of content and tools. *BMC Medicine.* **13**, 58 (2015).
17. Mayer, R. E. Applying the science of learning: evidence-based principles for the design of multimedia instruction. *American Psychologist.* **63** (8), 760-769 (2008).
18. Zhang, D. Interactive Multimedia-Based E-Learning: A Study of Effectiveness. *American Journal of Distance Education.* **19** (3), 149-162 (2005).
19. Northrup, P. A framework for designing interactivity intoWeb-based instruction. *Educational Technology.* **41** (2), 31-39 (2001).
20. Stalmeijer, R. E., McNaughton, N., Van Mook, W. N. Using focus groups in medical education research: AMEE Guide No. 91. *Medical Teacher.* **36** (11), 923-939 (2014).

Figure 1

Click here to access/download;Figure;Figure 1.ai

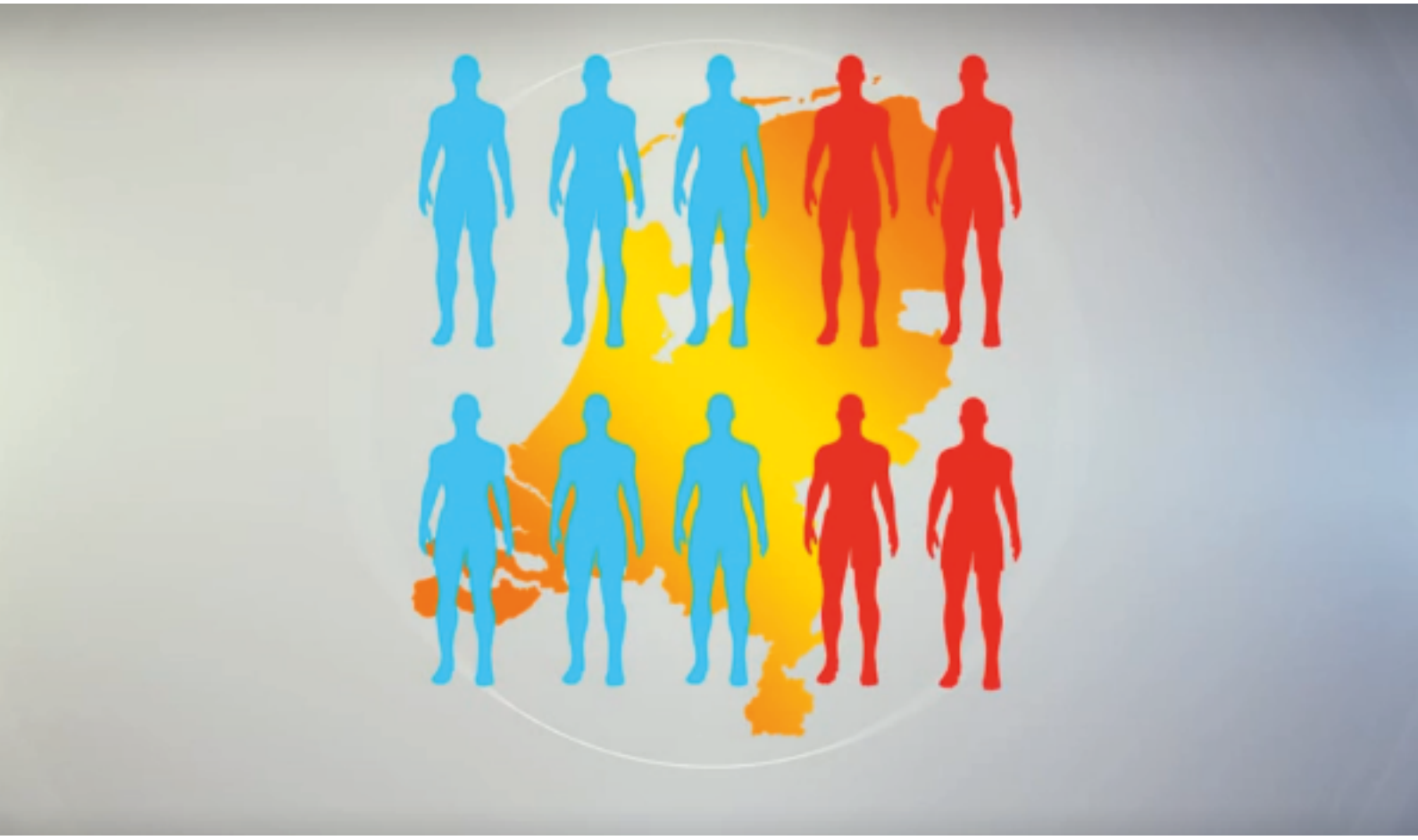

Figure 2

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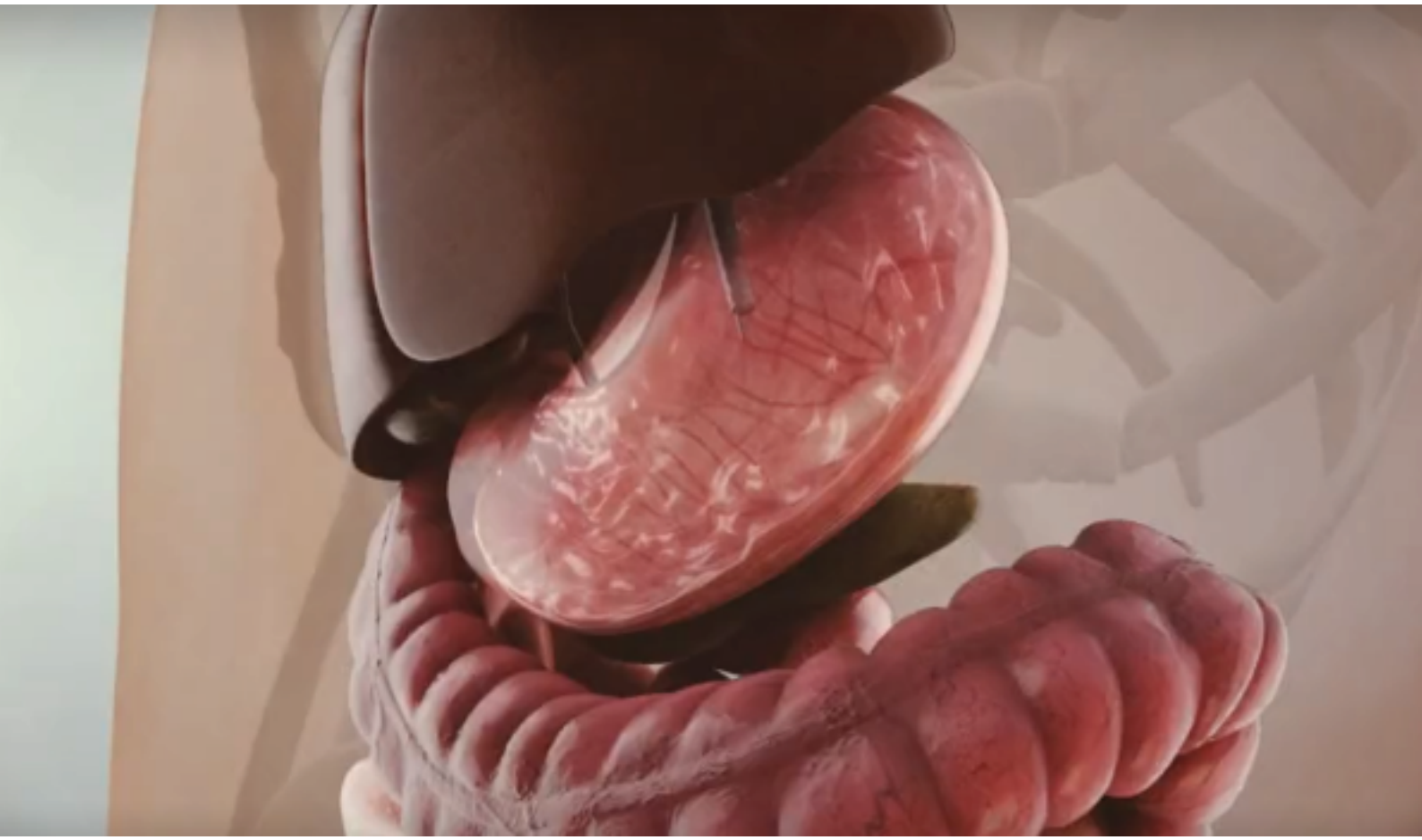

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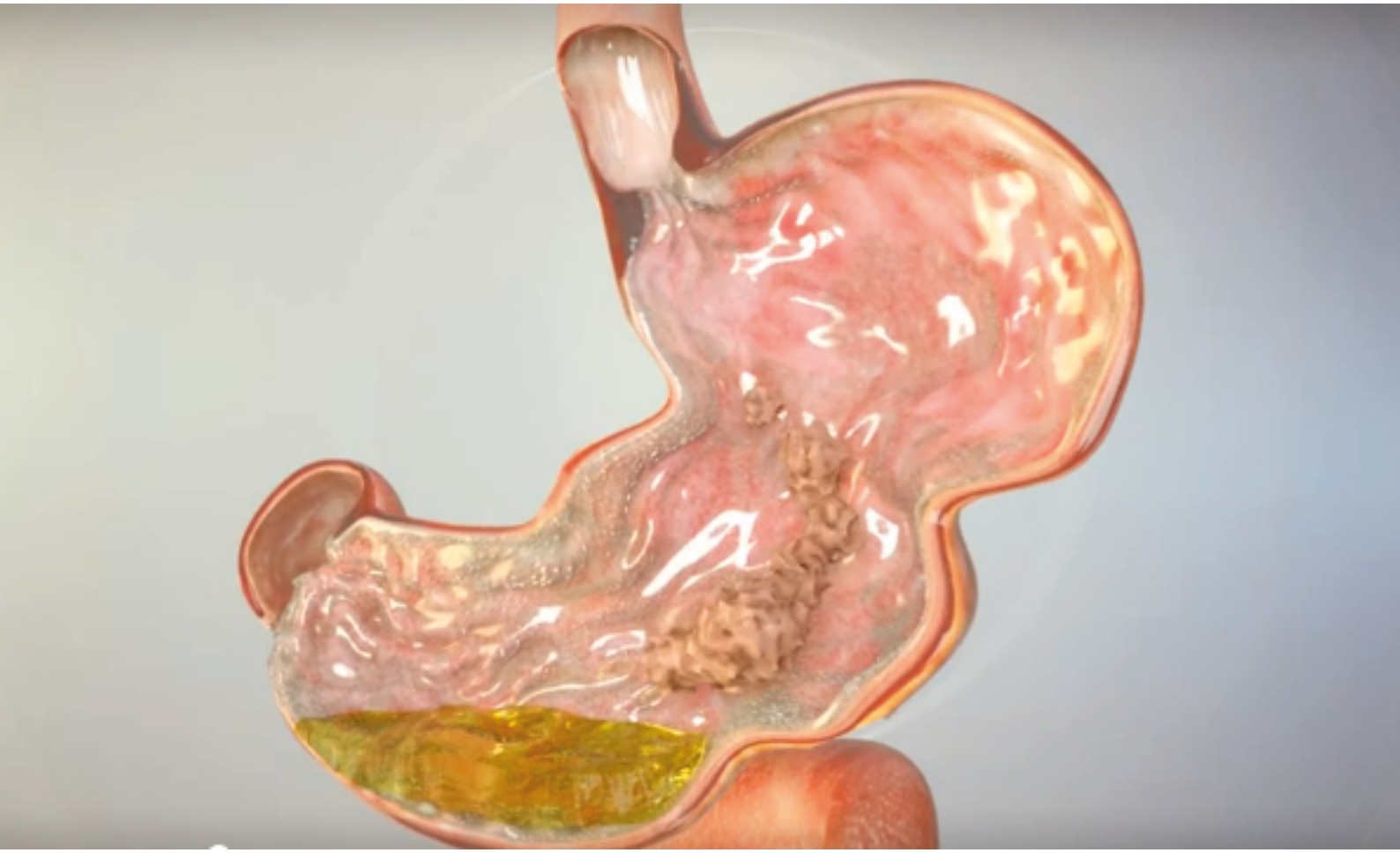

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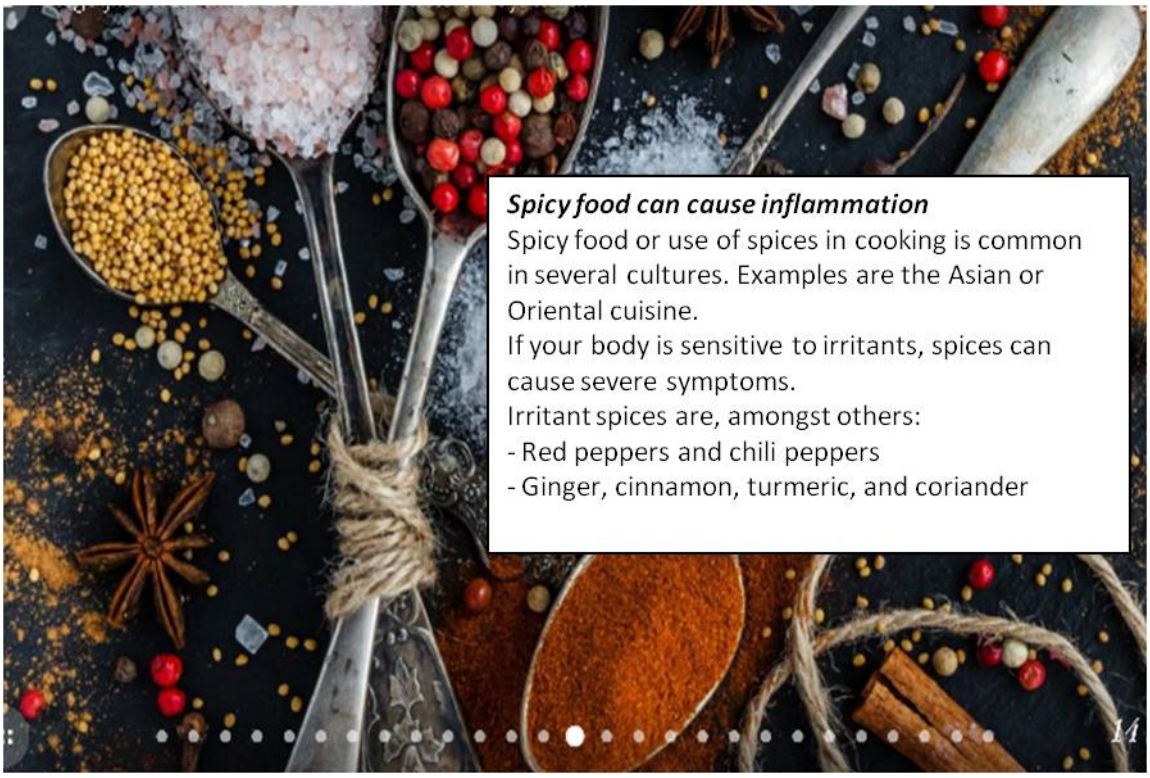

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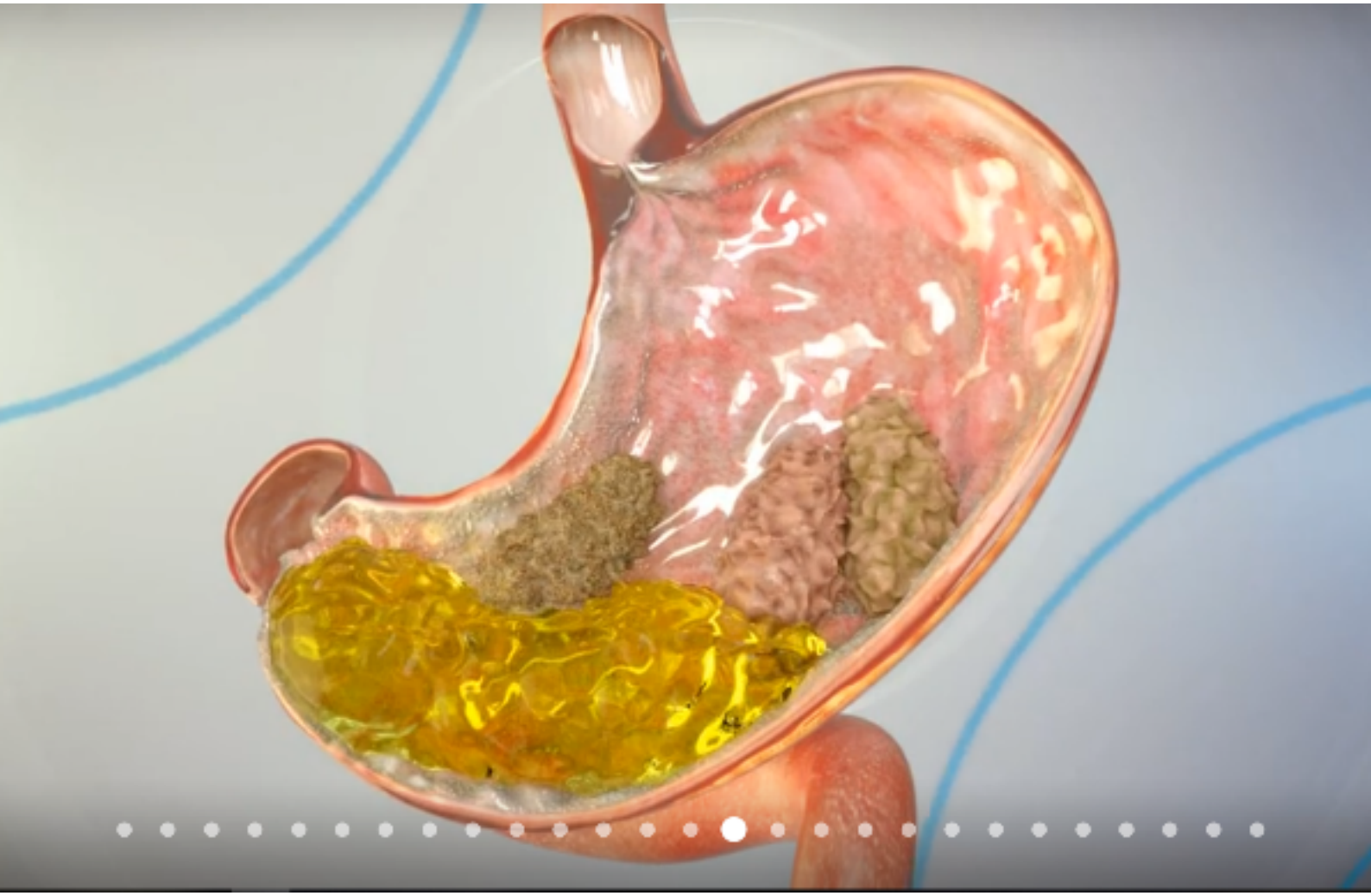

Figure 6

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Figure 7

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Figure 8

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Day / Date	Food			Symptoms				
	Time	Description	Amount	Description	Time start symptoms	Duration symptoms	Measures taken against symptoms	Effect of treatment
Monday ...../...../.....								
Tuesday ...../...../.....								

Figure 9

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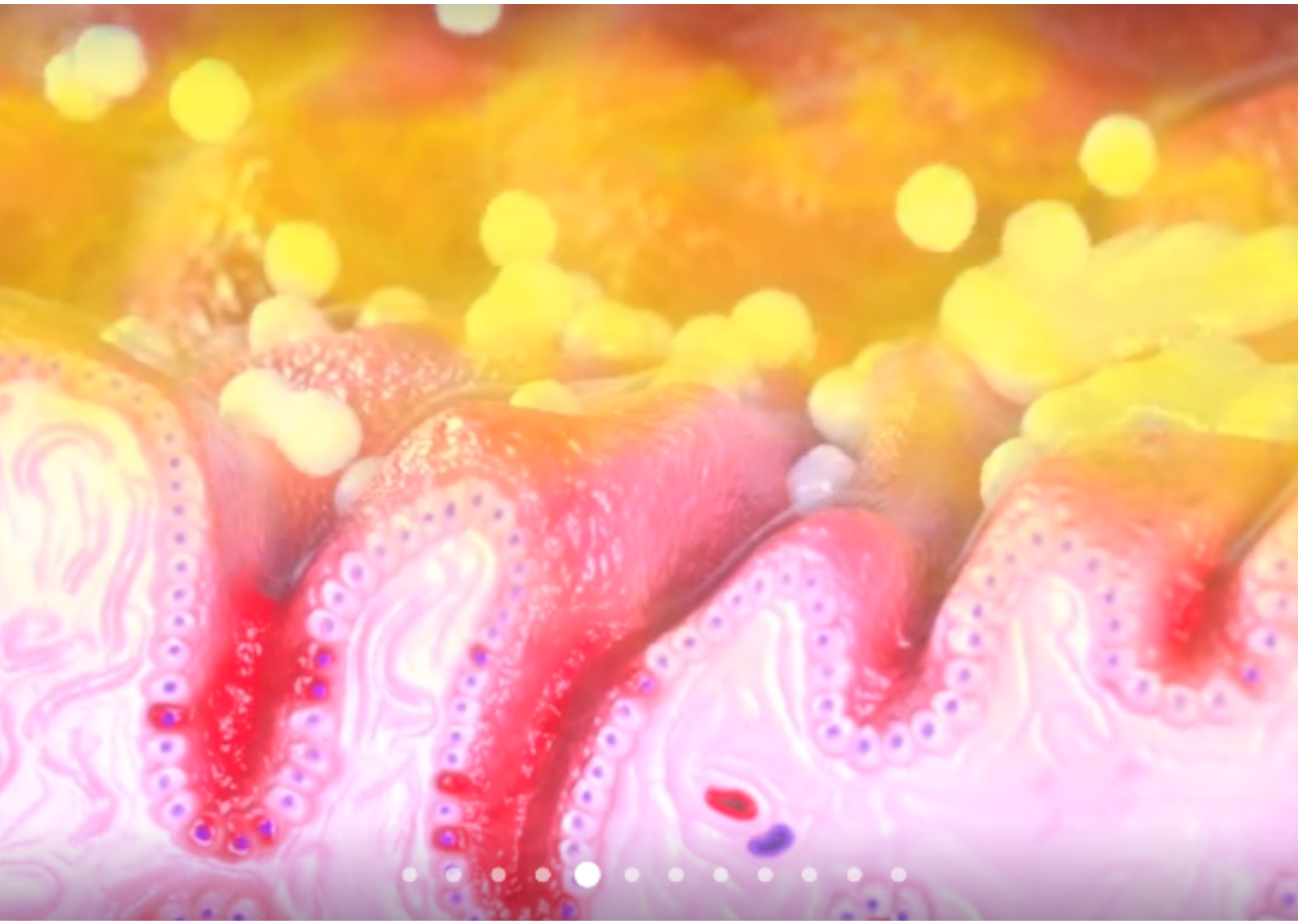

	n = 5
Age (Median [IQR])	44 (39-59)
Gender (% men)	20
Upper gastrointestinal endoscopy (%)	80
Duration of symptoms (n)	
12-24 months	2
>24 months	3
Type of symptoms	
Epigastric pain	100%
Early satiation or post-prandial fullness	40%
Epigastric burning	20%
Nausea	20%

Table 1. Characteristics of (patient) focus group participants.

Name of Material/ Equipment	Company	Catalog Number	Comments/Description
Dyspepsia e-learning	Dyspepsia e-learning		Digital educational tool for dyspepsia management
Paper Food Diary	Any		Schedule to record food consumption and symptoms
Computer	Any		A computer or tablet should be used to complete the e-learning
Medify Content Management System	Medify BV		A content management system to process the e-learning content

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Name of Journal: Journal of Video Experiments

Title: The dyspepsia educational tool as a novel aid in dyspepsia management

Authors: Judith J de Jong, Marten A Lantinga, Joost PH Drenth

Dear editor,

We kindly thank you and the reviewers for your valuable time and useful contributions. We thoroughly read and considered all comments.

Please find below a detailed point-to-point reply to the comments in blue font. Enclosed is the revised manuscript with all revisions marked in red, underlined font.

Kind regards,
Drs. Judith de Jong
Dr. Marten Lantinga
Prof. Dr. Joost Drenth

Editorial and production comments

1) Please take this opportunity to thoroughly proofread the manuscript to ensure that there are no spelling or grammar issues. The JoVE editor will not copy-edit your manuscript and any errors in the submitted revision may be present in the published version.

We have proofread the manuscript thoroughly and corrected all errors accordingly.

2) Title: Please revise to avoid the use of colon or hyphen.

We changed the title to: 'The dyspepsia educational tool as a novel aid in dyspepsia management' to avoid the use of a colon or hyphen.

3) Figures: All text should be in English. Please revise.

We apologize for any Dutch text in the figures. All figures have been revised accordingly.

4) Please include an Acknowledgements section, containing any acknowledgments and all funding sources for this work.

We added an Acknowledgements section (line 417-421).

5) References: Please do not abbreviate journal titles.

We revised the references following the advice of the reviewer.

6) Does the title of the protocol make grammatical sense? The authors refer to "e-learning" throughout the video as "an e-learning" or "the e-learning". I've only ever heard "e-learning" as a subject or field, not as a discreet physical thing.

This is an interesting query. To our knowledge, 'e-learning' is often used as an independent noun. However, after research and discussion following this comment we concluded that, grammatically, using e-learning as a noun is indeed incorrect. We adjusted this by hereafter referring to the program as a "digital educational tool".

Changes to be made by the author(s) regarding the video:
1. Please update the video according to the revised manuscript.
2. Please increase the homogeneity between the written protocol and the narration in the video. It would be best if the narration is a word for word from the written protocol text.
3. Please present the same results in the video as in the written manuscript.
4. Please upload a revised high-resolution video here:
https://www.dropbox.com/request/wZdgohY9ylxl0ymbazw5

We completely revised the protocol and results section of the video. The homogeneity between the written protocol and the narration is increased by changing the narrator's text to a near-exact copy. The visual material has been revised to match the figures in the results section of the written protocol.

Reviewer #1

Manuscript Summary:

de Jong, Lantinga and Drenth described the development process of dyspepsia e-learning, a tool to enhance the knowledge of patients regarding dyspepsia and the management of dyspepsia.

Major Concerns:

1) The authors developed a new tool regarding dyspepsia. I believe e-learning would be very interesting to expand the knowledge of patients and other health care providers. The video gives a nice overview of the protocol. However, this article only describes the tool and does not validate the tool.

We thank the reviewer for raising this relevant issue. Indeed, validation of the tool is essential before further use in clinical practice. We are therefore carrying out a randomized clinical trial (ClinicalTrials.gov Identifier NCT03205319*)*. We refer to this study in the penultimate paragraph of our discussion (line no. 405-407). As this manuscript is focused on the essentials of developing the e-learning educational tool, we believe that incorporating our validation study in the current manuscript would distract readers.

2) Patients were invited and recruited to participate in a focus group, but results of this focus group are missing. In addition, a group of five patients and five general practitioners is not enough to reach saturation. I would recommend to organize other focus groups and describe the results of those focus groups in the article. Furthermore, information of the patients of the focus group is lacking. Were they diagnosed with dyspepsia based on the opinion of a gastroenterologist, a general practitioner, the Rome criteria? Same type of symptoms? Age? All together in one focus group?

Indeed, two focus groups with five participants is limited in size. However, the ideal number of focus groups and group size remain a point of debate and can vary widely depending on factors such as goal of the focus group, complexity of the topic and experience of participants (Stalmeijer et al.; Medical Teacher 2014). While six to ten participants is considered an ideal situation, in some cases even as few as three to four participants are preferable (Bloor et al.; Focus Groups in Social Research 2001). Concerning the number of focus groups, a recent study (Guest et al.; Field Methods 2017) concluded that 80% of all themes will emerge within 2-3 focus group sessions

With this is mind, we would like to offer some additional arguments in support of our choices. Firstly, prior to the development process, we performed seven explorative semi-structured interviews with patients referred for upper gastro-intestinal endoscopy because of dyspeptic symptoms (unpublished). As acquired information was insufficiently substantial for the educational e-learning tool, we performed a focus group instead, using different participants. The group-element of a focus group has the capability of encouraging patients to engage in discussion, subsequently enriching the information. Rough comparison of the focus group results with the interview results showed a high level of similarity, albeit more detailed, allowing us to tentatively declare information saturation.

In addition, the focus group was conducted with the main goal to construct the outline of the tool, rather than the content. The scientific content is based on a systematic literature review, to ensure the scientific value of the tool. The outlines resulting from the two focus groups were extensive and encompassed a broad spectrum of dyspepsia issues. We did not expect any major supplementary items to result from additional focus groups. Nevertheless, future developers of e-learning tools should indeed ensure to conduct enough focus groups to reach information saturation. We therefore added a line (94-96) in the manuscript to emphasize this point.

In compliance with the reviewers' remark about the missing results and patient information, we added the results and information to the representative results section (line no. 252-273 and table

1.). We apologize for the initial omission. We agree with the reviewer that addition of these results improves the manuscript.

3) I would explain the different parts of the protocol in attachment. Too many details to put it in the article.

The protocol is indeed described in considerable detail and we thank the reviewer for this suggestion. We presented this level of detail following the instruction on JoVE's website, stating that: '*The protocol text should provide a detailed description to enable the accurate replication of the presented method (including setup, materials, actions, conditions, etc.) by both experts and researchers new to the field.*' . In order to replicate this tool accurately, we considered the presented details to be an essential part of the protocol. As the protocol-section is intended to be the central part of the manuscript, leaving out these details would result in loss of relevant information

Minor Concerns:

1) Symptoms of dyspepsia - The authors of this article described the main symptoms of dyspepsia: post-prandial fullness and epigastric pain, but they forgot to mention other very common symptoms as early satiation and epigastric burning

We thank the reviewer for this remark. We added the symptoms to the introduction (line 49-50). In addition, we would like to inform the reviewer that in the educational tool, these symptoms are indeed discussed.

2) Pathophysiology of dyspepsia - The role of impaired accommodation is not discussed as a pathophysiological mechanism that is likely to explain dyspepsia symptoms.

We agree with the reviewer that impaired accommodation is thought to be one of the cornerstones of dyspepsia's pathophysiological mechanisms, and that this was missing in the manuscript. We revised the lines on dyspepsia pathophysiology and added impaired accommodation (line 48-56).

3) Chapter 5: What can the doctor do to mitigate symptoms?
Some type of medication is listed that could avoid the occurrence of symptoms, but the list of medication does not contain groups as prokinetics and antidepressants/ antipsychotics. Do the authors explain this via the 3D animations?

The reviewer raises an important query, as these groups of medications are indeed part of dyspepsia management. We chose to mention existence of these groups of medication descriptively in the tool in a text block. Prokinetics and antidepressants/antipsychotics are beneficial for a selected group of patients and require thorough assessment of indication and contra-indications by a physician. For this reason we were hesitant to elaborate on these medications in the educational tool. We added a sentence about these medications under chapter 5, for clarification (line 322-323).

4) Spelling mistakes - 22 'used a guide' ◊ 'used as a guide', 286 Chapter 5. What can the doctor to mitigate symptoms? ◊ What can the doctor do to mitigate symptoms?

We thank the reviewer for reading the manuscript in extensive detail and corrected the aforementioned mistakes accordingly

Reviewer #2

This paper describes an interesting study describing a patient-centered educational approach for functional dyspepsia. I suggest some issues that may be clarified in the paper.

Minor comments:

1) Is it possible to show the characteristics of the patients involved in the focus group? (age, sex, duration of disease or some more information that can show their "experience" with the disease).

We thank the reviewer for this addition and kindly refer to the last paragraph of our reply to major comment #2 of reviewer #1. In short, as the reviewer suggested, we added characteristics (age, gender, previous endoscopy, duration of symptoms, type of symptoms) of participants and results of the focus group.

2) Line 49-50: If a cause of symptoms is found in 30% of cases, we should not consider these cases as functional dyspepsia. I understand the final message, but please consider an alternative text.

We agree with the reviewer that this sentence may imply unjust assumptions. We addressed this issue by revising this and adjacent sentences (line 48-56).

3) Line 97: Please confirm if the informed consent was obtained after organizing the focus group and all participants.

We can confirm that informed consent was obtained from all our participants and apologize for not stating this clearly. A sentence confirming this point was added (line 108).

4) Line 246 and 264: Please clarify the expression "peer's experiences".

With peers' experiences we meant the experiences of other dyspeptic patients with symptoms and therapies. We agree with the reviewer that this terminology was not clear and we used a different expression instead (line 279 and 297).

5) Please, check the expression "gastric irritation" as it is not usually employed in the medical literature.

The reviewer is correct in pointing out this error. This term is indeed incorrect and has been changed to 'inflammation of the stomach'.