



OPEN ACCESS

Teaching clinicians shared decision making and risk communication online: an evaluation study

Tammy C Hoffmann ¹, Chris Del Mar,¹ Ramai Santhirapala,² Alexandra Freeman ³

10.1136/bmjebm-2020-111521

¹Institute for Evidence-Based Healthcare, Bond University, Gold Coast, Queensland, Australia

²Department of Anaesthesia and Perioperative Medicine, Guy's and St Thomas' NHS Foundation Trust, London, UK

³Winton Centre for Risk & Evidence Communication, University of Cambridge, Cambridge, UK

Correspondence to:

Professor Tammy C Hoffmann, Institute for Evidence-Based Healthcare, Bond University, Gold Coast, Queensland, Australia; thoffmann@bond.edu.au



© Author(s) (or their employer(s)) 2020. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Hoffmann TC, Del Mar C, Santhirapala R, et al. *BMJ Evidence-Based Medicine* Epub ahead of print: [please include Day Month Year]. doi:10.1136/bmjebm-2020-111521

Abstract

Objectives To describe the development and initial evaluation of a brief e-learning course as a means of teaching shared decision making and risk communication skills to clinicians of all specialties.

Design Comparison pre-course and post-course of scores in subjective confidence and objective knowledge about shared decision making and risk communication.

Setting Online and open to all specialties and levels of clinical experience, including students. **Participants** The course is freely available online and all who started the course from September 2018 to May 2020 were invited to participate in the evaluation study.

Intervention The self-guided e-learning course is made up of four modules and takes approximately 2 hours to complete. It is hosted on the website of the Winton Centre for Risk Communication and the UK's National Health Service e-learning platform.

Main outcome measures Pre-course and post-course confidence in performing shared decision making (as measured by a 10-item scale adapted from the OPTION tool; total score range 10–50), and objective knowledge about basic principles of shared decision making and risk communication, as measured by performance on four knowledge questions and three calculations. At course commencement, a single item from the Berlin Numeracy Test, and the eight-item Subjective Numeracy Test were also asked.

Results Of 366 unique participants who consented and commenced the course, 210 completed all modules and the final post-course test. Participants' mean age was 38.1 years, 69% were in current clinical practice and had a mean of 10.5 years of clinical practice. Numeracy was relatively low, with 50.7% correctly answering the Berlin Numeracy Test item pre-course. Participants who completed the course showed a significant improvement in their confidence by a mean summed score of 3.7 units (95% CI 2.9 to 4.6, $p < 0.0001$) from a mean pre-course of 37.4 (SD 6.1) to post-course of 41.1 (SD 6.9). There was an increase in the proportion of correct answers for most knowledge questions ($p < 0.0001$, $p = 0.013$ for two directly compared), although no improvement in most skill questions that involved numbers (eg, calculating relative risks). Participants with higher numeracy appeared to show higher skill and confidence on most questions.

Key messages

What is already known about this subject?

- ▶ Most training opportunities for clinicians in shared decision making and risk communication are face-to-face workshops or not accessible for most clinicians.

What are the new findings?

- ▶ A brief online e-learning course can improve clinicians' knowledge and confidence in shared decision making, but in this study, little improvement in numerical tasks was demonstrated.

How might it impact clinical practice in the foreseeable future?

- ▶ These freely available e-learning courses could be incorporated into clinical training at all levels to help improve clinicians' knowledge and confidence in this area. Training to improve numeracy should also be included into curricula to enhance confidence and competence.

Conclusions This online, free e-learning course was successful in increasing participants' confidence in, and some aspects of knowledge about, shared decision making and risk communication. It also highlighted the need for improvements in clinicians' numerical skills as a vital part of training. We suggest that the course is used in combination with practical face-to-face experience and more intensive numerical skills training.

Introduction

Collaborative decision-making between clinicians and patients is an important component of contemporary, evidence-based healthcare. Shared decision making is a process that enables this and involves discussing the options; the pros and cons of these options, including the evidence-based estimates of benefits and harms for each (risk communication); and taking into account the patient's values, preferences and circumstances.¹ Shared decision making therefore relies on

clinicians bringing together their skills in evidence-based practice and patient communication.²

There is an increasing expectation of greater collaborative decision-making in health decisions between clinicians and patients, with many health bodies and agencies around the world now mandating such collaboration (eg, see previous works³⁻⁶). The legal basis for informed consent in most countries now demands dialogue and risk communication personalised to the individual patient's clinical and personal situation equally.⁷⁻⁹ However, shared decision making has not been routinely adopted by clinicians. Barriers to widespread implementation include clinicians not having sufficient knowledge about and skills in shared decision making,¹⁰ and believing that they are already undertaking it.¹¹ Lack of opportunities for clinicians to be trained in shared decision making is also a barrier to its uptake.¹²

Most training opportunities are face-to-face workshops and courses that are available on occasion, to specific specialties or as part of research projects and these are not accessible to most clinicians, and very few formally and publicly evaluate their impact.¹³ An advantage of online courses is that they can be undertaken at a time and location convenient to busy clinicians or integrated into a medical curriculum for students in institutions where there may not be the resources or skills to teach the topic. The aim of this article is to describe the development and initial evaluation of a recently developed online course in shared decision making and risk communication, tailored to a broad range of health professionals and made freely available.

Methods

Participants

Eligible participants were users who undertook an e-learning course on shared decision making and risk communication and provided consent, at the course login page, for their responses to be analysed for this study. This occurred between September 2018 and May 2020.

Intervention

The e-learning course was originally developed by two of the authors (TH, CDM) in partnership with the Australian Commission on Safety and Quality in Healthcare. Iterative feedback was provided on drafts of the course by an advisory committee that consisted of representatives from various medical colleges. Versions of the course for UK clinicians were adapted by the Winton Centre for Risk Communication at the University of Cambridge with support from the Academy of Medical Royal Colleges (UK).

The course is free and open to anyone to undertake. It is hosted on the e-learning website of the Winton Centre for Risk Communication (<https://moodle.wintoncentre.uk>) and eLearning for Healthcare, the UK's National Health Service (NHS) e-learning platform (<https://www.e-lfh.org.uk/programmes/shared-decision-making/>). It has been endorsed by the Academy of Medical Royal Colleges and accredited by relevant Royal Medical Colleges in the UK, including the Royal College of General Practitioners, the Royal College of Surgeons in England and the Royal College of Surgeons, Edinburgh, via newsletters, social media and website links.

Versions of the course have been created for different medical disciplines. There are five versions currently available: general practice, perioperative specialists (such as surgeons and anaesthetists), ophthalmologists, obstetricians and gynaecologists, and plastic surgeons. General content was common to each version; however, clinical scenarios and videos of demonstrated consultations were tailored to each discipline.

The course contains four parts, each commences with a list of learning objectives and concludes with list of relevant resources and further reading:

1. Part 1: Introduction to shared decision making and risk communication, the importance of these, how risk perception can affect behaviour, the need for accurate information about risks, introduction to absolute risks, relative risks, mortality rates and survival rates.
2. Part 2: Principles of shared decision making, what it is and what it is not, a model of shared decision making and its phases (3-talk model¹⁴), the relationship of shared decision making with motivational interviewing and informed consent, when it is and is not appropriate to undertake shared decision making, benefits of shared decision making, and inviting patients to participate in decision-making.
3. Part 3: Providing detailed information about options; considering benefits and harms; putting options into context and considering patients' values and preferences; the role of decision support tools; resources for locating patient decision aids; risk communication, including probability and chance, risk perception, framing, words versus numbers to describe risk, communicating the risk of a single event, risk calculators, simple frequency and simple percentage format, absolute risk, communicating relative risk, absolute risk reduction, relative risk reduction, number needed to treat (NNT), baseline risk and communicating uncertainty.
4. Part 4: From preferences to decision; shared decision making and health literacy; communication skills and tools to help patients of all health literacy levels engage in decision-making; putting shared decision making into practice; and addressing some of the myths about shared decision making. This part ends with a multiple-choice self-test, including both the 10-item confidence questionnaire and a range of knowledge questions reprising the content of all four parts of the course.

In Part 1, participants are introduced to various patients and provided with basic demographic and clinical details and their reason for coming to a consultation (see [figure 1](#)). Throughout the course, these patients are used to illustrate the content that is covered, with videos of segments of consultations between the patient and a doctor. In the videos, actors were used as patients and doctors of the relevant disciplines volunteered to be video-recorded and were provided with a script which they could adapt to suit their natural style. Nine to 10 video clips are contained in each course. Most of them are very brief (eg, 20s) and demonstrate the relevant element or step of shared decision making being taught. Towards the end of the course, there is a video of a consultation that demonstrates the entire shared decision making process.

The e-learning course is interactive and as part of the learning activities, participants complete knowledge and skills questions and are provided with immediate feedback and the correct answer. Most questions are forced-response. Some questions require a free-text response—these are not evaluated, but the elements of a model answer are provided after submitting a response to each question. At the end of the course there is a self-test section designed to test participants on key knowledge they should have gained during the course. All four modules in total take approximately 2 hours to complete.

Outcomes

In this evaluative study, we collected information on two aspects:

The figure consists of two screenshots from a primary care version of a course. The top screenshot shows a patient profile for Maria. It includes a photo of a woman with dark hair, a name tag 'Maria', gender 'F', and age '30'. Text next to the photo says 'Patient name Maria' and 'Maria is 30 and wants to discuss cervical screening.' Below the photo are navigation tabs for other patients: Julia, Maria (selected), Theresa, Rachel, Swati, Florence, Margot, and Barbara. The bottom screenshot shows a video player titled 'Option talk with Tim'. It includes a play button and a video camera icon. Text above the video says 'Let's talk to Tim about his options and find out how what matters to him affects the weighing up of benefits and harms of the options. Click on the play button to watch: if you are having trouble viewing the video, [read the transcript.](#)' Below the video player are navigation buttons for 'Communicating potential harms and benefits - Part 3' with 'BACK' and 'NEXT' options.

Figure 1 Screenshots from the primary care version of the course.

Confidence in knowledge and abilities

A set of questions about confidence in performing shared decision making behaviours were asked at the beginning and conclusion of the course. These questions were based on the 10 items adapted from the OPTION scale,¹⁵ with the stem question of “rate your confidence in the following...”.

Knowledge

We compared participants’ performance on the self-test questions at the end of the course with their previous answers to the same (or similar) questions which were embedded within the course. The questions embedded were all asked prior to any instruction in the relevant topic, designed to test the participants’ prior knowledge (and hence motivate their learning). These questions covered basic information about what shared decision making is and when it is appropriate; legal aspects of shared decision making and relationship with informed consent; the difference between mortality

rates and survival rates; whether words can be used instead of numbers during risk communication; how to calculate absolute risk differences, relative risk differences and NNT and which to use when communicating with patients.

Demographic variables collected from participants were age, gender, level of education, medical specialty, number of years of clinical practice and level of any prior training in both shared decision-making and risk communication. Participants also completed the Subjective Numeracy Test¹⁶ (eight questions, answered with a Likert scale, regarding confidence using numbers in different contexts such as calculating a percentage discount off an item on sale when shopping) and for a subset of participants (those whose data were collected in the second year of the evaluation), we additionally measured their objective numeracy via a single question from the Berlin Numeracy Test¹⁷ (“Out of 1000 people in a small town 500 are members of a choir. Out of these 500 members in the choir 100 are men. Out of the 500 inhabitants

that are not in the choir 300 are men. What is the probability that a randomly drawn man is a member of the choir? Please indicate the probability in percent.”) at the beginning of the course.

Data analysis

Data were collated from those who completed the courses on either of the two e-learning platforms hosting it and who consented for their responses to be used in this evaluation study. Responses to data were analysed descriptively. For the confidence questions, a paired t-test was used to compare pre-course and post-course summed scores within individuals. The association between explanatory variables (number of years of clinical experience, previous training in shared decision making, previous training in risk communication, or numeracy as measured by the single-measure question from the Berlin Numeracy Test) and post-course summed scores was assessed using analysis of covariance with adjustment for pre-course summed scores. McNemar's test was used to compare the proportion of correct responses pre and post for the paired knowledge questions.

Ethics

This evaluation study was reviewed by the Psychology Research Ethics Committee at the University of Cambridge and granted approval (PRE.2018.034). All participants gave electronic informed consent to taking part in the evaluation.

Patient and public involvement

Patients and the public were not involved in the design or implementation of this study.

Results

Out of approximately 850 people who signed up to complete one of the courses during the evaluation period (duplicates not checked), 366 unique participants consented to be part of the evaluation (34 duplicates—people who had completed more than one version of the course—were removed). Of these, 313 started the course and 210 completed all four modules and all of the final self-test questions. The characteristics of participants are shown in [table 1](#). The mean subjective numeracy score is 4.35 (SD 0.92), and the median is 4.5. Of the 133 who answered the objective numeracy question, 69 (50.7%) answered correctly.

Confidence

[Figure 2](#) shows participants' scores on each of the questions assessing confidence at the beginning and end of the course. There was an increase in mean summed score by 3.7 units (95% CI 2.9 to 4.6, $p < 0.0001$, $n = 210$) from pre-course to post-course (mean pre-course 37.4, SD 6.1; mean post-course 41.1, SD 6.9). The analysis of covariates showed that greater experience is associated with higher post-course summed scores by 0.09 units for each year of experience (95% CI 0.01 to 0.17, $p = 0.035$); and an association between Berlin test and summed scores where a correct Berlin test response is associated with higher scores by 2.7 units on average (95% CI 0.9 to 4.6, $p = 0.003$). There was no association between previous training in either shared decision making or risk communication and post-course summed scores (shared decision making: effect on score 0.17, 95% CI -1.4 to 1.8 , $p = 0.82$; risk communication: effect on score -0.18 , 95% CI -1.8 to 1.4 , $p = 0.80$).

Knowledge

Knowledge: questions asked once

As part of the course, participants complete questions and are provided with immediate feedback and the correct answer.

Table 1 Participant characteristics (n=366)

Characteristic	n (%)
Gender	
Female	208 (61.9)
Prefer not to say	8 (2.4)
Mean age (SD, range), years	38.1 (10.8)
Highest degree	
Undergraduate	101 (30.1)
Postgraduate	117 (34.8)
Medical doctorate	63 (18.8)
Research doctorate	22 (6.5)
Other	11 (3.0)
No degree	
Diploma	3 (0.9)
Current undergraduate	3 (0.9)
High school education	16 (4.4)
Discipline	
Anaesthesia	68 (20.2)
General practice	53 (15.8)
Surgery (various specialties)	19 (5.7)
Surgery—general	13 (3.9)
Obstetrics and gynaecology	13 (3.9)
Emergency medicine	10 (3.0)
Public health	7 (2.1)
Cardiology	5 (1.5)
Ophthalmology	5 (1.5)
Other medical specialties	28 (7.7)
Midwifery	32 (9.5)
Nursing	10 (3.0)
Physiotherapy	10 (3.0)
Pharmacy	3 (0.9)
Pharmaceutical medicine	3 (0.9)
Other	57 (17.0)
In clinical practice at time of completing e-course	233 (69.3)
Years of clinical experience	
Mean (SD)	10.5 (10.3)
Prior training	
Shared decision making	
Reading material	103 (30.8)
Single lecture or workshop	57 (17.0)
Course >1 day in length	18 (5.4)
None	158 (47.0)
Risk communication	
Reading material	89 (26.5)
Single lecture or workshop	56 (16.7)
Course >1 day in length	18 (5.4)
None	173 (51.5)
Subjective numeracy (mean summed score)	4.35* (SD 0.92)

*This compares with a mean score of 4.8 in first year medical students in a study in Croatia.⁴⁶

Questions are asked before the content is covered as a lead into the content. Many of these questions are not repeated, and some are not strictly relevant in assessing clinician's knowledge of the topic, however, they are presented in [table 2](#) to give an indication of participants' level of knowledge in this area. At the end of the final module of the course, there is a self-test quiz which reprised several of the key questions, or variations on them, as an

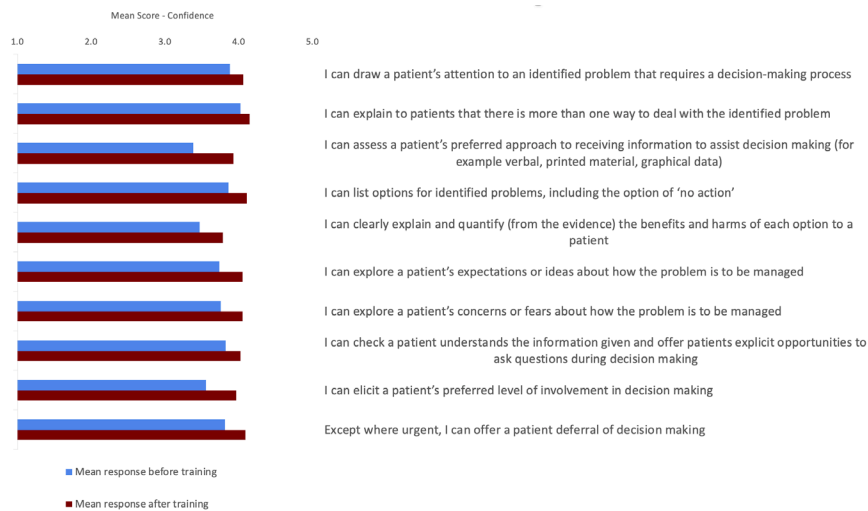


Figure 2 Mean scores, at the beginning and end of the course, for each confidence item.

indication of knowledge gained. This was designed both as a self-test for participants and as a part of the evaluation study.

With questions involving some arithmetic (such as calculating absolute and relative risks, and NNT), those with higher numeracy outperformed those with lower numeracy on each question. However, even those with higher numeracy performed less well on the calculation questions than on factual knowledge.

Knowledge: pre-course and post-course

In table 2, superscript letters mark similar questions that were asked both pre-course and post-course. Participants' knowledge about mortality versus 5-year survival rates showed no change ($p=0.09$, McNemar's test), but knowledge about documentation of shared decision making ($p=0.013$) and whether verbal terms are a good alternative to numbers in communicating risk ($p<0.0001$) increased. Overall, participants' factual, non-numerical knowledge was at a high level (>85% correct) after the course, apart from two questions ('SDM is a legal necessity as part of informed consent: true or false?', with 54% answering correctly and 'When communicating risks to be compared, it is best to communicate in the format 'one in x people are likely to experience...' (eg, 1 in 10 compared with 1 in 250) rather than keeping the denominator the same (eg, 100 in 1000 compared with 4 in 1000)?' with 68% answering correctly). The proportion of correct responses for the numerical questions (both those that required calculations and those about understanding numbers) showed no significant change from pre-course to post-course, with about half responding correctly to such questions throughout.

Discussion

Completing a brief (approximately 2 hours) online course in shared decision making and risk communication appeared to affect participants in several ways. First, it increased their confidence in their abilities to facilitate shared decision making and communicate risks. Those with more clinical experience and higher numeracy had higher confidence in their abilities. Second, it increased participants' knowledge about some of the basic principles of shared decision making and risk communication, and by the end of the course, participants' knowledge about basic concepts was at a good level, with over 85% answering correctly on all but two questions. Third, however, it did not appear to

help people consistently better calculate or interpret the statistical elements of risk communication.

Participants with higher numeracy performed better than those with lower numeracy on numerical questions, but many appeared to struggle with the concept of lead-time bias, and with the calculation of relative risks or NNT. In the pre-course question, relative risk increase was given as part of the question text, but even so only just over half of participants correctly recognised it. In the post-course test, two questions required calculations—one presenting the original numbers as frequencies and the other as percentages. Converting from frequencies into percentages (especially as the frequencies were not 'out of 100') seemed to cause difficulties, with only about a quarter of participants being able to say that a relative risk increase from 1 to 5 was 500%.

Comparison with other studies

Few studies assessing shared decision making training programmes have evaluated the impact of training on participants' confidence and knowledge.¹⁸ An 8-hour face-to-face training programme for physicians reported an increase in confidence and knowledge, but areas of knowledge assessed are not detailed.¹⁹ Evaluation of a brief online single case-based approach for primary care clinicians reported a reasonable level of confidence in performing and high level of knowledge of shared decision making steps after completing the case, but levels were not measured prior to undertaking it.²⁰ The online Ottawa Decision Support Tutorial,²¹ which has shown to increase participants' shared decision making skills when combined with face-to-face training (eg, previous work²²), does not include risk communication components. Other online courses for shared decision making are designed to train clinicians in specific clinical areas, such as diabetes care²³ or prostate cancer screening.^{24 25} A study evaluating the eDoctoring platform²⁶ (now technologically out of date as it requires Flash software), which had a shared decision making module as part of its online teaching of genetic counselling, found no increase in shared decision making knowledge scores, but an increase in behaviours in the clinic.²⁷ It is not clear whether this course included risk communication, and this component of training was particularly noted as lacking across all courses in the review of shared decision making training interventions by Coates and Clerke.¹⁸ There are few online courses that have been evaluated or published results.

Table 2 Percentage of correct responses to shared decision making and risk communication knowledge questions (in the course before content covered and at the end)

Question (correct answer in bold)	n	n (%) correct
Questions asked before content covered in the course		
1. Among groups of healthy adults, which group do you think is more likely to take up influenza vaccination? A. Adults who think they are at high risk of influenza B. Adults who do not think they are at high risk of influenza	298	258 (86.6)
2. ^a Which of the following statements about cancer screening <u>would</u> provide evidence that screening reduces deaths from cancer if true? A. More cancers are detected in screened populations than unscreened populations B. Screen detected cancers have better 5 year survival rates than cancers detected because of symptoms C. Mortality rates are lower among screened populations than unscreened populations in randomised trials D. The screening test has a post-test positive value of approximately 30%, making it highly accurate at detecting aggressive cancers	274	137 (50.0)
3. SDM is a continuum along which the extent a patient or a clinician takes responsibility for making decisions (True)	256	198 (77.3)
4. SDM is simply informing patients of their options and letting them choose (False)	256	216 (84.4)
5. SDM is a mechanism for applying evidence to an individual patient's situation (True)	256	226 (88.3)
6. SDM is a single step to be added into a consultation (False)	256	225 (87.9)
7. ^b There is no need to document SDM as it is part of a routine exchange between patient and clinician (False)	257	230 (89.5)
8. SDM and informed consent are essentially the same thing; both involve making patients aware of risks and signing a consent form (False)	257	201 (78.2)
9. ^b SDM is documented by making a note in the patient's medical record (True)	257	228 (88.7)
10. Shared decision making may not be appropriate in which of the following situations? More than one answer may be correct. A. In an emergency B. When it is not welcomed by the patient C. When it may lead to the patient making a decision that is against standard medical practice or your advice	257	121 (47.1)
11. ^c As both patients and clinicians can have difficulty with numbers, is it better to use terms like 'high risk', 'unlikely' or 'possible' to describe risk? (False)	231	152 (65.8)
12. If you wake up in the morning and hear/read that there is a 20% chance of rain today, what does this mean? A. It will rain 20% of the time today (5 hours) B. It will rain in 20% of the region today (so probably not in your area) C. It will rain on 20% of the days for which this prediction is made (therefore it probably won't rain) D. Two in 10 meteorologists predict it will rain today E. None of the above	231	124 (53.7)
13. Which of the following statements about relative risk is correct? More than one answer may be correct. A. Relative risk gives an idea of the risk of experiencing something over time B. Relative risk is a concept rather than something that can be measured C. Relative risk indicates whether a particular characteristic or exposure increases or decreases risk D. Relative risk compares two risks	245	35 (14.3)
14. Absolute risk is the same as incidence (True)	246	82 (33.3)
15. ^d Imagine that a new drug for osteoporosis has just been approved. In clinical trials, it was found to cut the risk of having a hip fracture in the next 3 years by 50%. The drug also seems to be well tolerated with no gastrointestinal or genitourinary side effects. You look up the evidence and find that 10% of the untreated people had a hip fracture at 3 years, compared with 5% of the people who took the osteoporosis drug every day for 3 years. Use the data provided to answer three questions about the study findings: i. Absolute risk reduction will be... A 5% B 10% C 20% D 30% E 40% F 50% ii. Relative risk reduction will be... A 5% B 10% C 20% D 30% E 40% F 50% [N.B. Answer is in the question] iii. Number needed to treat to benefit will be... A 5 B 10 C 20 D 30 E 40 F 50	245	145 (59.2)
	245	134 (54.7)
	245	112 (45.7)
16. ^e When talking to (a patient) about the risk reduction associated with this treatment, what format would you use? (Absolute risk reduction or Relative Risk Reduction but with the caveat that RRR can be misleading in some circumstances, such as when absolute risks are very small)	245	126 (51.4)
17. Does practising SDM routinely increase the length of consultations? (False)	220	178 (80.9)
Questions asked after content covered in the course		

Continued

Table 2 Continued

	Question (correct answer in bold)	n	n (%) correct
1.	An online breast cancer Risk Assessment tool states: "Women (taking tamoxifen) had 49% fewer diagnoses of invasive breast cancer" and "The annual rate of uterine cancer in the tamoxifen arm was 30 per 10 000 compared with 8 per 10 000 in the placebo arm." Which of these missing pieces of data would be most informative for weighing up the potential benefits against the potential harms of tamoxifen, when added to the information given above? i. Does this give all the information required for a patient to weigh up the benefits in terms of breast cancer against the risks in terms of uterine cancer? (No)	220	193 (87.7)
	ii. In relation to the scenario above, which of these missing pieces of data would be most informative for weighing up the potential benefits against the potential harms of tamoxifen, when added to the information given above? a) The annual rate of breast cancer per 10 000 women with and without tamoxifen b) The percentage increase in uterine cancer for those taking tamoxifen c) The number needed to treat for one woman to get uterine cancer as a result of taking tamoxifen	218	137 (62.8)
2. ^a	A website shows national statistics on cancer to allow comparison between different countries. Which statistic would you choose to compare the effectiveness of different healthcare programmes for those diagnosed with cancer? A. 5 year survival rate for those diagnosed with cancer B. Detection rate of cancer in screening programmes C. Mortality rate of cancer in the population D. Incidence of cancer in the country	217	86 (39.6)
3.	SDM is a legal necessity as part of Informed Consent (False)	217	117 (53.9)
4.	Risk communication is a legal necessity as a part of Informed Consent (True)	217	187 (86.2)
5. ^b	SDM should be documented in the patient's medical record (True)	217	208 (95.9)
6.	SDM is not appropriate where national guidelines for care are clear on what treatment is appropriate (False)	217	196 (90.3)
7.	Patients can choose to take part in SDM or not (True)	217	206 (94.9)
8. ^c	Since many people struggle with numbers, it is better to use verbal terms such as 'rare' and 'common' to communicate (False)	217	191 (88.0)
9.	When communicating risks to be compared, it is best to communicate in the format 'one in x people are likely to experience...' (eg, 1 in 10 compared with 1 in 250) rather than keeping the denominator the same (eg, 100 in 1000 compared with 4 in 1000)? (False)	217	148 (68.2)
10.	Appropriate visual aids such as pictographs or icon arrays can help see the risk numbers in context. (True)	217	205 (94.5)
11. ^d _e	A treatment has a side-effect which increases the chances of a fatal pulmonary embolism from 1 in 10 000 to 5 in 10 000		
	i. What is the absolute risk increase (in percentage points)? A 0.04 B 5 C 40 D 500 E 2500	215	140 (65.1)
	ii. What is the percentage relative risk increase? A 0.04 B 5 C 40 D 500 E 2500	215	55 (25.6)
	iii. What is the number needed to treat to harm one person? A 0.04 B 5 C 40 D 500 E 2500	215	119 (55.3)
	iv. Which would you use to communicate the risk to your patient? (Absolute risk increase)	215	140 (65.1)
12. ^d	Looking at the treatment options for your patient, you see that one treatment is likely to decrease their risk of complications from 25% to 5%		
	i. What is the absolute risk reduction in percentage points? A 4 B 5 C 20 D 60 E 80	214	152 (71.0)
	ii. What is the percentage relative risk reduction? A 4 B 5 C 20 D 60 E 80	214	78 (36.4)
	iii. What is the number needed to treat to benefit one person? A 4 B 5 C 20 D 60 E 80	214	101 (47.2)

Superscript letters mark similar questions that were asked both pre-course and post-course
SDM, shared decision-making.

While face-to-face training has been shown to increase knowledge and confidence in shared decision making, uptake of such training is greatly restricted by limitations in its accessibility.

Performance on the single objective numeracy question, with 50.7% (n=133) answering correctly, is higher than the 23% of those with a bachelors' degree or above (n=262) answering the question correctly in a recent survey of a UK population (representative by age and gender) carried out by one of the authors

(unpublished data), and 38% (n=175) in a survey of surgeons from developed countries.²⁸

Strengths and weaknesses

The sample in this study consisted of a broad range of health professionals, from medical students to experienced clinicians from a variety of specialties. The sample size is also large compared with other studies of this type. All participants were

completing the course under real-life conditions rather than as a laboratory-style controlled study, and the intervention—the e-learning course—is available freely online for use by medical schools, professional bodies, and clinicians at any time.

A weakness is that participants who opted to take part in the evaluation study were a minority of those undertaking the course and a self-selected group. There was also considerable attrition across the course, with a possible further bias in those who completed the whole course so these results cannot be taken as representative of participants in general. Subgroup analyses (such as those for high/low numeracy participants) are based on small numbers and must be considered only suggestive of patterns.

The self-test questions that form the 'post-course' test were at the end of an approximately 30 min module, and participant motivation and effort may have been lower than during pre-course tests at the start of individual modules, thus a potential contributory factor to poor performance on questions that required calculations or contemplation. The knowledge questions were not designed for an evaluative study, but as learning activities as part of the modules, and some of the paired questions are not identical from pretest to post-test. This was not possible as immediate feedback and the correct answer was provided as participants progressed through the course.

Meaning of the study

Confident shared decision making and good risk communication with patients is ultimately a skill that needs practice and cannot be learnt solely through theoretical knowledge and watching others. However, this evaluation shows that an e-learning course can help clinicians understand some of the theoretical underpinnings of shared decision making and risk communication and increase their confidence in being able to incorporate these skills into clinical practice. Both of these are valuable precursors to a full face-to-face course in shared decision making, including practice with (simulated) patients as improved confidence and knowledge are not necessarily enough for clinicians to carry the skills into their practice. While training is an important first step towards shared decision making uptake, previous experience shows that clinicians also need opportunities to practise and develop their skills, an appropriate attitude, and a supportive organisational culture to assist with the implementation of shared decision making.^{11 29}

This study also raises once again the issue of clinician numeracy. The poor performance of the participants throughout the study on questions that involved simple arithmetic (such as calculation of the absolute difference between two numbers) is worrying. Lower numeracy was also associated with lower confidence ratings on the post-course assessment. Although motivation to put thought into answers may be low during the e-learning course (where marks carried no consequences for the participants), clinicians who cannot easily do these sorts of calculations are unlikely to be able to accurately interpret or clearly communicate them to patients in real consultations).

While this is a problem that has been raised many times before (eg, see previous works^{28 30-34}), poor numeracy has been linked to poor decision-making ability in a number of scenarios (eg, see previous work³⁵⁻³⁹) and this study again raises the need to support clinicians further during and after their training to increase their skills and confidence when dealing with numbers. Additionally, ensuring that decision support tools are designed to communicate numbers simply, so that they are appropriate for use with both clinicians and patients regardless of numeracy level, is important. A recent study of risk communication training in a medical school in Germany highlighted the lack of teaching there,⁴⁰ and

effective—but intensive—courses have been developed elsewhere (eg, see previous works⁴¹⁻⁴³). These require many hours of face-to-face teaching, which is impractical for many medical schools to deliver and for clinicians to access. Our study shows that an e-learning course has the potential to increase understanding of and confidence in shared decision making—but that it needs to incorporate, or be accompanied by, more support around the numerical concepts and skills required for good interpretation of numerical evidence and risk communication.

Unanswered questions and future research

While we are hopeful that the increased confidence and knowledge of the importance of shared decision-making demonstrated by participants on completion of this e-learning course will translate to application of it in clinical practice, this remains to be demonstrated. It is also unclear how much participants' risk communication skills increased due to limitations in their numeracy. A study assessing participants' actual performance of shared decision making and risk communication in clinical practice before and after taking the online training may help to highlight what tools, training and other supports could best accompany the current e-learning course.

It is also clearly vital to work on ways to improve participants' numerical skills and risk communication. This could potentially be done through e-learning courses, such as spending more time on the numerical aspects in this course, as it is a skill that can be practised by individuals on their own. However, numerical training should also be a core part of face-to-face teaching and examination as part of medical curricula given its demonstrably important role in clinician confidence and competence. In addition, graphical aids designed to support people with a range of numeracy levels in clinical situations could help clinicians who lack confidence with numbers to deal with the communication of risk information.^{44 45}

Conclusions

This free e-learning course helps clinicians understand the principles and concepts of shared decision making and risk communication, and increases their confidence in being able to carry it out. However, clinician numeracy is worryingly low and a barrier to good risk communication. Both undergraduate curriculum and continuing medical education need to effectively teach knowledge and skills in evidence-based medicine, shared decision making and risk communication, with clear articulation of the interface and interdependence between these areas.

Acknowledgements We thank Associate Professor Mark Jones for assistance with statistical analysis and Dr Elizabeth Gibson for assistance with data preparation. We would also like to thank all the participants who opted to take part in this evaluation study.

Contributors TCH and CDM developed the original course, which was modified for the UK audience by AF with support and national endorsement from RS. AF collected and cleaned the evaluation data, which was analysed by TH. TCH, AF and CDM drafted the manuscript. The corresponding author acts as the guarantor and attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted, and that the manuscript represents an honest, accurate and transparent account of the study with no important aspects having been omitted.

Funding The development of the original e-learning course was funded by the Australian Commission on Safety and Quality in Health Care/Healthcare and is used under license by the Academy of Medical Royal Colleges. The adaptations for the UK and different specialties was funded by the Winton Centre for Risk and Evidence Communication at the University of Cambridge, which is itself funded by a donation from the David & Claudia Harding Foundation.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This evaluation study was reviewed by the Psychology Research Ethics Committee at the University of Cambridge and granted approval (PRE.2018.034).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. Anonymised data will be uploaded to an Open Science Framework repository on acceptance.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Tammy C Hoffmann <http://orcid.org/0000-0001-5210-8548>

Alexandra Freeman <http://orcid.org/0000-0002-4115-161X>

References

- Hoffmann TC, Légaré F, Simmons MB, *et al*. Shared decision making: what do clinicians need to know and why should they bother? *Med J Aust* 2014;201:35–9.
- Hoffmann TC, Montori VM, Del Mar C. The connection between evidence-based medicine and shared decision making. *JAMA* 2014;312:1295–6.
- Centers for Medicare & Medicaid Services. Decision MEMO for implantable cardioverter defibrillators (CAG-00157R4), 2018. Available: <https://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=288> [Accessed 24 Jul 2020].
- Centers for Medicare & Medicaid Services. Decision MEMO for percutaneous left atrial appendage (LAA) closure therapy (CAG-00445N) 2016.
- Centers for Medicare & Medicaid Services. Decision MEMO for screening for lung cancer with low dose computed tomography (LDCT) (CAG-00439N), 2015. Available: www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=274 [Accessed 24 Jul 2020].
- NHS England. Shared decision making. Available: <https://www.england.nhs.uk/ourwork/pe/sdm/> [Accessed 10 Apr 2017].
- Coulter A, Hopkins A, Moulton B. *Montgomery v Lanarkshire Health Board*: transforming informed consent. *Bulletin* 2017;99:36–8.
- Neuberger H, Kerr C, Wilson, Reed H. *Montgomery (Appellant) v Lanarkshire health board (Respondent) (Scotland). 1886–1887*, 2015.
- Härter M, Moumjid N, Cornuz J, *et al*. Shared decision making in 2017: international accomplishments in policy, research and implementation. *Z Evid Fortbild Qual Gesundheitswes* 2017;123–124:1–5.
- Légaré F, Ratté S, Gravel K, *et al*. Barriers and facilitators to implementing shared decision-making in clinical practice: update of a systematic review of health professionals' perceptions. *Patient Educ Couns* 2008;73:526–35.
- Joseph-Williams N, Lloyd A, Edwards A, *et al*. Implementing shared decision making in the NHS: lessons from the magic programme. *BMJ* 2017;357:j1744.
- Légaré F, Witteman HO. Shared decision making: examining key elements and barriers to adoption into routine clinical practice. *Health Aff* 2013;32:276–84.
- Légaré F, Politi MC, Drolet R, *et al*. Training health professionals in shared decision-making: an international environmental scan. *Patient Educ Couns* 2012;88:159–69.
- Elwyn G, Frosch D, Thomson R, *et al*. Shared decision making: a model for clinical practice. *J Gen Intern Med* 2012;27:1361–7.
- Elwyn G, Hutchings H, Edwards A, *et al*. The option scale: measuring the extent that clinicians involve patients in decision-making tasks. *Health Expect* 2005;8:34–42.
- Fagerlin A, Zikmund-Fisher BJ, Ubel PA, *et al*. Measuring numeracy without a math test: development of the subjective Numeracy scale. *Med Decis Making* 2007;27:672–80.
- Cokely ET, Galesic M, Schulz E, *et al*. Measuring risk literacy: the Berlin Numeracy test. *Judgm Decis Mak* 2012;7:25–47.
- Coates D, Clerke T. Training interventions to equip health care professionals with shared decision-making skills: a systematic scoping review. *J Contin Educ Health Prof* 2020;40:100–19.
- Bieber C, Nicolai J, Hartmann M, *et al*. Training physicians in shared decision-making—Who can be reached and what is achieved? *Patient Educ Couns* 2009;77:48–54.
- Volk RJ, Shokar NK, Leal VB, *et al*. Development and pilot testing of an online case-based approach to shared decision making skills training for clinicians. *BMC Med Inform Decis Mak* 2014;14:1–9.
- Ottawa decision support tutorial. Available: <https://decisionaid.ohri.ca/ODST/> [Accessed 24 Jul 2020].
- Murray MA, Stacey D, Wilson KG, *et al*. Skills training to support patients considering place of end-of-life care: a randomized control trial. *J Palliat Care* 2010;26:112–21.
- Rider BB, Lier SC, Johnson TK, *et al*. Interactive web-based learning: translating health policy into improved diabetes care. *Am J Prev Med* 2016;50:122–8.
- Feng B, Srinivasan M, Hoffman JR, *et al*. Physician communication regarding prostate cancer screening: analysis of unannounced standardized patient visits. *Ann Fam Med* 2013;11:315–23.
- Wilkes MS, Day FC, Srinivasan M, *et al*. Pairing physician education with patient activation to improve shared decisions in prostate cancer screening: a cluster randomized controlled trial. *Ann Fam Med* 2013;11:324–34.
- eDoctoring. Available: http://edoc.ucdavis.edu/Public_site/ [Accessed 24 Jul 2020].
- Wilkes MS, Day FC, Fancher TL, *et al*. Increasing confidence and changing behaviors in primary care providers engaged in genetic counselling. *BMC Med Educ* 2017;17:1–12.
- Garcia-Retamero R, Cokely ET, Wicki B, *et al*. Improving risk literacy in surgeons. *Patient Educ Couns* 2016;99:1156–61.
- Boland L, Lawson ML, Graham ID, *et al*. Post-training shared decision making barriers and facilitators for pediatric healthcare providers: a mixed-methods study. *Acad Pediatr* 2019;19:118–29.
- Gigerenzer G, Gaissmaier W, Kurz-Milcke E, *et al*. Helping doctors and patients make sense of health statistics: toward an evidence-based Society. *Psychol Sci Public Interes* 2007;8:53–96.
- Petrova D, Mas G, Navarrete G, *et al*. Cancer screening risk literacy of physicians in training: an experimental study. *PLoS One* 2019;14:e0218821.
- Wegwarth O, Schwartz LM, Woloshin S, *et al*. Do physicians understand cancer screening statistics? A national survey of primary care physicians in the United States. *Ann Intern Med* 2012;156:340–9.
- Klemperer D. Physicians' and patients' knowledge of cancer screening - a wake-up call. *Oncol Res Treat* 2014;37 Suppl 3:8–10.
- Taylor A, Byrne-Davis L, University of Manchester, Cheshire, England. Clinician Numeracy: use of the medical interpretation and Numeracy test in Foundation trainee doctors. *Numeracy* 2017;10.
- Nelson W, Reyna VF, Fagerlin A, *et al*. Clinical implications of numeracy: theory and practice. *Ann Behav Med* 2008;35:261–74.
- Reyna VF, Nelson WL, Han PK, *et al*. How numeracy influences risk comprehension and medical decision making. *Psychol Bull* 2009;135:943–73.

- 37 Reyna VF, Brainerd CJ. The importance of mathematics in health and human judgment: Numeracy, risk communication, and medical decision making. *Learn Individ Differ* 2007;17:147–59.
- 38 Peters E, Shoots-Reinhard B, Tompkins MK, *et al*. Improving numeracy through values affirmation enhances decision and stem outcomes. *PLoS One* 2017;12:e0180674.
- 39 Schwartz LM, Woloshin SS, Black WCW. The role of numeracy in understanding the benefit of screening mammography. *Ann Intern Med* 1997;127:966–72.
- 40 Baessler F, Weidlich J, Schweizer S, *et al*. What and how are students taught about communicating risks to patients? analysis of a medical curriculum. *PLoS One* 2020;15:e0233682.
- 41 Koch C, Dreimüller N, Weißkircher J, *et al*. Teaching conflicts of interest and shared decision-making to improve risk communication: a randomized controlled trial. *J Gen Intern Med* 2020;35:473–80.
- 42 Han PKJ, Joekes K, Elwyn G, *et al*. Development and evaluation of a risk communication curriculum for medical students. *Patient Educ Couns* 2014;94:43–9.
- 43 Spreckelsen C, Juenger J. Repeated testing improves achievement in a blended learning approach for risk competence training of medical students: results of a randomized controlled trial. *BMC Med Educ* 2017;17:1–10.
- 44 Ancker JS, Senathirajah Y, Kukafka R, *et al*. Design features of graphs in health risk communication: a systematic review. *J Am Med Inform Assoc* 2006;13:608–18.
- 45 Zipkin DA, Umscheid CA, Keating NL, *et al*. Evidence-Based risk communication: a systematic review. *Ann Intern Med* 2014;161:270–80.
- 46 Buljan I, Tokalić R, Marušić M, *et al*. Health numeracy skills of medical students: cross-sectional and controlled before-and-after study. *BMC Med Educ* 2019;19:1–10.