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E-learning on antibiotic prescribing—the role of autonomous motivation in participation: a prospective cohort study

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Objectives: E-learning is increasingly used in education on antimicrobial stewardship, but participation rates are often low. Insight into factors that affect participation is therefore needed. Autonomous motivation is associated with higher achievements in medical education and could also play a role in e-learning participation. We therefore aimed to investigate the role of residents' autonomous motivation in their participation in e-learning on antibiotic prescribing.

Methods: We performed a multicentre cohort study in two academic and two teaching hospitals. Residents who filled out questionnaires on antibiotic knowledge, the perceived importance of antibiotics and motivation [Self-Regulation Questionnaire – Academic (SRQ-a)] received e-learning access. We used the SRQ-a to calculate relative autonomous motivation (RAM), an index that estimates the amount of autonomous motivation compared with the amount of controlled motivation. We then analysed associations between RAM and participation in e-learning with logistic regression.

Results: Eighty-six residents participated (74% female, mean age 30 years). Overall e-learning participation was 58% ($n = 50$). Participation was 41% in residents with negative RAM (i.e. more controlled motivation) and 62% in residents with positive RAM (i.e. more autonomous motivation). RAM was positively associated with participation, adjusted for residency in an academic hospital (adjusted OR 2.6, 95% CI 1.5–4.6).

Conclusions: Participation in non-obligatory e-learning on antibiotic prescribing is higher in residents with more autonomous motivation. Interventions to increase autonomous motivation could improve participation. Preceding e-learning on antibiotic prescribing with face-to-face education, to explain the importance of the subject, could enhance autonomous motivation and thus optimize e-learning efficiency.

Introduction

A common scenario in the clinical setting is that residents report a lack of knowledge on antibiotics and ask for more education on antibiotic prescribing. Yet when we offer them e-learning on the subject, participation rates are low. Why do they not participate, when they say they want to learn?

This question is important, as e-learning is increasingly used in antimicrobial stewardship programmes.[1,2] The advantages of e-learning are legion: it provides flexibility and allows interactivity and progress tracking, and, after initial development, modules are easily distributed among large groups and across the globe, against relatively small investments of time and costs.[3,4] At the same time, e-learning requires a lot of motivation, as it is usually non-obligatory and followed individually.

In contrast to earlier beliefs, as stated by the self-determination theory (SDT), motivation should not be viewed as a trait that is either present or absent, but rather as a continuum with different states. More extrinsically motivated states, in which motivation comes from rewards (such as credits) are collectively called controlled motivation. Autonomous motivation comprises the more intrinsically motivated states, meaning that motivation originates from an interest in the subject or an understanding of its importance.[5] Studies have shown that autonomous motivation is associated with higher study effort in medical students,[6] higher

achievements in residents[7] and more participation in continuing education among pharmacists.[8] Autonomous motivation could therefore also play a role in e-learning participation.

We investigated this for the important subject of antibiotic prescribing. Inappropriate use of antibiotics can be found in up to a staggering 50% of prescriptions,[9,10] which can lead to unnecessary side effects, costs and development of antimicrobial resistance. Education is viewed as an essential element of any hospital programme that aims to influence antibiotic prescribing behaviour.[11] This is recognized by residents, who have expressed the need for more education on the subject.[12,13] We therefore developed an e-learning module on antibiotic prescribing and performed a multicentre cohort study among residents to investigate the association between autonomous motivation and participation in e-learning.

Methods

Design

We conducted a multicentre cohort study and asked residents from two university medical centres (providing tertiary care) and two teaching hospitals to participate during a scheduled teaching session. The study was conducted in the departments of internal medicine, cardiology and clinical geriatrics, because of their high number of in-hospital antibiotic prescriptions. At the time of study, none of the departments had mandatory education on antibiotic prescribing.

Data collection

Participants provided background information and filled out a questionnaire consisting of a knowledge test on antibiotics, questions on the perceived importance of antibiotics and the Dutch version of the Self-Regulation Questionnaire – Academic (SRQ-a). The English version of the SRQ-a is downloadable from the SDT website, after registration and after providing a declaration that it will be used for research purposes only (http://selfdeterminationtheory.org/self-regulation-questionnaires/). All respondents who completed the questionnaire received login credentials for the e-learning module, which were valid for 2 weeks. After 2 weeks, non-responders received a reminder, extending the credentials for another week.

The knowledge test comprised 37 questions. This test was adapted slightly from a previously designed test, which had been assessed for content validity by infectious diseases physicians, a medical microbiologist, a general practitioner and an assessment expert. The new version was assessed for content validity once more, by one physician researcher and three infectious diseases physicians.

The Dutch version of the SRQ-a[14] assesses motivation for a specific educational activity using four subscales and was previously assessed for internal consistency.[15] It is used to measure relative autonomous motivation (RAM), an index that provides a general self-determination score by estimating the amount of autonomous motivation compared with the amount of controlled motivation. RAM is calculated by assigning weights and adding scores of the four subscales of intrinsic regulation (+2), identified regulation (+1), introjected regulation (−1) and external regulation (−2). This generates a score from −48 to +48, in which a positive RAM suggests a predominantly autonomous motivation profile and a negative RAM indicates a predominantly controlled motivation profile.

We developed an e-learning module through Pscribe, a web-based programme based on the WHO Guide to Good Prescribing, which tracks participation.[16] The module comprised a case of endocarditis, interspersed with information on antibiotics. The subject was chosen because a more complicated infection, such as endocarditis, allowed us more room for background information. Participants were not aware of the subject before participation. The e-learning module included questions with direct feedback to increase interactivity. Local and national guidelines were provided to assist in decision making and to mimic the process of prescribing in the clinical setting. Completion took 60–90 min; participants were allowed to stop and resume. One physician–researcher and three infectious diseases physicians independently assessed the module for content validity.

After completion of the module, we administered the Instructional Materials Motivation Survey (IMMS). The IMMS is a frequently used questionnaire that measures motivation for educational materials and has been tested extensively for validity in medical education.[17,18] The IMMS consists of 36 statements on four domains (ARCS):[19] the Attention domain assesses whether the material can hold the student's attention; Relevance assesses whether the content relates to future application; Confidence assesses the connection with prior knowledge; and Satisfaction assesses appreciation of the material. We used the IMMS scores to assess the value of our e-learning module as an educational tool.

Table 1. Study population characteristics

Age (years), mean (SD)	30 (5)
Female, *n* (%)	64 (74)
Clinical experience (years), *n* (%)	
≤1	24 (28)
1–4	40 (47)
>4	22 (26)
Academic hospital, *n* (%)	58 (67)
Residency, *n* (%)	
cardiology	14 (16)
clinical geriatrics	5 (6)
internal medicine	63 (73)
other	4 (5)
RAM	
median (IQR)	7.3 (2–18)
min–max	−22 to +37

Analysis

Descriptive analyses were used to summarize study population characteristics and IMMS scores. We calculated means with standard deviations for normally distributed data, and medians with IQRs for data with non-normal distribution.

To our knowledge, there is no literature on the psychometric properties of the SRQ-a regarding responsiveness (i.e. whether the questionnaire is capable of measuring changes in score). As the scale of RAM spans from −48 to +48, we considered a 10 point difference relevant, indicating a change in RAM of around 10%. We therefore divided RAM by 10 and then assessed the association between RAM and e-learning participation with logistic regression analysis, adjusting for residency in an academic hospital, gender, clinical experience and prior knowledge of antibiotic prescribing (measured as test score). All analyses were performed in SPSS 22.0 for Windows (IBM SPSS Inc., Chicago, IL, USA).

Results

RAM and participation

Eighty-six residents participated in the study (characteristics in Table 1). Overall participation in the e-learning module was 58% ($n = 50$). Participation was 41% in residents with negative RAM (i.e. more controlled motivation) and 62% in residents with positive

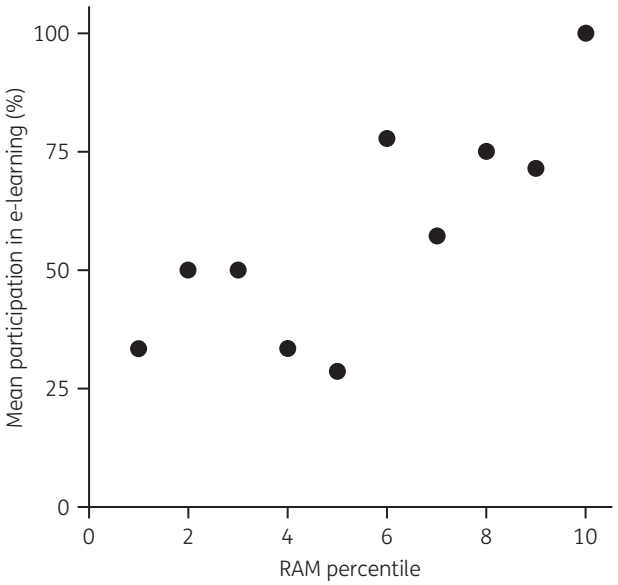

Figure 1. Mean participation in e-learning in RAM percentile groups.

RAM (i.e. more autonomous motivation). Figure 1 shows the mean participation in the RAM percentile groups.

Logistic regression analysis showed a significant association between RAM and participation in e-learning, with a crude OR of 2.1 (95% CI 1.3–3.4). This means that for every 10 point increase in RAM, the odds of participation increase by 2.1. Residency in an academic hospital was a significant confounder, providing an adjusted OR of 2.6 (95% CI 1.5–4.6), but was not an effect modifier. More clinical experience and prior knowledge were not significant confounders in either model and there were no differences between female or male participants, nor was there an association between receiving a reminder and participation.

Almost all residents (97%) agreed or strongly agreed that strong knowledge of antibiotics is important in their career and that they would like more education on the appropriate use of antibiotics and on antibiotic resistance.

IMMS

More than half of the participants completed the e-learning module ($n = 28$, 56%), of which 23 completed the IMMS. The median overall IMMS score was 71% (IQR 66%–78%). Median scores on the separate domains of Attention, Relevance, Confidence and Satisfaction were 70% (IQR 65%–82%), 76% (IQR 69%–82%), 76% (IQR 62%–78%) and 63% (IQR 57%–73%), respectively.

Discussion

Our study shows that residents who report more autonomous motivation for education on antibiotics are more likely to engage in an e-learning module on the subject. These findings are in line with earlier studies on type of motivation and performance in medical education: autonomous motivation was associated with higher study effort in medical students[6] and more participation in continuing education among pharmacists.[8] However, the role of autonomous motivation in participation in e-learning on antibiotic prescribing has not been previously described.

In our study, 97% of residents indicated that strong knowledge of antibiotics is important in their career and that they would like more education on its appropriate use. Still, participation in the e-learning module was only 58%. This discrepancy, i.e. the wish for more education but lack of participation when this is provided, is in line with the small amount of data available on the subject,[20] and is often attributed to a lack of motivation. However, in contrast to earlier beliefs, motivation should not be viewed as a trait that is either present or absent, but rather as dynamic along a continuum with different states. More importantly, a person's state of motivation is not set in stone, but can vary across different subjects,[21] and can change over time.

The SDT describes motivation as controlled (originating from sanctions or rewards) or autonomous (coming from a genuine interest in the subject or identifying with the subject's value or importance).[5,22] In contrast to controlled motivation, autonomous motivation facilitates deep learning and integration of what is taught[23] and is therefore the sought-after state of motivation. Making e-learning obligatory, although perhaps effective, would thus not be a desirable solution. The SDT points to several prerequisites for autonomous motivation: autonomy (the perception of having a choice in learning efforts), competence (feeling capable of mastering the material) and relatedness (a sense of belonging to a professional learning community).[24] This means that we can enhance autonomous motivation by incorporating these prerequisites in our educational activities.[21,25]

So how can this help us to improve participation in e-learning? E-learning already appeals to autonomy and competence, as it provides learners with a flexible, adaptive form of learning. However, as a remote learning method, it can lack a sense of relatedness. Relatedness can be enhanced by providing learners with a meaningful rationale, so that they can identify with reasons to learn more on the subject and thus engage in learning activities.[26] This approach is supported by several behaviour change models, such as the theory of planned behaviour (TPB)[27] and the Knowledge, Attitude, Behaviour Change (KAB) model, which focus on the importance of attitude when aiming to change behaviour. The KAB model, for instance, states that better understanding leads to a change in attitude, which in turn leads to a change in behaviour, thereby suggesting that education can influence behaviour.[28] This has also been shown in relation to autonomous motivation: if students identify with the value or importance of the subject, their autonomous motivation for education increases, indicating that attitude towards a subject influences motivation to learn.[5,22] For e-learning in antimicrobial stewardship, this means that face-to-face education prior to the module, explaining the importance and thereby influencing attitude, could enhance autonomous motivation and thus increase participation.[29,30] This is already applied in 'blended' learning, which is increasingly used as an innovative and effective method to integrate e-learning with face-to-face instruction.[31]

Our study has strengths and limitations. To our knowledge, this is the first study to address the role of autonomous motivation in participation in e-learning on antibiotic prescribing. Although our sample was limited, we included residents from multiple centres and specialties, and found a consistent association between autonomous motivation and participation across subgroups.

We adjusted for factors that could have influenced participation, such as workload (which is usually considered lower in university medical centres compared with teaching hospitals), clinical experience and previous knowledge on the subject of antibiotics. Our findings are supported by the SDT, which is a rigorously investigated and validated theory of motivation, and fit into the larger frameworks of behaviour change. However, supervisors of the participating residents were aware of the study and availability of the e-learning module. This may have triggered participation in residents with more controlled motivation, which could have reduced differences in participation with their autonomously motivated colleagues. The module was available for 3 weeks; participation rates could have been higher had availability been extended. We did not collect data on reasons for non-participation; factors unrelated to autonomous motivation, such as distractions at work or at home, could have influenced the effect.

E-learning is increasingly used in antimicrobial stewardship interventions, but simply making a module available may not be sufficient, as many people may not participate.[26] Participation could be improved by increasing autonomous motivation, for instance by combining e-learning with face-to-face education that explains the importance and relevance of prudent use of antibiotics. Future studies should focus on ways to provide these learning environments and investigate the effect of enhanced autonomous motivation on participation.

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Transparency declarations

None to declare.

Author contributions

M. G. C.: conception and design of the study, acquisition, analysis and interpretation of data and drafting the article. J. J. S.: conception and design of the study, interpretation of data and critical revision of the article. R. A. K.: interpretation of data and critical revision of the article. M. A. v. A.: conception and design of the study, interpretation of data and critical revision of the article.

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