

The Role Of Remote Educational Technologies In The Formation Of Geriatric Approach In Primary Medical Care

Natalia Stasevich ^a , Shamatava Nana ^a , Denis Serov ^b

^a N.A. Semashko National Research Institute of Public Health, Moscow, 105064, Russia

^b State budgetary institution of healthcare of the city of Moscow "City polyclinic No. 46 Department of Healthcare of the city of Moscow", Moscow, 105064, Russia,

Abstract

The development of medical and social programs within the framework of the primary medical care system that make it possible to successfully cope with age-associated syndromes is focused on achieving the ultimate goal of providing geriatric care – maintaining the highest possible quality of life in the elderly and senile age. In this regard, this article discusses the use of innovative information and communication remote educational technologies in relation to medical staff of various specialties providing medical care to older age groups. Thus, according to the results of the education, 95.8% of internists began to diagnose and carry out therapeutic and rehabilitation measures for falls syndrome, malnutrition syndrome, anxiety-depressive syndrome, 91.7% - for incontinence syndrome. The introduction of these technologies contributes to improving quality of life and the level of functionality of patients of older age groups, thereby prolonging their active longevity. For example, the level of physical and role-based emotional functioning, determined by the SF-36 scale, significantly increased (86.3+2.0 vs 69.2+2.1; 74.2+2.9 vs 56.8+2.3) in the group of patients with the implemented geriatric approach. In the study, qualitative and quantitative characteristics of the level of knowledge of medical staff and the volume of activities carried out in patients with geriatric syndromes were analyzed. It was revealed that the persons involved in the implementation of medical and social expertise and rehabilitation competence indicators in the information and communication technologies are the basis for successful self-development and effective professional activity.

Keywords: remote educational technologies, geriatric care

I. Introduction

Currently, the healthcare system around the world is experiencing an increased need for specialized geriatric care, which is due to an increase in life expectancy, a high level of morbidity and disability in patients of older age groups [1, 2]. At the same time, it should be noted that the so-called geriatric approach in healthcare has been formed in recent years [3-4]. Its main principles are the following:

orientation during diagnostic and therapeutic measures primarily to improve quality of life (QOL), improve the functional state of elderly and senile people; increase the status of the functional state of a person, in contrast to the generally accepted system of influence on the etiology and pathogenesis of the disease; increasing the importance of non-pharmacological methods of exposure, since it has been proven that in the elderly and senile age, pharmacodynamic and pharmacokinetic features are formed that enhance the side effects of medications and reduce their effectiveness; giving special importance to the principle of individuality in providing medical care to patients of older age groups due to significant features of clinical manifestations of diseases in geriatrics (slight symptoms etc.); the importance of knowledge of the rules of communication with the elderly people, knowledge of psychotherapy techniques, knowledge of the basics of the psychology of old age and aging by physicians; strengthening the role of the social component in providing medical and social assistance to an elderly and senile persons.

The geriatric approach in healthcare is based on the impact on the cascade of geriatric syndromes that worsen the functional status of the patient and lead to the development of a specific condition - senile asthenia syndrome (frailty), which is characterized by symptoms such as weight loss, when there is a decrease in body weight of at least 4.5 kg per year; gait disorder; decreased muscle strength and the development of severe sarcopenia; the development of cognitive disorders and decreased motivation, loss of former vital interests; low level of motion activity.

About 60 geriatric syndromes lead to the development of senile asthenia syndrome, such as aphasia, amnesia, anorexia, apathy, apraxia, aspiration syndrome, chronic pain syndrome, bradykinesia, age-related androgen deficiency, dehydration, bedsores, delirium, dementia, depression, disorientation in time and space, dysphagia, dyspepsia, dysuria, elder abuse and neglect, weight loss, hypobulia, low mobility, hypothermia, urinary incontinence, insomnia, instability and falls, cognitive deficits, contractures, malnutrition, obstipation syndrome, orthostatic hypotension, loneliness, paranoid syndrome, gait disorders, hearing disorders, visual disturbances, sarcopenia, syncopal syndrome, tremor, traumatic syndrome, syndrome of dependence on outside help, loss of the meaning in life and others [6-22]. Unfortunately, in relation to the geriatric patients, the traditional, general therapeutic approach is still maintained, which consists in relieving individual symptoms of pathology by etiopathogenetic or symptomatic effects, while the above-described geriatric approach is not widespread.

One of the strategies to solve this problem is to increase the level of competence of medical staff through the use of modern remote educational technologies, in particular, based on the European Credit Transfer System (ECTS). The analysis has shown that for the introduction of a credit-modular system of educational process organization (CMSEPO) into postgraduate educational programs in

gerontology and geriatrics, special scientifically based organizational and pedagogical approaches are needed that do not change the basic ideas of the Bologna process, but take into account the specifics of professional development of medical staff.

CMSEPO is the model of the educational process organization, which is based on modular educational technologies and the system of educational units (credits). At its core, the CMSEPO is one of the main components, along with information packages and key documents, of the structural and functional model of the ECTS.

The correct approach to the implementation of the ECTS model in advanced training courses (ATC) and thematic improvement courses (TIC) in gerontology and geriatrics for specialists in the medical and social rehabilitation determined the development of a model that describes the procedure at a qualitative level and contributes to the implementation of practical aspects. When developing this model, a top-down design strategy is proposed, visualized in Figure 1.

The organization of ATC and TIC in the gerontology and geriatrics for specialists in medical and social expertise (MSE) and rehabilitation on the basis of CMSEPO is best consistent with the introduction of remote educational technologies based on electronic educational and methodological complexes (EEMC) into the educational process. EEMC, in turn, are based on educational resource management systems (ERMS). Based on the experience of testing various ERMS in national and foreign universities, the authors came to the conclusion that the most optimal technological platform for the system of ATC and TIC in the gerontology and geriatrics for specialists in MSE and rehabilitation in full-time and remote educational and CMSEPO are cloud-oriented distributed computing technologies. It is these technologies that represent the current trend in the development of network information and communication technologies (ICT). The cloud distributed computing model provides free on-demand access via the global Internet to a common pool of computing resources and educational information. This access can be provided promptly with minimal costs and requests to the service provider.

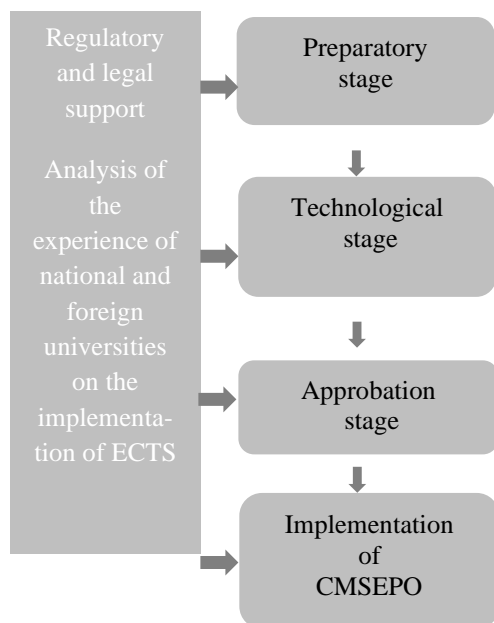


Figure 1. Structural and functional model of the introduction of ECTS into the educational activities of the ATC and TIC in the gerontology and geriatrics for specialists in MSE.

II. Research Methods

During 2019-2020 years, a three-stage study was conducted, which consisted in analyzing the level of knowledge of internists working in the primary health care system on issues of modern geriatrics, as well as their training on TIC in the specialty "Geriatrics" (72 hours) using remote technologies, followed by studying the dynamics of the approach to patients of older age groups based on the knowledge gained.

During the first stage of the study, a survey was conducted of 24 district internists of the clinical and diagnostic center of the State Budgetary Healthcare Institution of the city of Moscow "City Hospital named after A.K. Eramishantseva of the Moscow Department of Health" by means of a specially created questionnaire, which included information on knowledge in the field of concepts specific to the geriatric approach – senile asthenia syndrome, specialized geriatric examination, detection and prevention of certain geriatric syndromes (falls syndrome, urinary incontinence, polypharmacy, obstipation syndrome, cognitive deficits), as well as information on the application of this information in everyday practice. The purpose of this stage was to identify the need to train physicians on topical issues of geriatrics.

The second stage consisted of training the interviewed physicians through TIC in the specialty "Geriatrics" (72 hours) using remote educational technologies at the Department of therapy, geriatrics

and anti-aging medicine of the private higher educational institution "Reaviz". The following main issues were considered within the framework of the conducted TIC: the modern concept of geriatric care to the population, the organization of geriatric care, the syndrome of senile asthenia as the basis of the concept of geriatric care, the rules of examination of a geriatric patient using the innovative computer program "Specialized geriatric examination", as well as the main geriatric syndromes – falls, malnutrition, anxiety and depression in older age groups, cognitive deficits, incontinence syndrome, stool disorders, rules and approaches to drug therapy in older age groups, differentiated management of patients depending on the type of aging. At the conclusion of this stage of the study, the dynamics of the knowledge of internists in the modern geriatrics was assessed.

At the third stage, 176 patients aged 67 to 84 years (average age 69.5±2.5 years) were interviewed, some of whom - 89 patients were observed by trained physicians who implemented modern principles of geriatric care in their activities, and some - 87 patients received traditional measures that did not include geriatric approaches, for satisfaction with care and QOL according to the SF-36 questionnaire. The obtained results were processed statistically using the t-Student criterion, while the difference in indicators was considered reliable at $p < 0.05$.

As for the ERMS, the cloud-oriented Google Apps environment (service) for educational institutions was chosen as the basis for its development. This choice was due to the following features of Google Apps for educational institutions (Google Apps for Education or Google Apps Education Edition) :

1. Using cloud storage of information. With Google Apps for educational institutions, data is automatically stored in the cloud, and all work is done via the Internet.
2. Ease of collaborative work in training. Tools for creating websites and documents provide real-time editing, effective access controls and full compatibility.
3. Optimization of planning and organization of daily tasks of the educational process, implemented with the joint use of Google Documents and Google Calendar.
4. Reliable infrastructure. Users of the system always have access to the latest version of the software, including new features and security updates.
5. Economy. Google Apps for educational institutions does not require licensing fees, the purchase of servers and client software.
6. High level of security and confidentiality.

Developed on the basis of a cloud-oriented ERMS, EEMC ATC and TIC in gerontology and geriatrics for MSE and rehabilitation specialists of fully provide their main purpose and corresponding functions: organizational, informational, didactic, controlling and managing (Figure 2).

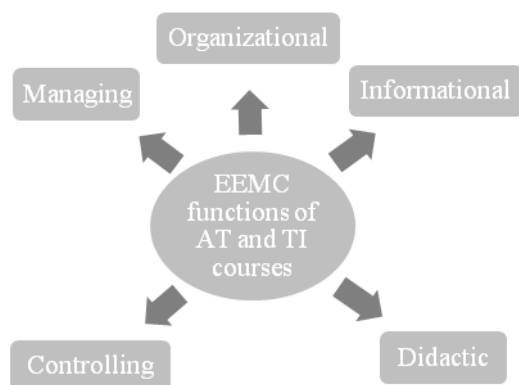


Figure 2. The main functions of the EEMC of ATC and TIC in the gerontology and geriatrics for specialists in MSE and rehabilitation in full-time and remote educational and CMSEPO.

III. Research Results

A. Integration of the geriatric approach into the routine practice of primary care physicians as a tool for improving their professional competence and optimizing therapeutic and diagnostic measures in older age groups

When studying the level of knowledge and practical application of the geriatric approach, it was revealed that the highest level of knowledge and the volume of activities took place with such geriatric syndrome as stool disorders in the elderly and senile age - 22 respondent physicians answered this question positively (91.7%), cognitive deficit syndrome was in the second place – 18 physicians (75.0%), incontinence syndrome was in the third place - 12 physicians (50.0%) and anxiety–depressive syndrome was in the fourth place - 10 specialists (41.7%). At the same time, the level of knowledge and their practical application in relation to other geriatric syndromes was insufficient. In particular, the problems of eating disorders in the elderly and senile age were well known to only 3 of the surveyed physicians (12.5%), the syndrome of falls – 1 physician (4.2%), the syndrome of senile asthenia - 2 physicians (8.3%). None of the interviewed physicians used in practice a specialized geriatric examination, which, through a combination of questionnaires and scales, allows identifying leading geriatric syndromes for a particular patient that reduce the level of functionality and QOL. The presented results allow us to conclude that the level of knowledge of primary care physicians in the modern geriatrics is insufficient, which requires their training on this issue.

After the training, there was a positive dynamics in the level of knowledge of specialists in the geriatrics: all the interviewed physicians began to conduct a specialized geriatric examination in order to identify the syndrome of senile asthenia, cognitive disorders and other major geriatric syndromes, 23 specialists (95.8%) began to diagnose and carry out treatment and rehabilitation measures for falls

syndrome, malnutrition syndrome, anxiety-depressive syndrome, 22 specialists (91.7%) - for incontinence syndrome.

The results of studying the dynamics of QOL indicators (SF-36 scale) in elderly and senile patients having internal diseases are presented in Table 1.

Table 1. Dynamics of QOL indicators in elderly and senile patients depending on the implementation of the geriatric approach

Scale value (SF-36)	Control group		Main group	
	Before	After	Before	After
General health	59.2± 3.1	72.8 ± 2.0*	58.8± 0.9	80.0± 2.0*
Role-based functioning	68.3± 5.4	72.5 ± 6.1	71.5± 5.0	74.7± 6.2
Pain	54.6± 2.1	75.2 ± 2.9*	59.3± 2.4	72.8± 3.4*
Physical functioning	66.1± 3.3	69.2 ± 2.1	69.1± 4.6	86.3± 2.0*,* *
Viability	50.3± 2.1	70.8 ± 1.0*	52.2± 2.6	76.4± 2.5*
Psychological health	51.3± 2.3	64.1 ± 3.9*	52.4± 2.4	82.3± 1.2*,* *
Role-based emotional	52.0± 2.2	56.8 ± 2.3	55.5± 0.7	74.2± 2.9*,* *

functioni ng				
Social functioni ng	59.8± 3.4	79.9 ± 0.8*	58.5± 2.9	82.4± 4.0*

* $p < 0.05$ compared to the level before the introduction of the geriatric approach

** $p < 0.05$ compared between groups after the introduction of the geriatric approach

B. ICT competence of ATC students as a factor of the success of knowledge acquisition

During the pedagogical experiment, it was shown that ICT competence of MSE and rehabilitation specialists - students of ATC - is the basis for their successful development of the course, further self-development and effective professional activity.

According to the results of a survey of specialists in MSE and rehabilitation (a 12-point scale of self-assessment of the level of ICT competence, where 1-4 points correspond to a low level, 5-8 points correspond to an average level and 9-12 points correspond to a high level), it was found that the level of individual success of professional development of the student (ISPDS) in all categories is significantly higher in persons with a high level of ICT competence compared with specialists with a low level of this indicator ($p < 0.05$). The same differences were reliably found between students with a high and average level of ICT competence ($p < 0.05$), with the exception of the category of the out-patient nurse staff ($p > 0.05$) (Figure 3).

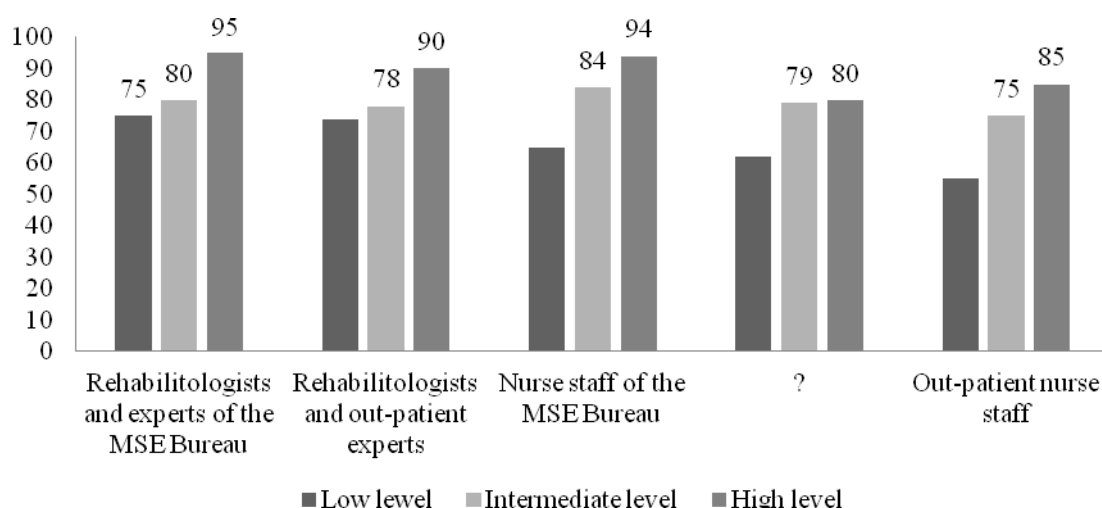


Figure 3. Dependence of ISPDS in the gerontology and geriatrics on the initial level of ICT competence among specialists of various departments of MSE institutions.

C. The use of audio-visual educational tools to increase the cognitive motivation of ATC students

As a result of the conducted research, it was found that the use of video clips integrated into the body of the lecture presentation can positively influence the change in cognitive motivation of specialists in MSE and rehabilitation - students of ATC and TIC in the gerontology and geriatrics during studying program material. Video clips of medium duration (from 180 to 360 seconds) with an additional link to resources for repeated independent viewing make students more actively refer to the material of the training site compared to short-duration video clips (from 45 to 150 seconds).

The working program of the training session, within the framework of which the study was conducted, assumed the study of the provisions of regulatory documents and numerous regulated signs, actions, and so on in certain situations, in connection with which it was possible to assume a low level of cognitive motivation of the trainees. Approximately 50% of the study time was allocated for the independent work of the student of the ATC and TIC. The average number of students in each group was 25 ± 3 people. In order to increase the efficiency of studying the material of the training session, the organization of controlled independent work of students, the technology of advanced training based on the EEMC of the ATC and TIC was chosen. The main condition that was set before the audience was the requirement to prepare for future lecture by printing a presentation on paper, first familiarizing with the material and actively participating in the introduction of additional data, comments, examples into the text of the presentation during the lecture.

Analysis of the statistics of attendance of the EEMC of the ATC showed that when using conventional presentations in the form of slides with lists and indicators, the average attendance for two days before the day of the lecture session was 14 ± 3 people per day, on the day of the lecture session and the following day - 9 ± 3 people per day (Figure 4).

When integrating short video clips with a duration of 45 to 150 seconds into the presentation body, the average attendance of the discipline's website for two days before the day of the lecture session remained at the same level (14 ± 3 people per day), however, on the day of the lecture session and the following day was 17 ± 3 people per day and significantly ($p < 0.05$) differed from that when using presentations without video clips. This suggests an increase in the cognitive motivation of students of ATC due to the use of remote educational elements integrated into the full-time educational process.

IV. Discussion

The knowledge gained during TIC with the use of remote educational technologies in the specialty "Geriatrics" made it possible to implement in the practical conditions of primary health care a modern

approach to the management of elderly and senile patients, depending on the type of aging, which consisted in the following:

1). Ideal aging, which is characterized by a high degree of preservation of the functional reserves of the body until the last days of life. In relation to this contingent of elderly and senile people, it is important to organize adequate dynamic monitoring and carry out geroprophylaxis measures based on non-drug and behavioral methods.

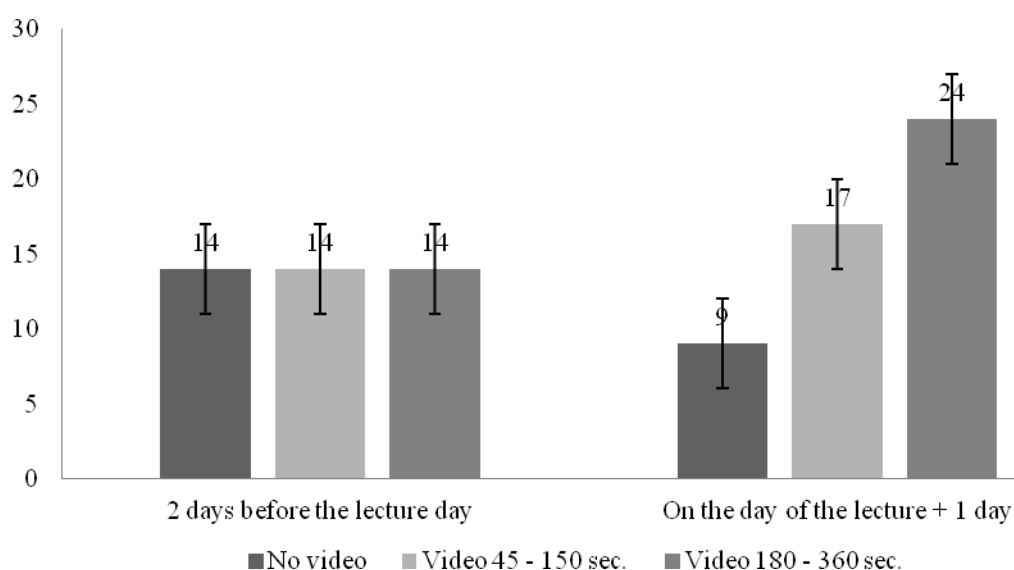


Figure 4. The average number of visits to the website of the

discipline (persons per day), depending on the availability and duration of the video clip integrated into the text of the presentation

2). Preserved aging, in which there is a gradually fading, but still preserved state of motor and labor activity. With this type of aging, it is important to ensure timely detection of exacerbation / decompensation of existing pathology, as well as new diseases; carrying out measures of geroprophylaxis.

3). Independent aging, when there is a significant decrease in the degree of functioning of the body, limitations of the functional activity of the elderly person, but at the same time he is able to take care of himself and maintain independence from outside help. In this case, it is necessary to conduct a comprehensive geriatric examination with the identification of geriatric syndromes and the development of medical and social rehabilitation programs.

4). Aging with the formation of asthenia is characterized by lability of health and social activity; such people have a significant number of chronic diseases that occur with frequent exacerbations and decompensations. With this type of aging, a significant dependence on outside help is formed, there is a strong need for medical and social rehabilitation measures. With aging with the formation of asthenia, it is necessary to ensure the identification of geriatric syndromes, as well as their timely relief.

5). Aging with the formation of partial dependence on outside help, in which there is a low potential for health, a significant part of the elderly person's time passes in an environment of dependence on outside help, only a small area of activities that a person is able to perform independently remains. In this case, the role of social services in maintaining normal life is increasing, while it is also important to ensure the identification of geriatric syndromes and rehabilitation of an elderly person, taking into account his functional status.

6). Aging with the formation of complete and permanent dependence - there is a complete permanent dependence on outside help, an elderly person is completely bedridden, there is the development of severe disabling diseases, for example, dementia. When caring for such people, social and nursing care activities that are aimed at maintaining decent living conditions come first.

As for the indicators of ICT competence of students of educational courses, based on the experimental data obtained, all newly developed programs of these courses in the gerontology and geriatrics for specialists in MSE and rehabilitation include:

1. A system for measuring and evaluating ICT competence of students, before the start of the course and after its completion;
2. Separate training modules (topics) dedicated to the study of open education systems, remote education, ICT;
3. Separate training modules (topics) devoted to didactic methods of gerogogy.

ATC and TIC in the gerontology and geriatrics for specialists in MSE and rehabilitation should be considered as a definite promotion of each student to self-development and advanced self-education in ICT.

With regard to the use of audio-visual educational tools to increase the cognitive motivation of students of ATC and TIC, significant shifts in the attendance of the discipline's website were noted when video clips of average duration (from 180 to 360 seconds) were integrated into the presentation body with hyperlinks to cloud video services on the website, where it was possible to view the full version of the video or a significant part of it. At the same time, the average attendance of the discipline's website for two days before the day of the lecture session remained at the same level (14 ± 3 people per day),

however, on the day of the lecture session and the following day was 23 ± 2 people per day, which is significantly higher than in the case of using short-duration video clips ($p < 0.05$).

V. Conclusion

1.The current basic level of knowledge of physicians about the modern geriatric approach in the primary health care system and its practical application are not sufficient for effective therapeutic and diagnostic measures and require measures to optimize them.

2.Short-term TIC in the specialty "Geriatrics" with the use of remote educational technologies contributes to increasing the level of knowledge of physicians in this branch of practical healthcare.

3.The introduction of the geriatric approach into the primary health care system through modern educational technologies contributes to a statistically significant increase in the level of functionality and QOL of patients of older age groups.

4.The ICT competence of medical staff - students of the ATC and TIC, is not only a prerequisite for the successful development of the program, but also an important vital need for effective daily professional activities at their workplace.

5.The organization of ATC and TIC in the gerontology and geriatrics for specialists in MSE and rehabilitation on the basis of CMSEPO is in good agreement with the introduction of remote educational technologies based on EEMC into the educational process, built, in turn, using cloud-oriented ERMS.

6.During developing presentations of training sessions of ATC and TIC in the gerontology and geriatrics, it is necessary to use audiovisual materials of average duration from 180 to 360 seconds, which positively affect the attendance of the educational discipline website.

References

- [1]ABURTO, J.M., VILLAVICENCIO, F., BASELLINI, U., KJÆRGAARD, S., VAUPEL, J.W. (2020) Dynamics of life expectancy and life span equality. *Proceedings of the National Academy of Sciences of the United States of America*, 117 (10), pp. 5250-5259. <https://doi.org/10.1073/pnas.1915884117>
- [2]MEYER, A.C., DREFAHL, S., AHLBOM, A., LAMBE, M., MODIG, K. (2020) Trends in life expectancy: did the gap between the healthy and the ill widen or close? *BMC medicine*, 18 (1), p.41. <https://doi.org/10.1186/s12916-020-01514-z>
- [3]UNGAR, A., RIVASI, G., PETROVIC, M., et al. (2020) Toward a geriatric approach to patients with advanced age and cardiovascular diseases: position statement of the EuGMS Special Interest Group on Cardiovascular Medicine. *European geriatric medicine*, 11 (1), pp. 179-184. <https://doi.org/10.1007/s41999-019-00267-0>

- [4] VAN DEN NOORTGATE, N., PETROVIC, M. (2009) The importance of a geriatric approach in medicine. *Acta clinica Belgica*, 64 (1), pp. 7-10. <https://doi.org/10.1179/acb.2009.003>
- [5] BERNABEU-WITTEL, M., GONZÁLEZ-MOLINA, Á., FERNÁNDEZ-OJEDA, R., et al. (2019) Impact of Sarcopenia and Frailty in a Multicenter Cohort of Polypathological Patients. *Journal of clinical medicine*, 8 (4), p. 535. <https://doi.org/10.3390/jcm8040535>
- [6] PIEDALLU, J.B., LORENZO-VILLALBA, N., CHASSAGNE, P., SCHUERS, M., ZULFIQAR, A.A. (2020) Syndrome de fragilité : évaluation des connaissances et de ses outils de dépistage concernant les internes de médecine générale [Frailty syndrome: evaluation of its knowledge and screening tools by general medicine interns]. *Gériatrie et psychologie neuropsychiatrie du vieillissement*, 18 (1), pp. 53-62. <https://doi.org/10.1684/pnv.2019.0840>
- [7] ASSAR, M.E., LAOSA, O., RODRÍGUEZ MAÑAS, L. (2019) Diabetes and frailty. *Current opinion in clinical nutrition and metabolic care*, 22 (1), pp. 52-57. <https://doi.org/10.1097/MCO.0000000000000535>
- [8] KHAN, K.T., HEMATI, K., DONOVAN, A.L. (2019) Geriatric Physiology and the Frailty Syndrome. *Anesthesiology clinics of North America*, 37 (3), pp. 453-474. <https://doi.org/10.1016/j.anclin.2019.04.006>
- [9] LORENZO-LÓPEZ, L., MASEDA, A., DE LABRA, C., REGUEIRO-FOLGUEIRA, L., RODRÍGUEZ-VILLAMIL, J.L., MILLÁN-CALENTI, J.C. (2017) Nutritional determinants of frailty in older adults: A systematic review. *BMC geriatrics*, 17 (1), p. 108. <https://doi.org/10.1186/s12877-017-0496-2>
- [10] SCHOUFOUR, J.D., OVERDEVEST, E., WEIJS, P.J.M., TIELAND, M. (2019) Dietary Protein, Exercise, and Frailty Domains. *Nutrients*, 11 (10), p. 2399. <https://doi.org/10.3390/nu11102399>
- [11] JAYANAMA, K., THEOU, O., BLODGETT, J.M., CAHILL, L., ROCKWOOD, K. (2018) Frailty, nutrition-related parameters, and mortality across the adult age spectrum. *BMC medicine*, 16 (1), p. 188. <https://doi.org/10.1186/s12916-018-1176-6>
- [12] STEINMEYER, Z., DELPIERRE, C., SORIANO, G., et al. (2020) Hemoglobin concentration; a pathway to frailty. *BMC geriatrics*, 20 (1), p. 202. <https://doi.org/10.1186/s12877-020-0159>
- [13] ARAI, H., SATAKE, S., KOZAKI, K. (2018) Cognitive Frailty in Geriatrics. *Clinics in geriatric medicine*, 34 (4), pp. 667-675. <https://doi.org/10.1016/j.cger.2018.06.011>
- [14] SOYSAL, P., VERONESE, N., THOMPSON, T., et al. (2017) Relationship between depression and frailty in older adults: A systematic review and meta-analysis. *Ageing research reviews*, 36, pp. 78-87. <https://doi.org/10.1016/j.arr.2017.03.005>
- [15] GUTIÉRREZ-VALENCIA, M., IZQUIERDO, M., CESARI, M., CASAS-HERRERO, Á., INZITARI, M., MARTÍNEZ-VELILLA, N. (2018) The relationship between frailty and polypharmacy in older people: A

systematic review. British journal of clinical pharmacology, 84 (7), pp. 1432-1444.
<https://doi.org/10.1111/bcp.13590>

[16] KEHLER, D.S., THEOU, O. (2019) The impact of physical activity and sedentary behaviors on frailty levels. Mechanisms of ageing and development, 180, pp. 29-41.
<https://doi.org/10.1016/j.mad.2019.03.004>

[17] KWAN, R.Y.C, LEUNG, A.Y.M, YEE, A, LAU, L.T, XU, X.Y., DAI, D.L.K. (2019) Cognitive Frailty and Its Association with Nutrition and Depression in Community-Dwelling Older People. The journal of nutrition, health & aging, 23 (10), pp. 943-948. <https://doi.org/10.1007/s12603-019-1258-y>

[18] GIMENO-MALLENCH, L., SANCHEZ-MORATE, E., PAREJO-PEDRAJAS, S., et al. (2020) The Relationship between Diet and Frailty in Aging. Endocrine, metabolic & immune disorders drug targets, 20 (9), pp. 1373-1382. <https://doi.org/10.2174/1871530320666200513083212>

[19] THILLAINADESAN, J., SCOTT, I.A., LE COUTEUR, D.G. (2020) Frailty, a multisystem ageing syndrome. Age and ageing, 49 (5), pp. 758-763. <https://doi.org/10.1093/ageing/afaa112>

[20] NASCIMENTO, C.M., INGLES, M., SALVADOR-PASCUAL, A., COMINETTI M.R., GOMEZ-CABRERA, M.C., VIÑA, J. (2019) Sarcopenia, frailty and their prevention by exercise. Free radical biology & medicine, 132, pp. 42-49. <https://doi.org/10.1016/j.freeradbiomed.2018.08.035>

[21] KAMEDA, M., TERUYA, T., YANAGIDA, M., KONDOH, H. (2020) Frailty markers comprise blood metabolites involved in antioxidation, cognition, and mobility. Proceedings of the National Academy of Sciences of the United States of America, 117 (17), pp. 9483-9489.
<https://doi.org/10.1073/pnas.1920795117>