

Quality of life in different age groups resulting from the availability of CAD programs

Danuta Rak

Master, e-mail: danuta_projektyizskolenia@wp.pl, ORCID: 0009-0006-2172-2936

3DR design and training studio, Poland

Received: September 5, 2023 | **Revised:** September 25, 2023 | **Accepted:** September 30, 2023

DOI: 10.5281/zenodo.8397039

Abstract

The concept of the standard of living, or in other words the broadly understood quality of life, is of interest to many fields of science in the field of social economy, philosophy, medicine, psychology and sociology. Each of these teachings applies to different aspects of our lives and serves to create different determinants that become important for different social groups at different ages. The World Health Organization (WHO) has developed definitions of health and disease, as well as guidelines on quality of life, which allow us to look at these definitions differently. Each disease, including cancer, significantly reduces the standard of living of the patient and his family. The disease leads to anxiety and depression, excludes the patient and sometimes the family from paid work, and this is closely related to the care of the patient. Uncertainty is associated with the entire treatment process, hospitalization and what their lives will look like after recovering from the disease. Stress and anxiety are alleviated by available software, technologies and treatment methods that increase treatment options and raise patients' awareness of the disease and the course of treatment. AutoCAD software available on the market allows you to design and model in 3D space, e.g. medical devices, anatomical models, modern medical and measuring equipment and also allows, thanks to available tools, to export models to files cooperating with 3D printers and to create projects in virtual VR space. which increase treatment options and raise patient awareness of the disease and the course of treatment. AutoCAD software available on the market allows you to design and model in 3D space, e.g. medical devices, anatomical models, modern medical and measuring equipment and also allows, thanks to available tools, to export models to files cooperating with 3D printers and to create projects in virtual VR space. which increase treatment options and raise patient awareness of the disease and the course of treatment. AutoCAD software available on the market allows you to design and model in 3D space, e.g. medical devices, anatomical models, modern medical and measuring equipment and also allows, thanks to available tools, to export models to files cooperating with 3D printers and to create projects in virtual VR space.

Key words: AutoCAD software, medical browsers, virtual reality, quality of life, photodynamic therapy, cancer.

Introduction

AutoCAD is a Computer Aided Design (CAD) system designed for any industry and intended for everyone (Auto) (Jaskulski, A., 2019). In AutoCAD, we can design two-dimensional 2D elements (work in x,y space) and model three-dimensional 3D objects (work in x,y,z space). For each of these two-dimensional and three-dimensional objects, we can specify very precise parameters and specify the coordinates of all points. Modeling is the process of creating and modifying 3D objects using AutoCAD. The AutoCAD program provides a set of tools as well as a palette of solids, e.g. rectangular prisms, spheres, which can be used to build 3D objects. 3D objects in AutoCAD can be built from polygon meshes, they can be defined with curves or parametric surfaces. Thanks to the software, built 3D objects can be freely modified using modification tools, i.e. rotation, mirror image, scale, twisting, etc.

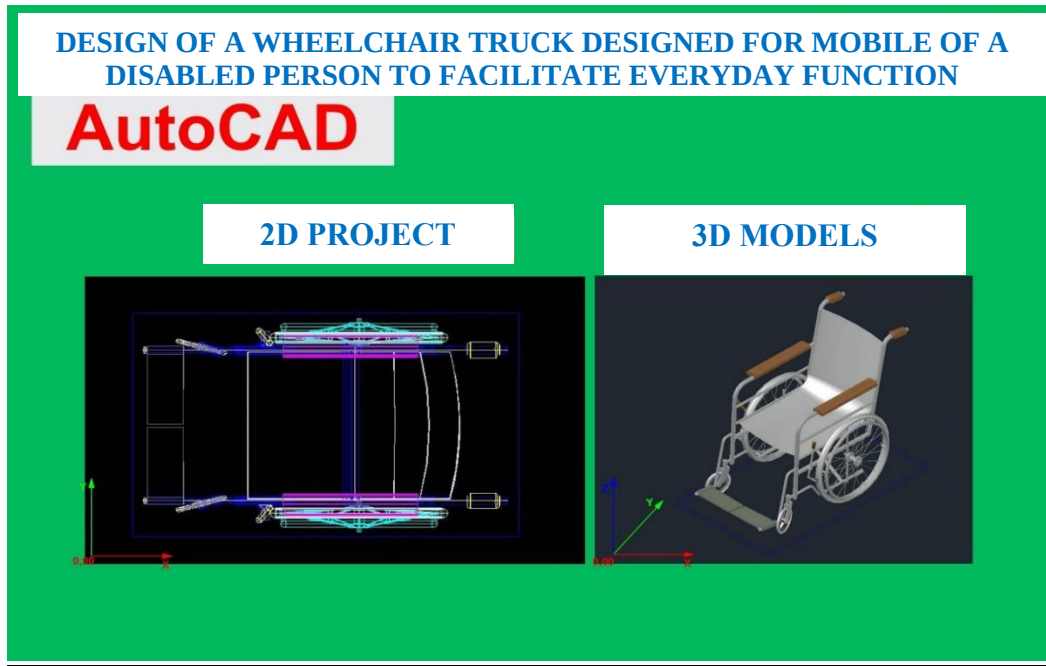


Figure1 – Design of a wheelchair intended for the movement of a disabled person, facilitating the functioning of a disabled person. Project made in AutoCAD software technology showing representation in 2D space and 3D model

With AutoCAD technology, you can create solids of revolution by rotating 2D cross-sections around an axis.

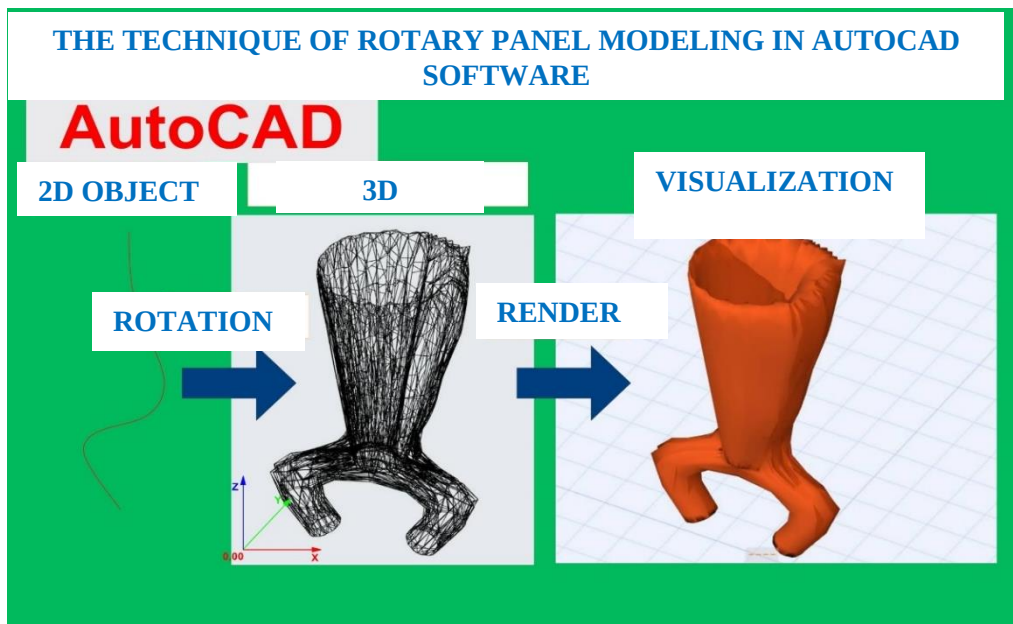


Figure2 – A drawing showing the technique of modeling solids of revolution on the example of a diseased section of the aorta in AutoCAD software and the transition of a three-dimensional 3D model into visualization

Another method in AutoCAD for creating 3D solids is the Constructive Solid Geometry (CSG) method, i.e. defining solids through operations, i.e. sum, difference, common part on other solids.

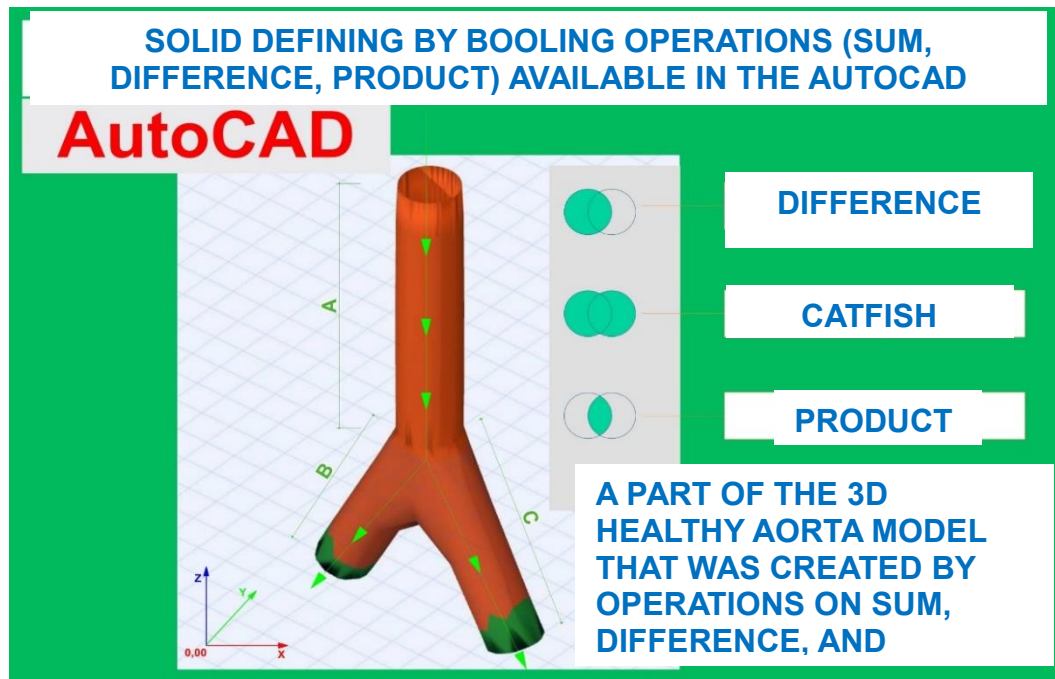


Figure 3 – Defining solids by Boolean operations (sum, difference, product) available in AutoCAD software on the example of a 3D model of a healthy segment of the aorta

It is also worth mentioning the methods of modeling using subdivision surfaces or creating height maps, in which the height of a point is related to the color of pixels on the map.

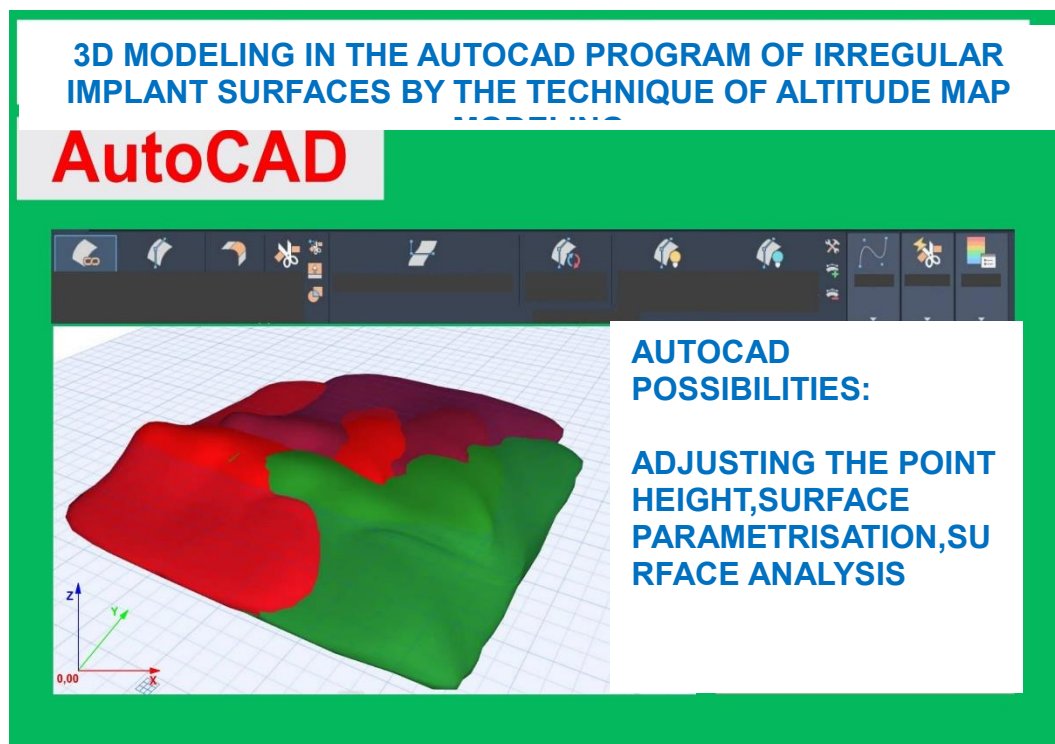


Figure 4 – 3D modeling in AutoCAD software of irregular surfaces of implants using the modeling technique – height maps

Considering the above, AutoCAD software technology is a tool that works perfectly well in various fields of medicine as well. Thanks to the AutoCAD software technology, it is possible to model e.g.

- dentures,
- skin patches,
- pills,
- anatomical models,
- stiffening of broken limbs as a substitute for plaster,
- organs or bones
- skull implants, single tooth implants or entire dental arches.

Designed 3D models in CAD technology, combined with the possibility of exporting them to files compatible with 3D printers and the 3D print itself, give a real chance for medical patients struggling with various diseases to function efficiently in society, this applies to patients of all ages. In the case of children, their physical development and psychological conditions should be taken into account. Another very important aspect of the impact of AutoCAD software technology is its combination with virtual reality (VR) shaping technology. VR technology can be used in many ways, making life easier for both patients and doctors. VR glasses combined with three-dimensional 3D models give the opportunity to support the work of surgeons, especially with oncolological patients,

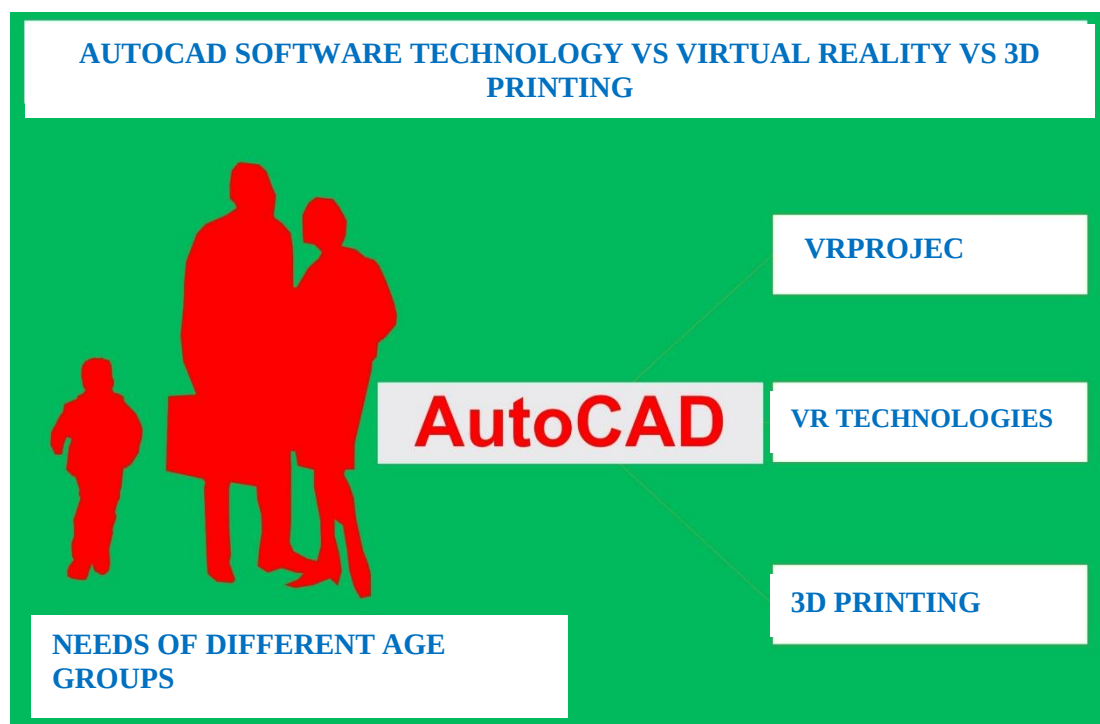


Figure 5 – Relationship of AutoCAD software with Virtual Reality projects and 3D printing

Materials and Methods

Materials on AutoCAD programming technology have been taken from the available literature on the use of AutoCAD, experience in working in AutoCAD, literature on modern treatment methods and technologies available in medicine. Materials constituting the basis for writing the article were also available scientific publications in the field of available CAD software as well as 3D printing technology and materials. An important role in the analysis of the study of AutoCAD software on the standard of living in different age groups was played by the literature on methods of examining the quality of life.

Results

AutoCAD software technology and photodynamic therapy of skin cancer treatment. The society is more and more often exposed to cancer, either in its own or in the family, as shown by the data from the National Cancer Registry. Cancer patients may undergo surgery or laser therapy, in which case the photodynamic method (PTD) turns out to be an effective form of treatment. Photodynamic therapy (PDT) is a modern form of skin cancer treatment that is used in various fields of medicine.

The photodynamic method is a method with a high degree of safety and efficiency, and an important advantage is its non-invasiveness. This form of treatment works well in the treatment of tumors located in the top layer of the skin. Of course, this form of treatment is selected on the basis of the patient's individual examinations as well as the patient's individual circumstances. In photodynamic therapy, as already mentioned, the destruction of cancer cells occurs through irradiation, a photosensitizer, i.e. a chemical substance sensitive to light, is applied to the diseased skin. Under the influence of light, the photosensitizer is activated, and in this way, the affected skin cells oxidize. In most cases, the healing process leaves no scars or marks.

Explaining the answer to the question, AutoCAD software is software that is also very willingly used by the medical industry. Thanks to the available tools as well as the high accuracy of drawings and measurements, the program allows you to design devices and modern medical technologies, assess the effectiveness of medical equipment, model anatomical structures, the program allows you to evaluate research in the field of skin cancer by using measuring tools, tools for assigning your own attributes and the results of measurements or statements generated in the program allow for further diagnostic tests. Thanks to the combination of available tools in AutoCAD for 3D modeling as well as the possibility of printing on 3D printers, the program also allows you to model other necessary medical devices, which will facilitate the treatment process with the photodynamic method. Such a medical device may be a face shield created for an individual patient, protecting the delicate skin and facial organs with a cut-out for the affected area. Below I present my own concept, which can be a prototype and the basis for further research.

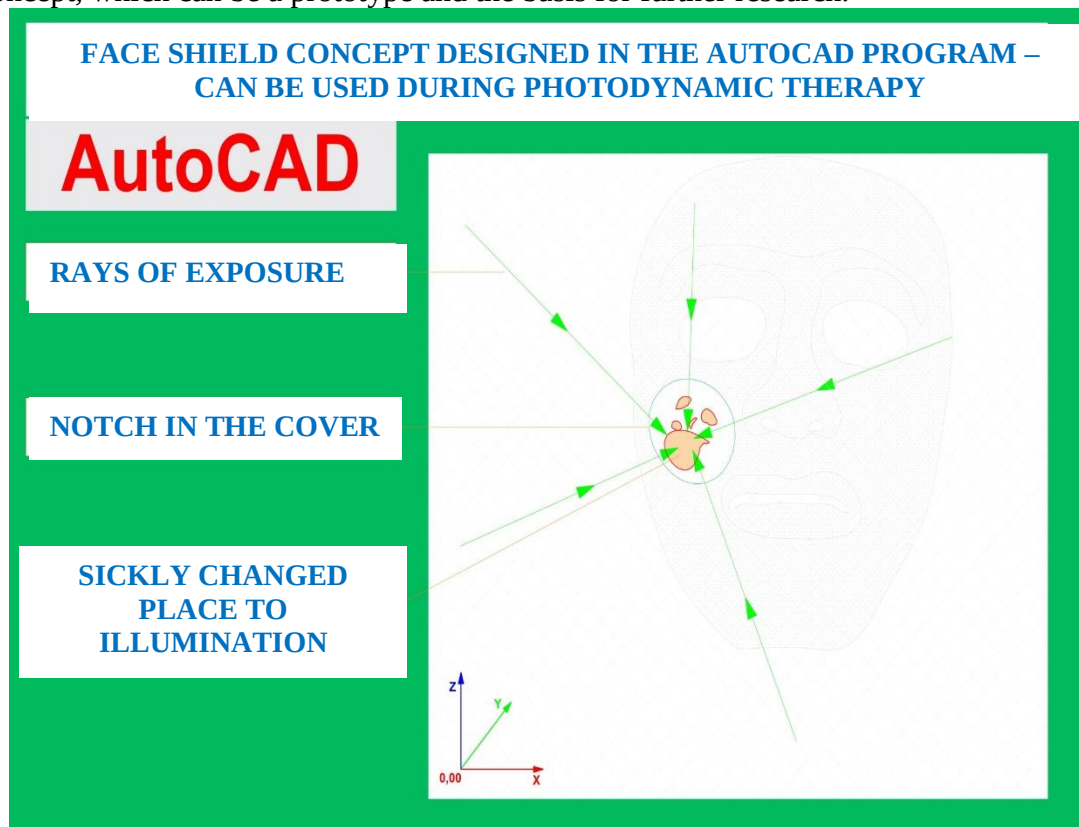


Figure 6 – The concept of a face shield that can be used during photodynamic therapy with a cut-out designed for an individual patient. The concept was created in AutoCAD software

The cut-out in the face shield allows only the affected area to be irradiated. This increased the safety of the photodynamic method in the case of skin cancers occurring on the face. The concept requires further research and is an individual concept. With the introduction of computed tomography (CT) and subsequently other digital diagnostic imaging methods and the increasing use of computers in clinical applications, it became necessary to develop a standard to enable the exchange of graphical information and accompanying medical data between various devices and information systems (Maciejewski, R.; Zubrzycki, J., 2015). Another important issue should be noted, namely the cooperation of AutoCAD software with other CAD programs, medical viewers, e.g. Radiant RadiAnt DICOM Viewer, which allow you to create volumetric renderings of large volume data. This tool allows you to freely rotate the 3D model, change the position of the model, zoom in, adjust color and transparency. Volumetric renderings generated in this way from the medical viewer can also be imported to AutoCAD software and subjected to further modifications, measurements, etc. Such cooperation of the engineering program which is AutoCAD and medical viewers allows for the creation of modern treatment methods and technologies in medicine. 3D models in AutoCAD software can also be made on the basis of data obtained from magnetic resonance imaging (MRI) studies.

The impact of AutoCAD software technology on the standard of living in different age groups.

Various age groups benefit directly and indirectly from modern technologies in medicine. This applies to both people working in the medical industry and patients. An example of modern technologies used in medicine is:

- 3D printing,
- smartphone apps,
- artificial intelligence,
- robotics in medicine,
- software and CAD software,
- virtual reality VR,
- technologies for facial recognition and biometric features,
- online platforms,
- voice assistants.

Each of these modern technologies has its beginning in the design phase and most of them can be assigned projects in AutoCAD software.

Another important aspect is the clarification of the concept of standard of living. Standard of living, understood as the material well-being of a person, meaning the amount of goods, products, services that a person has or can purchase. The standard of living most often depends on the level of income. The quality of human life is an extremely important problem, which has recently been of interest not only to medicine, including nursing, sociology, psychology, philosophy, but also to mathematics, statistics and economics. The above was certainly influenced by the increased interest in health care costs and the need to assess the effectiveness and efficiency of treatment (Kowalewski B; Jankowiak, B, Rolka, H; Krajewska-Kułak, E., 2017, p.9).

In general, it can be said that the standard of living has many meanings and concerns economic conditions, free time, social security, housing conditions and, above all, health. Illness, including cancer, affects all aspects of our lives and also reduces its standard. The assessment of the standard of living together with the clinical assessment allows for the selection of therapy in the case of cancer. The number of people suffering from malignant tumors is constantly increasing, as shown by the statistics of the National Cancer Registry. The reports of the National Cancer Registry show that morbidity is closely related to age. The statistics of skin cancer are shown in the following statistics:

Report according to the National Cancer Registry: Age Pyramid
 Years: from 2000 to 2019
 Province: All of Poland

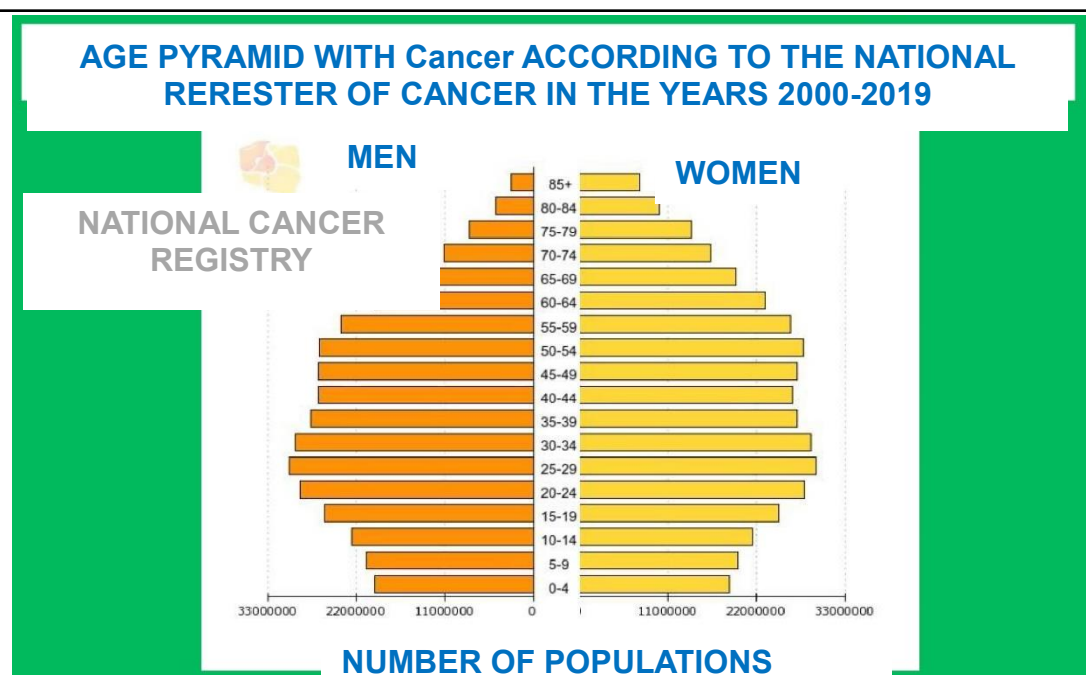


Figure 7 – Age pyramid according to the National Cancer Registry in 2000-2019 (Raporty)

The standard of living is closely related to the health of different age groups in a specific population, which is why it is of interest to many fields of science, including medicine, for which methods of assessing the quality of life in cancer have been developed. A significant contribution to the methodological achievements was the measurement of the quality of life, which was intended to identify the concept of quality of life. There are many research tools used in assessing the quality of life, which, as you know, is difficult to measure. Using the available methodological tools, it is possible to assess the standard - the quality of life of both healthy people, during cancer treatment, including cancer, and people who managed to overcome the disease.

These measurement tools include:

1. WHOQOL-BREF (World Health Organization Quality of Life – BREF) questionnaire. The questionnaire consists of 26 questions to be answered on a 5-point scale and concerns such areas of life as physical and psychological functioning, social relations and the functioning environment.
2. The EORTC QLQ-C30 questionnaire (European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire – Core 30) is a tool consisting of 30 questions for patients struggling with cancer regarding physical, emotional and social functioning.
3. SF-36 (Short Form Health Survey). A questionnaire consisting of 11 questions, which are designed to assess health by assessing aspects, i.e. physical conditions, pain, vitality, activity conditioned by psychological state.
4. NHP (The Nottingham Health Profile). The questionnaire consists of 38 questions divided into two parts, the first of which relates to physical fitness, emotional state and functioning in society. The second part of the survey consists of single statements that allow us to assess what aspects have an impact on our health.
5. SIP (Sickness Impact Profile) questionnaire. The questionnaire consists of 126 questions and allows the disease to affect physical and psychosocial functioning.
6. Ferrans and Powers Quality of Life Index. The index allows you to assess the quality of life in a quantitative way and consists of 36 questions, grouped into two parts. The results are calculated in terms of the level of quality of life in four areas: health and functioning, psychological / spiritual functioning, social - economic and family functioning (quote).
7. McGill Quality of Life Questionnaire. A tool consisting of four parts, also allowing to assess the quality of life of a sick person in the physical, mental and social spheres.

8. Spitzer's Quality of Life Index. The index is used in oncological treatment and differentiates patients with different types of diseases at different stages of the disease.

9. ESAS scale (Edmonton Symptom Assessment System). It contains 10 visual-analog scales consisting of two opposite poles. On the left, the least intensity of the symptom, and on the right, the greatest intensity of the symptom.

10. Acceptance of Illness Scale (AIS). The scale contains 8 statements describing the negative effects of poor health and limitations imposed by the disease.

11. Mental Adjustment to Cancer Scale Mini. The tool can be used to assess the reaction to the diagnosis of cancer, the tool also includes the process of treatment and rehabilitation.

12. Satisfaction with Life Scale (SWLS). The Satisfaction with Life Scale allows you to assess the quality of life in relation to your own sense of satisfaction with your own achievements and conditions.

13. HADS Depression and Anxiety Scale (Hospital Anxiety and Depression Scale). The tool can be used to assess the occurrence and intensity of negative emotions in the form of anxiety and depression in a group of non-psychiatric patients.

14. The Karnofsky Performance Status Index. The index allows you to assess the degree of functional efficiency, expressed in the form of one number (Kowalewski B; Jankowiak, B, Rolka, H; Krajewska-Kułak, E., 2017, pp. 65-70).

Tools used to assess the standard – quality of life are the basis for assessing the health of patients, the herd of health care, which is closely related to modern technologies. Information collected from patients, especially cancer patients, allows to obtain valuable information not only in terms of the effects of the disease itself, but also to assess important aspects of life, such as physical, mental or social functioning. Modern technologies introduced to hospitals make treatment in them more effective. An important element will be the digitization of surgery, thanks to which it will be able to inform about each doctor's action, which will help to avoid the negative effects of a given operational activity. The development of technologies such as virtual reality (VR) or artificial intelligence (AI) affects the level and standard of health care. Undoubtedly, 3D printing is very popular in the medical industry, which is of course closely connected with VR technology, in which 3D modeling takes place. Virtual Reality is the direction of 3D design, it allows engineers to enter a completely different level. 3D software technology is perfect here. AutoCAD software enables photorealistic panoramic images from 3D files. Currently, it is a program that provides the highest quality of currently available visualization solutions. The available tools in AutoCAD allow you to select materials, colors, light settings, this allows you to set the reflection and refraction of light, so you can get realistic effects. So the advantages of VR for AutoCAD software are obvious. Virtual Reality allows users to create, edit projects in virtual space. Thanks to VR technology combined with AutoCAD software, you can walk around objects, the ability to test and modify models saves time and money, and the ability to detect errors turns out to be invaluable, and in the case of various fields of medicine, it can save a patient's life and raise the standard of living. Nowadays, a high standard is also characterized by access to modern technologies, thanks to which various age groups of the society have a sense of security that these technologies will positively affect their health and life in the event of an illness. Modern methods of treatment and technology in medicine include recently introduced virtual hospitals and games for depression, which, thanks to visualization and 3D modeling, allow patients to better understand the treatment process, encourage them to take medications or rehabilitate. The virtual world of health is for providers, patients and healthcare professionals. The 3D format offered by the AutoCAD software will allow you to raise the standard of living and make it easier to go through the difficult process of treating cancer. patients and healthcare professionals. The 3D format offered by the AutoCAD software will allow you to raise the standard of living and make it easier to go through the difficult process of treating cancer. patients and healthcare professionals. The 3D format offered by the AutoCAD software will allow you to raise the standard of living and make it easier to go through the difficult process of treating cancer.

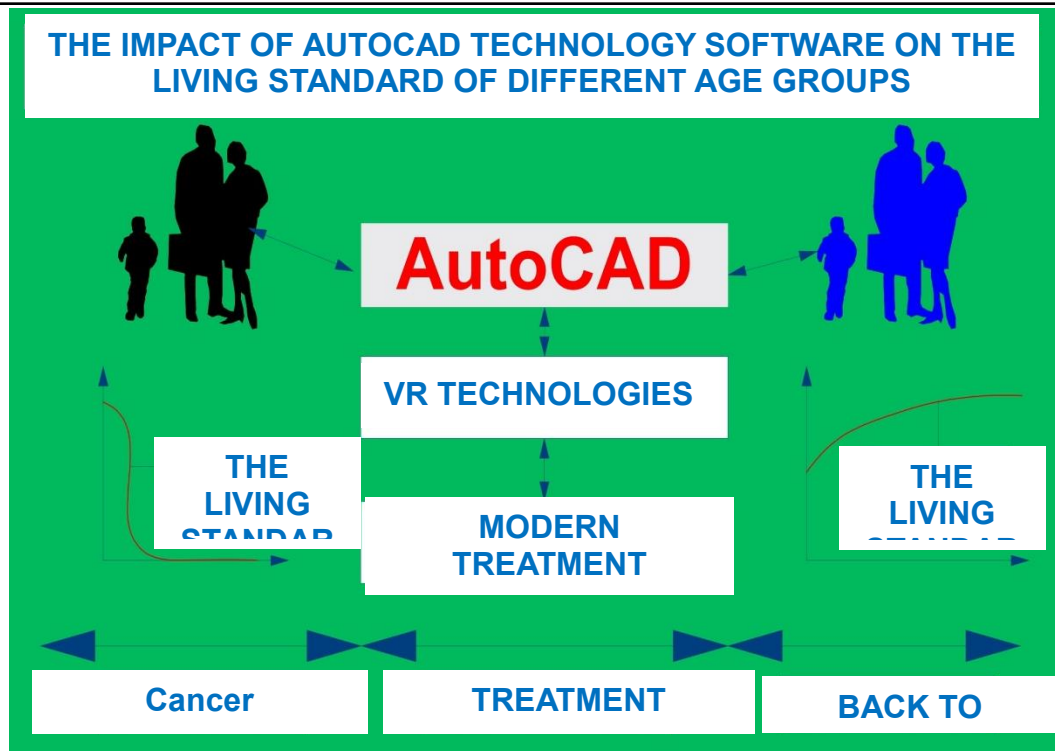


Figure 8 – Dependence of the availability of AutoCAD software technology on the standard of living in different age groups

Discussion

Forecasts of new applications

It is predicted that the use of AutoCAD software technology to create modern technologies in medicine and to improve currently available technologies. Creating new and improved products for the medical industry using AutoCAD software technology will introduce new devices for treatment or home or hospital care to the market, and the development of modeling and 3D printing materials will increase the quality of life of society in various age groups, which will prevent and facilitate the treatment of diseases cancerous. Currently, there are two methods of integration, i.e. modeling in CAD software and a combination of modeling with methods of shaping virtual reality. It is predicted that VR projects will become the standard of education at universities and medical schools, as well as the standard of conducting the patient treatment process in every hospital. A great opportunity for the development of the medical industry is the ability to create a database of VR models and projects in various fields of medicine.

Comparison with other possibilities on the market

Currently, the nXtRender plug-in for AutoCAD has appeared on the market of CAD technology software, which allows you to create even better renders in the program. nXtRender allows you to create photorealistic images from 3D files. Currently, it provides the highest quality in the field of visualization solutions. This plugin uses modern technology to achieve the expected results in a short time. It also includes a very wide database of materials, textures and models available as well as support for multiple lighting channels. Currently, these are models for the architectural, construction or road industry, these are just examples, there is still a lack of texture base, materials for the medical industry. There are also medical viewers on the market that work with AutoCAD software. Thanks to medical browser, we can export 3D models, which in the next steps we can import to AutoCAD software and create projects in virtual reality. In addition to software and modern technologies, there are also developed tools for measuring the quality of life of people in different age groups.

Conclusions

This section is mandatory.

The standard of living of cancer patients and their families is significantly deteriorating. Cancer patients face a significant decrease in physical strength and lack of mental condition. Since the diagnosis, these people live in constant stress, and the fatigue associated with long-term treatment and pain increases the risk of depression. Pain and malnutrition also reduce the standard of living. Thanks to modern technology and treatment methods used in medicine, the chances of surviving cancer are much greater. Life standard studies on various age groups of the society increase the level of security in terms of modern treatment methods, and the patient who has access to online platforms is kept informed about the course of the disease and the actions taken in the field of treatment. AutoCAD software, allows for 3D design and modeling, shaping virtual reality and 3D printing, which allows for raising the standard of living of patients after reconstructions, skin transplants, allows for designing prostheses, medical devices that will allow the patient to cope independently in life. Thus, the self-confidence of the patient increases, it also allows to create a level of psychological comfort for the patient and his family. Summing up, considering the available technology of AutoCAD software, it can be said that it is one of the best software, which, thanks to the universal interface and available tools, is perfect for designing for various fields of medicine. The direction of development of AutoCAD technology software is the creation of specialized overlays for the medical industry. shaping virtual reality and 3D printing, and this allows you to raise the standard of living of patients after reconstructions, skin transplants, allows you to design prostheses, medical devices that will allow you to cope independently in the patient's life. Thus, the self-confidence of the patient increases, it also allows to create a level of psychological comfort for the patient and his family. Summing up, considering the available technology of AutoCAD software, it can be said that it is one of the best software, which, thanks to the universal interface and available tools, is perfect for designing for various fields of medicine. The direction of development of AutoCAD technology software is the creation of specialized overlays for the medical industry. skin grafts allows for the design of prostheses and medical devices that will allow the patient to cope independently in the life of the patient. Thus, the self-confidence of the patient increases, it also allows to create a level of psychological comfort for the patient and his family. Summing up, considering the available technology of AutoCAD software, it can be said that it is one of the best software, which, thanks to the universal interface and available tools, is perfect for designing for various fields of medicine. The direction of development of AutoCAD technology software is the creation of specialized overlays for the medical industry. skin grafts allows for the design of prostheses and medical devices that will allow the patient to cope independently in the life of the patient. Thus, the self-confidence of the patient increases, it also allows to create a level of psychological comfort for the patient and his family. Summing up, considering the available technology of AutoCAD software, it can be said that it is one of the best software, which, thanks to the universal interface and available tools, is perfect for designing for various fields of medicine. The direction of development of AutoCAD technology software is the creation of specialized overlays for the medical industry. it also allows you to create a level of psychological comfort for the patient and his family. Summing up, considering the available technology of AutoCAD software, it can be said that it is one of the best software, which, thanks to the universal interface and available tools, is perfect for designing for various fields of medicine. The direction of development of AutoCAD technology software is the creation of specialized overlays for the medical

industry. it also allows you to create a level of psychological comfort for the patient and his family. Summing up, considering the available technology of AutoCAD software, it can be said that it is one of the best software, which, thanks to the universal interface and available tools, is perfect for designing for various fields of medicine. The direction of development of AutoCAD technology software is the creation of specialized overlays for the medical industry.

References

- Wallach, Kloski L.; Clouds, N. 3D printing. A practical guide to hardware, software and services. 2nd edition. Year 2022. Publisher: Helion.
- Dodziuk, H. 3D printing/AM. Uses and social and economic effects. Publisher: Scientific PWN SA (2019).
- Dodziuk, H. 3D printing/AM. Uses and social and economic effects. Publisher: Scientific PWN SA (2019).
- Plevniak, K.; Campbell, M.; Myers, T.; Hodges A.; Hey M 3D printed auto-mixing chip enables rapid smartphone diagnosis of anemia. Conf Proc IEEE Eng Med Biol Soc. 2016 Aug; 2016: 267–270. Available from : <https://doi.org/10.1109%2FEMBC.2016.7590691>
- Chen, J.; Li, N.; He, D.; Wu, M.; Long, H.; Yang, K.; Qi, S.; Zhang, W.; Wang J. 3-D printing for constructing the burr hole ring of lead fixation device in deep brain stimulation. *Tools and Techniques*, Volume 58, pp 229-233 (2018). Available from : <https://doi.org/10.1016/j.jocn.2018.10.086>
- Fay, C.D. Computer-Aided Design and Manufacturing (CAD/CAM) for Bioprinting. Year 2020. 3D Bioprintingpp. 27–41 Protocol First Online: 24 March 2020 1602 Accesses 3 Citations Part of the Methods in Molecular Biology book series (MIMB, volume 2140) Available from : https://experiments.springernature.com/articles/10.1007/978-1-0716-0520-2_3#:~:text=10.1007/978%2D1%2D0716%2D0520%2D2_3
- Pikoń, A. AutoCAD 2022 PL: first steps. Publisher: Helion (2021).
- Jaskulski, A. AutoCad 2021 PL/EN/LT+: methodology for efficient 2D and 3D parametric and non-parametric design. Publisher: Helen. (2020).
- Krzysiak Z. 2D design in AutoCAD. WNIT Publishing House (2016).
- Lisowski E.; Czyżycki, W. AutoCAD 2000 and InterCAD Windows programs supported by applications prepared in DELPHI: a textbook for students of technical universities. Publisher: Cracow University of Technology (2000).
- Pikon, A. AutoCAD LT 97. Publisher: Helion (1998).
- Dobosz, M. AutoCAD LT v.11. Publisher: EXIT (1992).
- Helt P. Introduction to AutoCAD: includes versions 2, 6 and 9. Publisher: Komputerowa Oficyna Wydawnicza “HELP” (1990).
- Sydor, M. Introduction to CAD (ebook). an item describing the introduction of CAD programs to the market, possibilities of application. PWN Scientific Publishing House (2019).
- Jaskulski, A. AutoCAD 2020/LT 2020 (2013+). Fundamentals of parametric and non-parametric design. Polish and English version. Wydawnictwo PWN SA. Warsaw 2019, p.10.
- Maciejewski, R.; Zubrzycki, J. Biomedical engineering Techniques, technologies, research. Publisher: Lublin University of Technology. Lublin 2015, p.16.
- Kowalewski B; Jankowiak, B, Rolka, H; Krajewska-Kułak, E. Quality of life in medical and social sciences. Publishing House of the Medical University of Białystok. Białystok 2017, p.9., pp. 65-70.
- Raporty. Available from : http://onkologia.org.pl/raporty/#wykres_piramida_wiku [accessed on August 29, 2023]