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Contemporary Models, New Approaches and Perspectives in Training Students of the Medical Laboratory Technician Speciality

THESIS SUMMARY

Of a PhD Thesis

For awarding the educational and scientific degree "Philosophy Doctor"

Research Supervisor:

Assoc. Prof. Emilia Georgieva, PhD

Varna, 2023

The thesis contains 122 pages, including 9 tables and 33 figures. The bibliographic list contains 158 references, of which 96 are in Bulgarian and 62 in English.

There are 4 thesis-related publications that have been presented. The thesis has been discussed and referred for public defence by the Department of Healthcare at the Medical University – Varna.

The formal thesis defence will take place on 13.02.2024 y. according to Order № R-109-511/ 29.11.2023y.

The thesis defence documentation is published on the MU-Varna website and is available to the interested parties in the Library of MU-Varna.

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INTRODUCTION

Laboratory medicine is an integral part of modern medicine and healthcare. It is conventionally defined as a science focusing on observation, study, and application of knowledge for the use of various modern technologies, the analysis of biological fluids, the composition and properties of cells and tissues, and the interpretation of results under normal and pathological conditions. Clinical laboratory diagnostics is a complex speciality involving different areas. In recent years, it has made notable technological and scientific advancements. Respectively, this has been manifested in laboratory activities and diagnostic technologies, and the requirements for laboratory diagnostic services are constantly increasing.

This thesis aims to focus on the analysis of specific features, new approaches in the training and perspectives of medical laboratory technicians and their professional development. A comparative analysis of the data regarding the speciality across various EU member countries has been made. Established European practices are detailed, facilitating timely changes for the development of the profession and shaping the current perception of medical laboratory personnel.

Dynamic living conditions necessitate a swift and appropriate professional response in the laboratory profession. Patients expect quality services, high professionalism and competence. All these changes necessitate a change in the qualification and motivation of students, corresponding to their competitiveness in the European and other job markets. This creates a prerequisite for expanding their knowledge of technology and new software products used in laboratory practice. This will support their flexibility and self-confidence to explore their potential for mobility during the course of study.

The transformation of training due to the change in the qualification of the Medical Laboratory Technician speciality will enhance the competencies of healthcare professionals and respond adequately to the rapidly evolving environment and competitiveness of the labour market.

I. AIM, TASKS, METHODOLOGY AND ORGANISATION OF RESEARCH

1. Aim and Tasks

1.1. Aim: To assess present models and advanced approaches in student learning in order to enhance their competitiveness in the labour market in all EU Member States.

In order to accomplish this purpose, the following **tasks** have been outlined:

1. To study the educational qualifications in Bulgaria and other countries and to prepare a comparative analysis.

2. To investigate the attitudes of students and working medical laboratory technicians regarding improving educational qualifications.

3. To investigate the factors and impediments hindering the improvement of the educational qualification of medical laboratory technicians.

4. To study the opinion of health professional users regarding professional training and competencies of medical laboratory technicians.

5. To develop a curriculum model for a Master's program that will ensure the cultivation of applicable knowledge and managerial proficiency in the medical laboratory technician trainees to integrate strategies and new approaches into their medical diagnostic laboratory work.

1.2. Research hypotheses:

1. The current educational qualification of the Medical Laboratory Technician speciality is incompatible with the European terminology and classification.

2. The introduction of a Master's degree program for medical laboratory technicians, associated with the application of new educational approaches, will meet the demand among medical laboratory technicians.

3. Encouraging the educational mobility of students and faculty from the medical colleges will impact the exchange of innovative activities and approaches – both in training and work organisation in medical diagnostic laboratories.

1.3. Organisation of research

The research subject is the training of medical laboratory technicians in Bulgaria and their European counterparts – similarities or differences in theoretical knowledge, practical skills and acquired professional qualifications.

1.4. Object of research exploration

1) Medical laboratory technicians practising their profession on the territory of Varna.

2) Students at the Medical Colleges of Varna Stara Zagora in the Medical Laboratory Technician speciality.

3) Experts – managers of medical diagnostic laboratories.

1.5. **Scope of research** – the survey included 189 respondents, distributed as follows:

- Medical laboratory technicians working in Varna – 79
- Students studying in the speciality Medical Laboratory Technician at the Medical College – Varna and the Medical College – Stara Zagora– 100
- Working experts – 10

Inclusion criteria:

- Individuals over 18 years of age;
- Medical laboratory technicians practising their profession on the territory of Varna;
- Students studying at the Medical College – Varna and the Medical College – Stara Zagora in the Medical Laboratory Technician speciality;
- Expert managers of medical diagnostic laboratories.

Exclusion criteria:

- Individuals under 18 years of age;
- Students not studying at the Medical College – Varna and the Medical College – Stara Zagora in the speciality Medical Laboratory Technician;
- Medical laboratory technicians who do not practice their profession on the territory of Varna;
- Experts who are not managers of medical diagnostic laboratories.

1.6. Duration and location of research

The survey was conducted at the Medical College – Varna and the Medical College – Stara Zagora, as well as at locations convenient for the experts.

The main part of the research was carried out independently by the author.

1.7. Research stages

Thesis-related activities were conducted in five stages, as described in Table 1.

Table 1. Research stages

Stages	Activities	Covered	Duration	Location	Guidance and tools
Stage I	Study the relevance of the problem and identify it. Outlining the issue, object and subject of the study. Definition of aim, tasks and working hypotheses. Procuring tools for the study.		Nov. 2020 – March 2022	Varna	Regulatory documents, literature sources, bibliographic references, papers, reports, etc.
Stage II	Actual research ✓ Conducting an anonymous survey to determine the attitudes towards the training of medical laboratory technicians and students training at ES Medical Laboratory Technician. ✓ Conducting a semi-structured interview with users of laboratory services to ascertain views on the level of education, turnover and working practices of the medical laboratory technicians.	Medical laboratory technicians – 79 Students – 100 Experts – 10	May 2022 - Oct. 2022 г.	Medical College – Varna; Medical College – Stara Zagora Varna	Questionnaire No. 1 (Annex 1) Questionnaire No 2 (Annex 2) Semi-structured interview (questionnaire) (Annex 3)
Stage III	Data processing and analysis – the primary information obtained in stage II was processed using a statistical program. The analysis of the aggregated data is performed through selected research methods.		Nov. 2022 – May 2023 г.	Varna	SPSS – SPSS for Windows 13.0
Stage IV	Description of results		June 2023 – July 2023	Varna	
Stage V	Conclusions and contributions		July 2023 – Oct. 2023	Varna	

Sources of information:

- Available scientific literature;
- Available national and international regulatory documents;

- Opinions of medical laboratory technicians, students and laboratory physicians.

The research was approved by the Research Ethics Committee (REC) of the Medical University – Varna (DECISION No. 116/28.04.2022).

2. Survey methods

To achieve the aim and objectives, the following studies were conducted:

2.1. Documentary method

- ✓ Study and analysis of national and international regulatory documents;
- ✓ Study and analysis of literature sources.

2.2. Sociological method

- ✓ Anonymous questionnaire survey of 1st, 2nd and 3rd-year students in Medical Laboratory Technicians speciality at the Medical College – Varna and the Medical College – Stara Zagora.
- ✓ Anonymous questionnaire survey of medical laboratory technicians working in the following medical institutions: St. Marina University Hospital – Varna, St. Anna Hospital – Varna, Military Hospital Varna.
- ✓ Interview with experts (users of healthcare personnel) from the following medical institutions: St. Marina University Hospital – Varna, St. Anna Hospital – Varna, and Military Hospital Varna.

2.3. Statistical method – data consolidation through various techniques, activities, approaches, methods and tools. Interpretation of data.

The following methods were applied for the statistical analysis:

1) **Descriptive analysis** characterises the status and dynamics of the studied processes.

- ✓ Variance analysis of quantitative changes – mean, standard deviation, median, minimum and maximum.
- ✓ Frequency analysis of qualitative variables, including relative frequencies, absolute frequencies, and cumulative relative frequencies.
- ✓ Graphical representations.

2) **Hypothesis testing methods** – non-parametric methods: χ^2 (Chi-square test) and Fisher's exact test; Kolmogorov-Smirnov and Shapiro-Wilk methods.

3) **Correlation analysis** – parametric linear correlation coefficient – Pearson; non-parametric linear correlation coefficient – Spearman.

4) **Regression analysis** – logistic regression analysis and the critical significance level we used is $\alpha = 0.05$. The corresponding null hypothesis is rejected when the P-value is less than α. The SPSS version, SPSS for Windows 13.0, was used to process the survey data associated with this thesis.

5) **Factor analysis** – a statistical technique for transforming a set of correlated data into a new set with uncorrelated factors.

6) **Tabular and graphical methods** of data presentation – simple and multivariate tables; line, pie and bar charts.

7) **T-test** – for statistical hypothesis. It is used to accept or reject the null hypothesis.

3. Research tools

Proprietary survey tools were developed to survey the three groups of respondents: questionnaires and interviews.

Questionnaire №1 investigates the opinion of medical laboratory technicians regarding their level of professional competence acquired during their training in medical colleges. The questionnaire includes 17 questions (15 closed and 2 open). The questions are structured in 3 groups:

1. *Socio-demographic characteristics* – gender, age, year of graduation and level of education;

2. *Professional competencies* – respondents should express the level of satisfaction with their studies, job opportunities, and competitiveness in the labour market.

3. *Possible professional perspectives* – respondents evaluate their professional opportunities, competencies and possibilities depending on their educational qualifications (*Annex 1*).

Questionnaire No. 2 explores the students' opinions on the status, barriers and real opportunities for professional training according to the state regulations. The questionnaire includes 20 questions (18 closed and 2 open). The questions are structured in 4 groups:

1. *Socio-demographic characteristics* – gender, age and year of study.

2. *Assessment of the level of training* – respondents should reflect the level of satisfaction with the training in view of the methods, approaches and standard of teaching, as well as the provision of facilities.

3. *Professional competencies* – respondents should evaluate their competitiveness in the labour market, professional skills and advancement opportunities.

4. *Recommendations and suggestions* – respondents have the opportunity to indicate new approaches to training to improve the quality of training, the number of class hours, advancement and postgraduate training (Annex 2).

Semi-structured interviews – semi-structured face-to-face interviews were conducted at locations convenient to the respondents. In cases when a physical meeting was impossible, the interview was conducted by telephone. The information obtained during the interview was recorded, transcribed, processed and summarised (Annex 3).

The interview includes 12 open-ended questions divided into 3 sections:

1. Professional competencies of the graduated medical laboratory technicians – the focus is on the training of the medical laboratory technicians and their attitude to the working environment, their ability to make decisions and work in a team.

2. Competitiveness of medical laboratory technicians – the focus is on the allure of the profession at home and abroad and the ability of medical laboratory technicians to practice the profession in other countries.

3. Suggestions and recommendations – the focus is on upgrading the speciality, student mobility, summer internships and other innovations in modern training.

The average duration of an interview is about 60 minutes. All interviews are transcribed within a day of being conducted. An inductive approach, most commonly used in qualitative research, was used to analyse the data.

II. RESULTS AND DISCUSSION OF THE SURVEY AMONG WORKING MEDICAL LABORATORY TECHNICIANS

Chapter two discusses the main characteristics of the surveyed medical laboratory technicians. It explores the career opportunities in laboratory medicine, outlines the reasons for the shortage of medical laboratory technicians, and investigates new opportunities in the workplace regarding the acquisition of higher qualifications. Opinions on the organisation of courses or postgraduate training programs are explored.

1. Socio-demographic characteristics of the medical laboratory technicians surveyed

The study included 79 medical laboratory technicians working in medical diagnostic laboratories in the District of Varna. The gender distribution showed a lower relative proportion of male subjects (12.66%, n=10) compared to female subjects (87.34%, n=69) (Fig. 1).

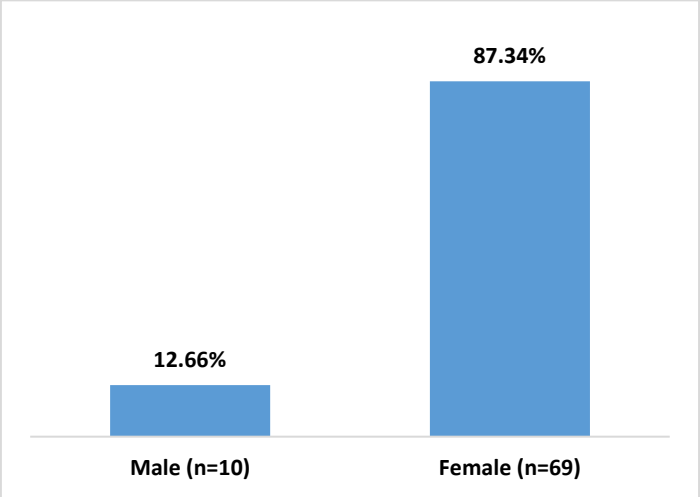

Figure 1. Distribution of medical laboratory technicians by gender

Statistical analysis shows a statistically significant difference in the relative share of respondents of both sexes ($\chi 2=44.063$, $p<0.01$), which is explained by the fact that the profession of medical laboratory technician is favoured mostly by women for professional realisation.

The mean age of the respondent laboratory technicians in our study was 37.11 years (SD ± 13.399), with a minimum age of 21 years and a maximum age of 66 years shown in Table 2.

Table 2. Minimum, maximum and mean age of respondents

Indicator	N	Min	Max	Mean	Std. Dev
Age	79	21	66	37,11	±13.399

The mean age of female medical laboratory assistants surveyed was 38.59 years (SD ± 13.647), with a minimum age of 21 years and a maximum age of 66 years, while in the group

of male medical laboratory assistants, the mean age was 26.09 (SD ± 4.012) years with a minimum age of 22 years and a maximum age of 37 years (Table 3).

Table 3. Age of the surveyed medical laboratory technicians by gender

Gender	N	Min	Max	Mean	Std. Dev
Female	69	21	66	38.59	±13.647
Male	10	22	37	26.09	± 4.012

In order to test the hypothesis that the arithmetic mean of age for the two groups of respondents, males and females in the group of medical laboratory technicians, is equal, an independent sample Student's t-test was applied, which revealed that there is a difference between the arithmetic means of age of males (M=26.09, SD=4.012) and females (M=38.59, SD=13.647): $p<0.05$.

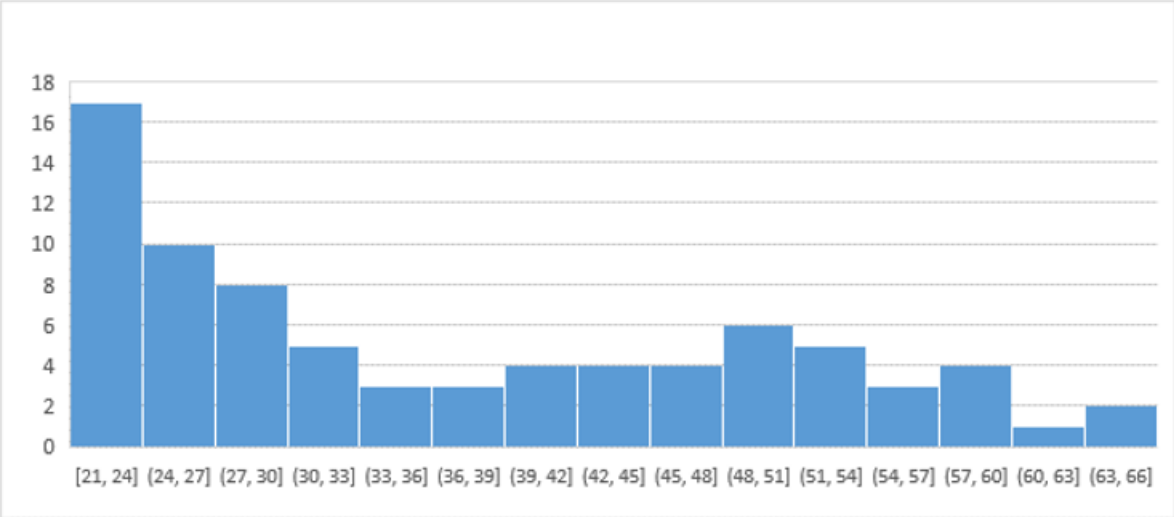

Figure 2. Distribution of respondents in the group of medical laboratory technicians by age (histogram with interval width k=3)*

2. Competencies possessed by young medical laboratory technicians for successful professional realisation

Student learning was **highly rated** by 39.24% (n=31) of the responding working medical laboratory technicians. The level was **very high** for two respondents (2.53%). The level was **average** for 9 of them (11.39%) (Figure 3).

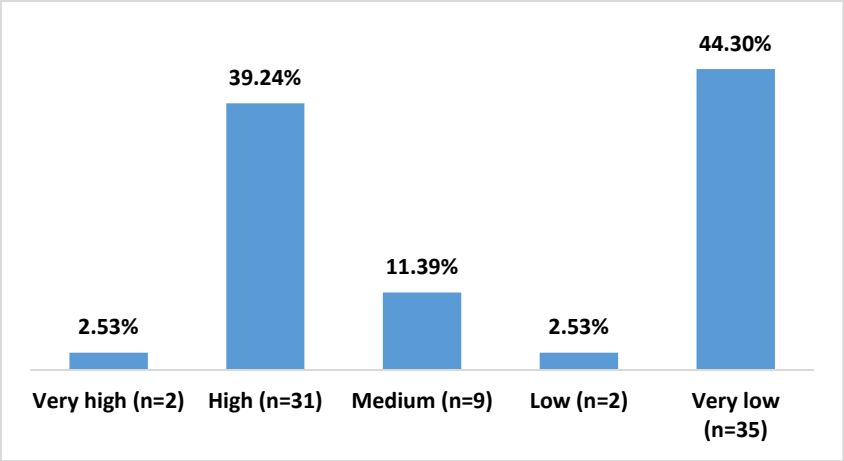

Figure 3. Overall evaluation of the training in Medical Laboratory Technician speciality

There was a statistically significant difference ($\chi 2=43.728$, $p<0.05$) in the relative share of respondents who evaluated to different degrees the training of students in the Medical Laboratory Technician speciality.

Regarding the competencies that young medical laboratory technicians must possess to be successful in their professional careers, the respondents evaluated to different degrees the competencies we proposed. From a statistical point of view, we could not identify the competencies that had the highest significance or insignificance in the respective degrees ($p>0.05$). Over half of the respondents attributed high importance to all seven proposed competencies ($p<0.05$). The respondents in our study revealed "Ethics and loyalty in relationships" as the most substantial competency. It was rated in very high degree by 76.68% (n=59) of the medical laboratory technicians, in high degree by 15.19% (n=12), in medium degree by 8.86% (n=7) and in low degree by the remaining 2.53% (n=2) ($\chi 2=106.570$, $p<0.05$) (Table 4).

Table 4. Evaluation of some competencies possessed by young medical laboratory technicians for successful professional realisation

Competency	**Very high degree**		**High degree**		**Medium degree**		**Low Degree**		**χ^2**	**p-value**
	N	%	N	%	N	%	N	%		
Basic knowledge of the professional field	52	65.82%	18	22.78%	8	10.13%	1	1.27%	77.608	p<0.05
Ability to apply knowledge in practice	57	72.15%	13	16.46%	8	10.13%	4	1.27%	97.354	p<0.05
Information technology (IT) skills	48	60.76%	16	20.25%	11	13.92%	4	5.06%	91.316	p<0.05
Communication and teamwork skills	51	64.56%	19	24.05%	7	8.86%	2	2.53%	73.658	p<0.05
Independent working skills	45	56.96%	23	29.11%	9	11.39%	2	2.53%	54.620	p<0.05
Ethics and loyalty in relationships	59	76.68%	12	15.19%	6	7.59%	2	2.53%	106.570	p<0.05
Conduct in conflict situations	54	68.35%	16	20.25%	7	8.86%	2	2.53%	84.291	p<0.05
p-value	-	p>0.05	-	p>0.05	-	p>0.05	-	p>0.05	-	-

Nearly 80% of the respondents (79.75%, n=63) reported that they were satisfied with the opportunities provided to them in the laboratory where they work. In comparison, the remaining 20.25% (n=16) were dissatisfied with the opportunities for professional development and self-improvement in the environment where they perform their professional activities ($\chi 2=27.962$, $p<0.05$) (Fig. 4).

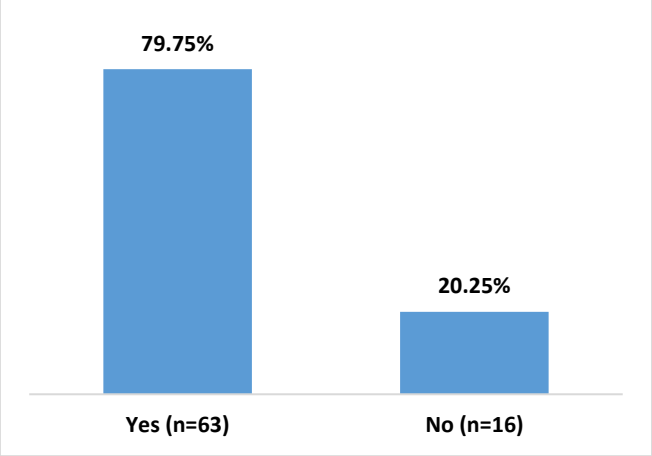

Figure 4. Satisfaction with opportunities in the work environment

The high relative share of respondents who are satisfied with the provided opportunities for realisation in the work environment can be interpreted as a positive trend in terms of employers who strive to provide both safe working conditions for their employees and provide them with the potential for upgrading, development and improvement of professional knowledge, skills and competencies.

A high relative share (81.01%, n=64) of surveyed working medical laboratory technicians reported having high levels of professional self-confidence in the work environment compared to those who held the opposite view (18.99%, n=15). The latter did not state that they had sufficient motivation and self-confidence in the medical diagnostic laboratory in which they worked ($\chi 2=30.393$, $p<0.05$) (Fig. 5).

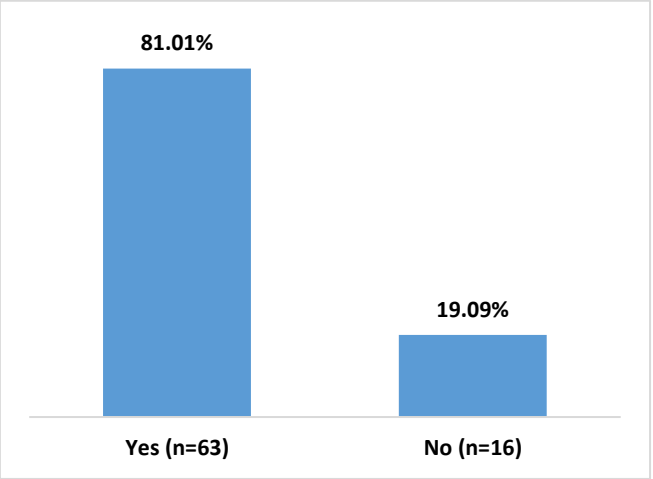

Figure 5. Presence of motivation and professional self-confidence in the working environment of medical laboratory technicians

A statistically significant higher relative share of respondents feel motivated and professionally confident in the work environment. Based on this, we can conclude that a large share of medical laboratory technicians carry out their activities in a work environment that develops their potential for development and self-improvement.

The highest relative proportion of respondents in the study were those working in a **clinical laboratory** (51.90%, n=41), followed by laboratory technicians practising their profession in **microbiology** (20.25%, n=16), **histology** (16.46%, n=13) or **parasitology** (16.46%, n=5) laboratories. Only 5.06% (n=4) of the respondents work in another area of laboratory practice ($\chi 2=56.886$, $p<0.05$) (Figure 6).

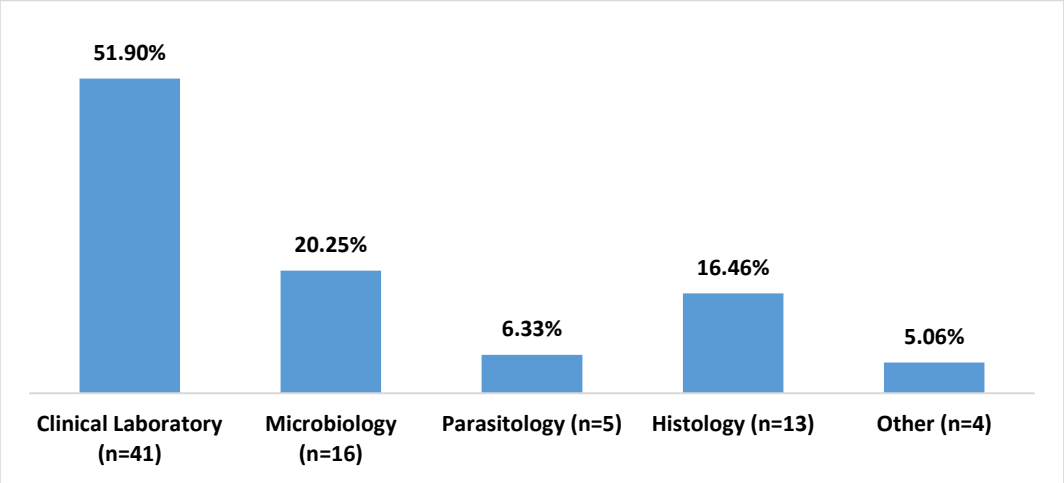

Figure 6. Career path in laboratory medicine

This distribution is directly related to the structures available in the different fields of laboratory medicine nationally – the most widespread are the specialised medical diagnostic laboratories with a profile of clinical laboratory and microbiology and, to a lesser extent, the laboratories for parasitological diagnostics and those with histology and histopathology profile.

3. Main reasons for the shortage of medical laboratory technicians in healthcare

The government recently adopted the National Long-Term Healthcare Needs Map has identified a severe shortage and uneven distribution of medical personnel.

The most serious staffing problem in the healthcare system is the shortage of healthcare professionals. The reasons for this shortage are considered to be: turnover, level of satisfaction, stress, management style, professional and career development, and role conflicts.

Turnover of medical laboratory technicians in the workplace emerged as a significant problem for 39.74% (n=31) of respondents. The opposite opinion was held by 22.78% (n=18) of the medical laboratory technicians surveyed, while the remaining 12.66% (n=10) of their colleagues could not judge the severity of the problem related to turnover in the laboratory where they work. These disparities between the comparative ratio of turnover in the respective medical diagnostic laboratories were statistically significant ($\chi 2=16.127$, $p<0.05$), implying that patterns, rather than chance, account for this distribution in the responses given (Fig. 7).

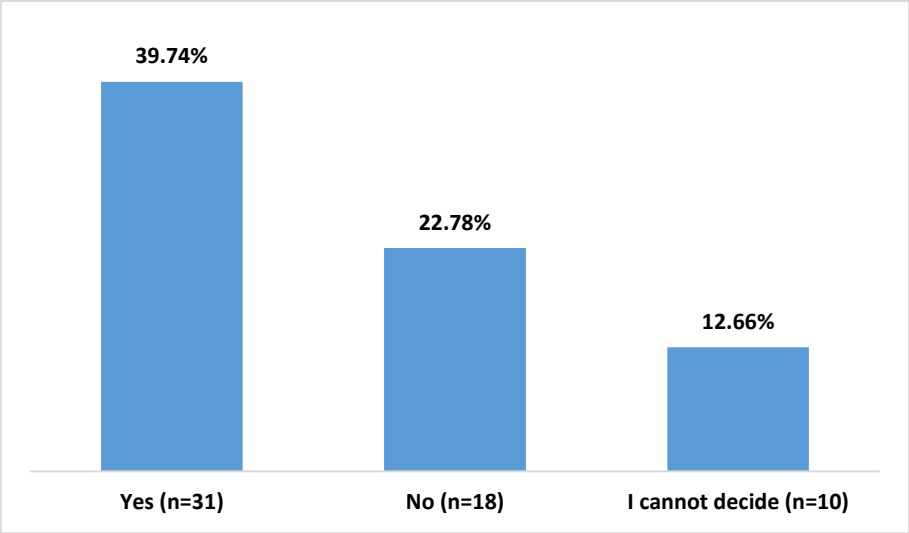

Figure 7. Turnover of medical laboratory technicians in the workplace

We set out to determine the reasons leading to medical laboratory technician turnover by analysing the opinions of those respondents who answered in the affirmative to the question of whether the medical diagnostic laboratory in which they work experiences turnover due to various financial factors or factors related to the advancement of medical laboratory technicians, etc.

Data analysis on the presence of turnover of laboratory professionals could hardly identify a leading cause for this phenomenon, as no statistically significant difference was found in the relative proportions of the reasons medical laboratory technicians leave their jobs ($p>0.05$). However, the significant ones are listed in Table 5.

Table 5. Reasons for medical laboratory technicians' turnover in the workplace

Reason for turnover*	**N**	**Yes, this is the reason**		**No, that is not the reason**		**p-value**
		%	**n**	**%**	**n**	
Medical laboratory technicians leaving the country to work abroad	31	3	9,68%	28	90,32%	p<0,05
Low pay in the relevant medical diagnostic laboratory (MDL)	31	29	93,55%	2	6,45%	p<0,05
Inability to obtain higher qualifications in the same professional field	31	27	87,10%	4	12,90%	p<0,05
Taking up higher-paid work outside of healthcare	31	23	74,19%	8	25,81%	p<0,05
High workload	31	28	90,32%	3	9,68%	p<0,05
Another reason	31	15	48,39%	16	51,61	p>0,05

** Responses are based on respondents indicating in a previous question that there is a turnover of medical laboratory technicians in their medical diagnostic laboratory (n=31).*

According to the respondents, the **low remuneration** of the qualified medical laboratory technicians is the reason to leave their jobs in the respective medical diagnostic laboratory (93.55%, n=29), followed by the **high workload** (90.32%, n=28) and the **inability to obtain higher qualifications** in the same professional field (87.10%, n=27). **Another reason** shared by respondents is pursuing a more lucrative job in an area unrelated to healthcare (74.19%, n=23). Starting a job abroad (9.68%, n=3) was ranked as the least important reason for turnover.

In the context of turnover, our research interest was drawn to the impact of COVID-19-related anti-epidemic measures and their influence on the relationships within the team where the surveyed medical laboratory technicians work. A large majority of respondents in our study (60.76%, n=48) reported that the introduction of measures to contain the spread of the pandemic did not have a positive or negative impact on work-team relationships, while the remaining 39.24% (n=31) of respondents held the opposite opinion ($\chi 2=3.658$, $p>0.05$). The data suggests that the pandemic and its related measures did not affect work-team relations and work process dynamics – as indicated in Figure 8.

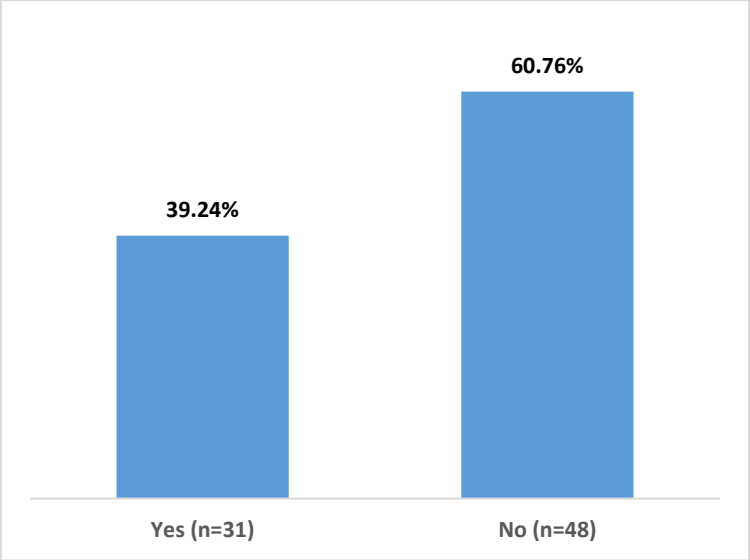

Figure 8: Impact of anti-epidemic measures on team relationships in the workplace

4. Qualification degree held by medical laboratory technicians

Nearly ¼ of the respondents (24.05%, n=19) have an educational and qualification degree higher than a Professional Bachelor's degree. This indicates that these professionals seek opportunities to develop and upgrade their professional competencies through further university education and to further their educational and qualification credentials (Figure 9).

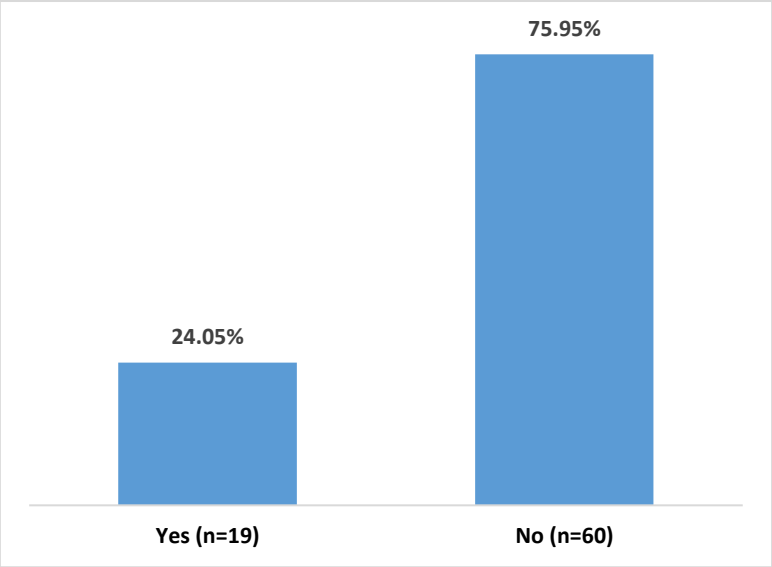

Figure 9. Possession of a higher qualification degree than a Professional Bachelor

In the group of respondents who advanced their qualifications after acquiring a degree as a Medical Laboratory Technician, several specialities in which laboratory professionals found opportunities for further development and education surfaced.

Medical laboratory technicians most often continue their studies in BSc or MSc in **Nursing Care** (18.99%, n=15), BSc or MSc in **Healthcare Management** (8.86%, n=7), and BSc or MSc in **Biology** (6.33%, n=5). A low relative share (8.86%, n=8.86) of respondents obtained higher educational and qualification degrees beyond those mentioned in the survey (Economics, Finance and Insurance, Philology, etc.) (Table 6).

Table 6. Possession of a higher qualification degree by medical laboratory technicians

Higher qualification in one of the fields:	**N**	**Yes**		**No**		**p-value**
		n	**%**	**%**	**n**	
Bachelor's or Master's degrees in Nursing Care	79	15	18.99%	64	81.01%	p<0,05
Bachelor's or Master's degrees in Healthcare Management	79	7	8.86%	72	91.14%	p<0.05
Bachelor's or Master's degrees in Pedagogy	79	4	5.06%	75	94.94%	p<0.05
Bachelor's or Master's degrees in Biology	79	5	6.33%	74	93.67%	p<0.05
College/University education in another field	79	7	8.86%	72	91.14%	p<0.05

It was found that some respondents acquired more than one degree and qualification. This is likely related to a desire for career development and the possibility of increasing opportunities in the labour market should circumstances related to job change due to external causes arise.

A relatively large share of respondents (43.04%, n=34) felt that acquiring a higher level of qualification would not lead to new opportunities in the workplace. On the other hand, 37.97% (n=30) of the medical laboratory respondents felt that obtaining a more advanced degree would present them with novel alternatives for advancement within the laboratory in which they work. About 20% of respondents in our survey (18.99%, n=15) could not assess

this opportunity. The difference in the relative shares of respondents expressing different opinions on this survey question is statistically significant ($\chi 2=7.620$, $p<0.05$) (Fig. 10).

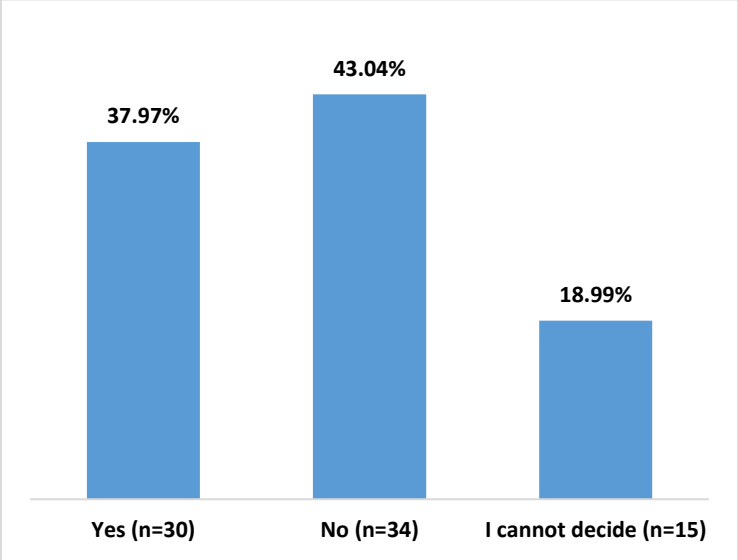

Figure 10. Provision of new workplace prospects in relation to increased qualifications

Almost unanimously, the medical laboratory technicians surveyed believed that postgraduate courses or programs should be introduced in their work field. The definitive opinion of 82.28% (n=65) of respondents is an indicator of medical laboratory technicians' desire to have opportunities for occupational development through courses and Master's programs organised in a university setting ($\chi 2=86.380$, $p<0.05$) (Fig. 11).

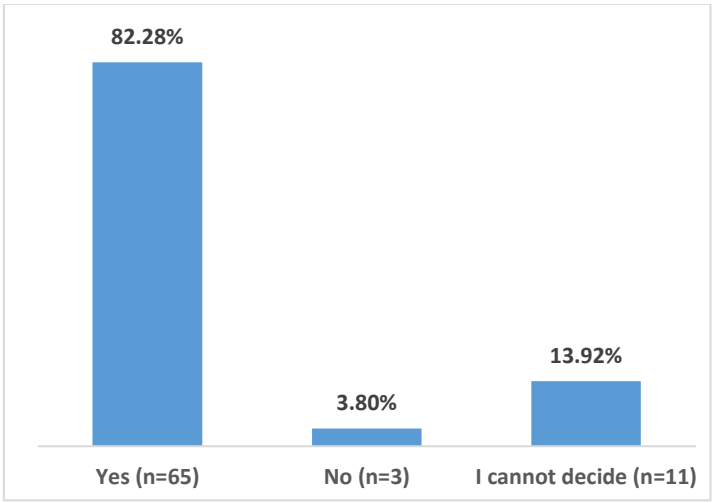

Figure 11. Attitudes towards postgraduate courses or Master's programs

Introducing courses or postgraduate training programs will increase the knowledge, skills and competencies of medical laboratory technicians, as well as enhance professional self-confidence and self-esteem among specialists.

Many medical laboratory technicians work on a single contract, i.e. in a single workplace (60.76%, n=48). However, the percentage of respondents working on more than one contract (39.24%, n=31) is not to be underestimated ($\chi 2= 3.658$, $p>0.05$) (Fig. 12).

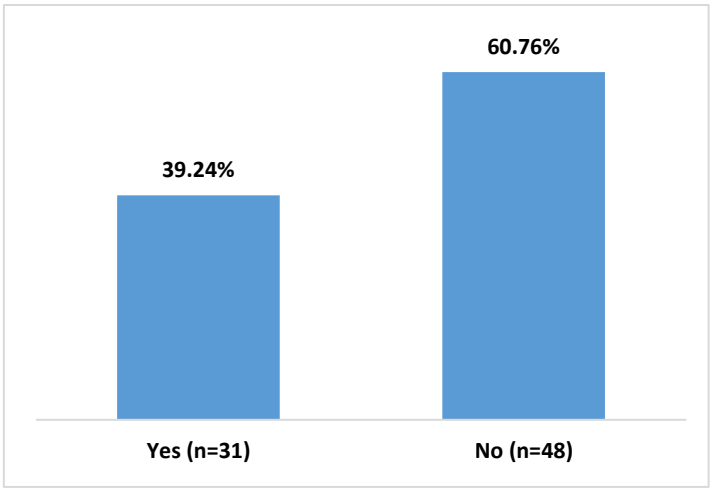

Figure 12. Medical laboratory technicians holding a second job

The basic reason for medical laboratory technicians to take a second job is the low remuneration of their primary job. It is interesting to note that medical laboratory technicians working in laboratories within state or municipal medical facilities often work on a second contract. The higher salaries in private medical diagnostic laboratories could explain this.

5. Attitudes towards the establishment of a postgraduate qualification degree

Almost all (89.87%, n=71) of the respondents in our study believed that increasing the number of practice hours during training at the Medical College would result in a higher level of expertise ($\chi 2=113.646$, $p<0.05$) (Fig. 13).

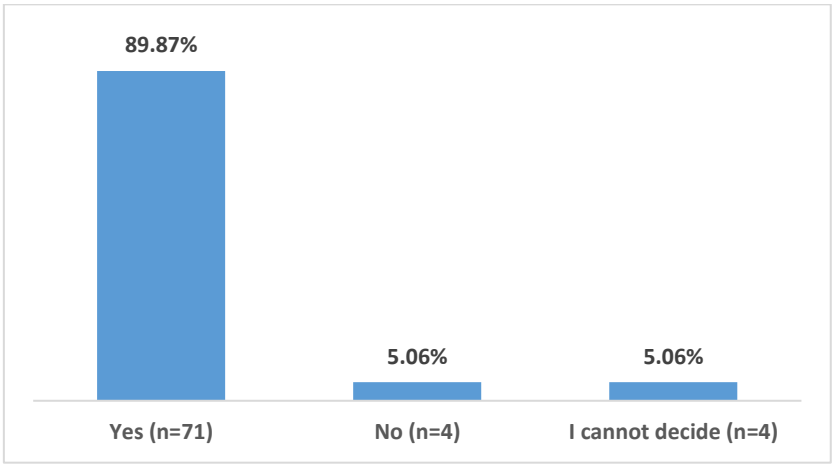

Figure 13. Respondents' opinions on increasing the number of practice hours proposing summer internships during the training of medical laboratory technicians

Providing an opportunity for practice during training establishes the groundwork for developing professional skills and competencies based on which students start their professional careers as full-fledged medical laboratory technicians. Increasing the number of practical training hours will undoubtedly increase students' knowledge and professional self-confidence. Some students actively participate in the student internships under the Ministry of Education and Science project, but the program is limited in capacity and is highly insufficient.

Students are willing to participate in such programs and show excellent results. An increase in the number of practice hours with the option for summer internships would result in more effective practical training of medical laboratory technicians.

Greater diversity was reported in the opinions of medical laboratory scientists regarding increasing the number of hours of core courses during their college training – 54.43% (n=43) of our survey respondents favour the proposal for a new master's program ($\chi 2=31.013$, $p<0.05$) (Fig. 14).

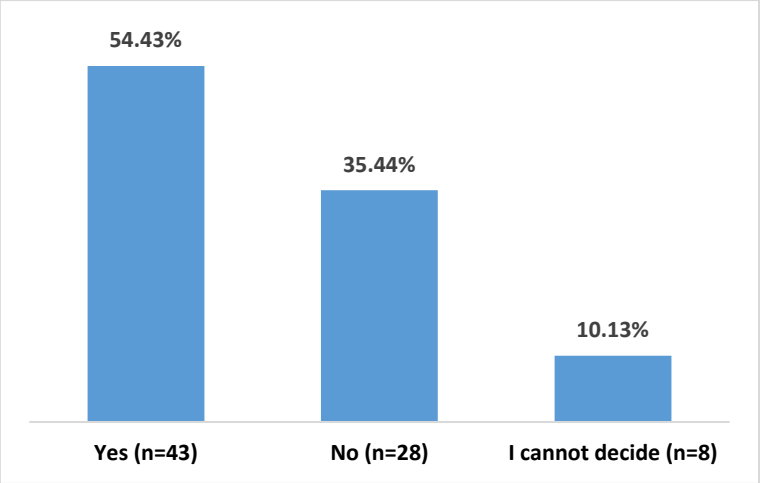

Figure 14. Respondents' opinions on increasing the number of class hours of core subjects during the training of medical laboratory technicians

The number of class hours in core subjects studied at the Medical College by students of the Medical Laboratory Technician speciality is the starting point for students' theoretical and practical proficiency and expertise. According to the respondents, increasing study hours will enhance students' qualification as laboratory technicians, preparing them as equipped and well-trained personnel. Hence, they will be set to efficiently join all areas of laboratory medicine in Bulgaria and abroad (Fig. 15).

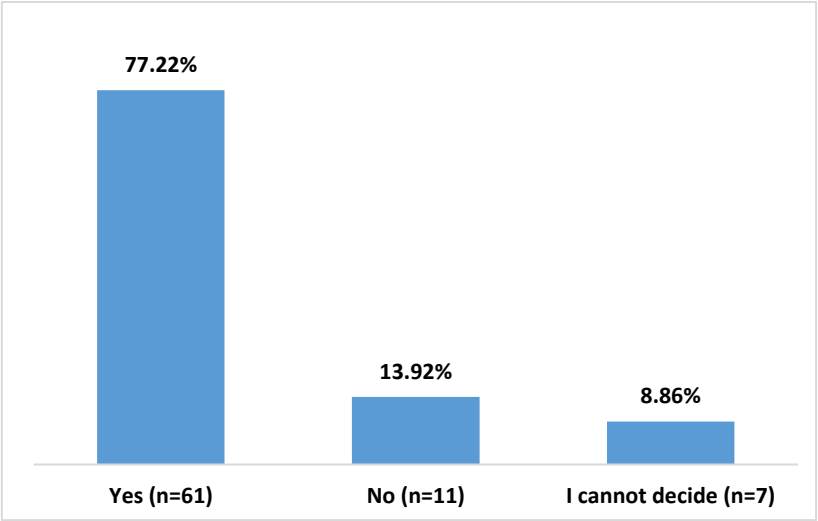

Figure 15. Respondents' opinions on launching a postgraduate qualification degree

The results reflect good professional skills and qualities, together with a yearning for ongoing education and development. Respondent lab technicians are willing to increase their level of education. This also increases their competitiveness in the labour market at home and abroad, providing opportunities to pursue managerial roles and research.

Medical staff turnover can be viewed in two aspects – actual and potential. Often in practice, potential turnover is not manifested and is underestimated. According to the analysis, it is due to the following factors:

1. Willingness to practice the profession in another laboratory or abroad.

2. Intentions to leave the profession.

3. Aspiration for a higher level of education in the same field, which will secure a higher position.

A management model must be implemented to address turnover and minimise the shortage of medical laboratory technicians in healthcare facilities. Addressing the underlying causes of this will achieve this.

Medical laboratory technicians have the least enthusiasm for working abroad. This is a consequence of the difference in the educational qualification – a professional bachelor's degree in our country and a Bachelor's degree in European countries have similar curricula and teaching processes.

Conclusions from the quantitative study

- Medical laboratory professionals highlight some significant competencies necessary for their professional activity: “Ethics and loyalty in relationships”, “Conduct in conflict situations”, and "Communication and teamwork skills”.
- A high level of satisfaction (79,75%) of medical laboratory technicians with the acquired knowledge and skills and their career prospects in the workplace was reflected.
- Willingness to enhance knowledge and skills in the same field is demonstrated by ¼ of working medical laboratory technicians. This is primarily driven by higher autonomy in the profession and more variety in work.
- Seeking to expand knowledge via academic courses and postgraduate qualifications (Master's programs) have 82,28% of respondents. Prestige, career growth, greater efficacy in patient care, and professional advancement impact the results.
- The regulations allow medical laboratory technicians to continue in the Master’s program for Public Health Protection and Control. The program is aimed at the needs of healthcare professionals with a tertiary education (three-year course of study), with a vocational bachelor's degree or a higher degree in the Nursing care speciality. The program does not specify the growing need for medical laboratory technicians for competencies in information systems – in laboratory practice, clinical laboratory, microbiology, histotechniques and parasitology, healthcare management, and project management in healthcare.
- There is a need to regulate the addition of summer internships in training medical laboratory technicians – 89.87% of respondents favour this. Some students fail to qualify for the student internship program under the Ministry of Education and Science project due to limited capacity.

III. RESULTS AND DISCUSSION OF THE SURVEY AMONG STUDENTS STUDYING IN THE MEDICAL LABORATORY TECHNICIAN SPECIALITY

The socio-demographic characteristics of students in the Medical Laboratory Technician speciality are presented in the fourth chapter. It focuses on satisfaction with the training process, the theoretical and practical training, as well as the hybrid form of training (online and face-to-face). Competitiveness and awareness of continuing education among students have been analysed.

1. Socio-demographic characteristics of students studying in the Medical Laboratory Technician speciality

The survey included 100 students in the Medical Laboratory Technician speciality in MC-Varna and MC-Stara Zagora. The distribution shows a lower relative share (5.00%, n=5) of male respondents compared to the relative share of female respondents (95.00%, n=5) (Fig. 16).

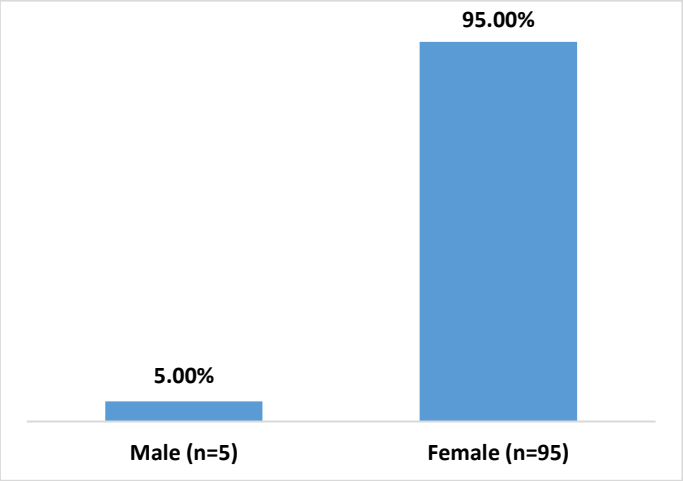

Figure 16. Distribution of students in the Medical Laboratory Technician specialty by gender

The difference in the relative shares of male and female students was statistically significant ($\chi 2=81.000$, $p<0.01$), which is related to the tendency that the Medical Laboratory Technician speciality is preferred for professional career by female students. This also corresponds to the gender distribution of the respondents working as medical laboratory technicians, in which a higher relative share of female respondents participated ($p<0.05$).

The mean age of the students surveyed in our study was 22.26 years (SD ± 4.079), with a minimum age of 18 years and a maximum age of 35 years (Table 7).

Table 7. Minimum, maximum and mean age of respondents in the group of medical laboratory students

Indicator	N	Min	Max	Mean	Std. Dev
Age	100	18	35	22,26	± 4,079

The mean age of female students surveyed was 22.22 years (SD ± 4.118), with a minimum age of 18 years and a maximum age of 35 years. In the group of male students, the mean age was

23.00 (SD ± 3.536) years, with a minimum age of 19 years and a maximum age of 28 years (Table 8).

Table 8. Age of the respondent students by gender

Gender	N	Min	Max	Mean	Std. Dev
Female	95	18	35	22,22	± 4,1180
Male	5	19	28	23,00	± 3,536

In order to test the hypothesis that the arithmetic mean of age for the two groups of respondents, males and females in the group of medical laboratory technician students, was equal, a Student's t-test for independent samples was conducted. We established that there was no difference between the arithmetic means of the values for males (M = 23.00, SD = 3.536) and females (M = 22.22, SD = 4.118) at p>0.05 (Figure 17).

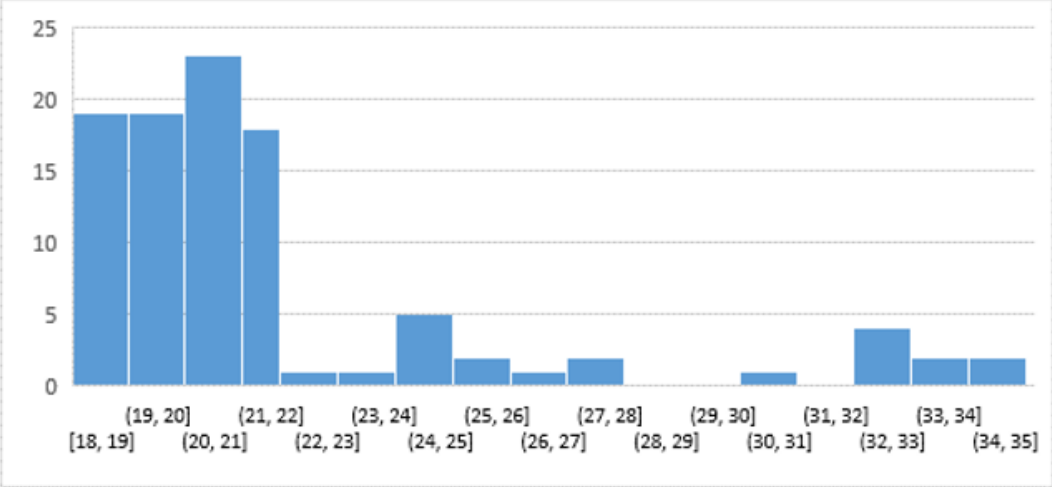

Figure 17. Distribution of respondents in the group of medical laboratory students by age (histogram with interval width k=1)*

The highest relative share (38.00%, n=38) reflects the respondents in their 2nd year of study, followed by those in their 3rd year (33.00%, n=33); the lowest relative share was of respondents in the 1st year (29.00%, n=29) (Figure 18).

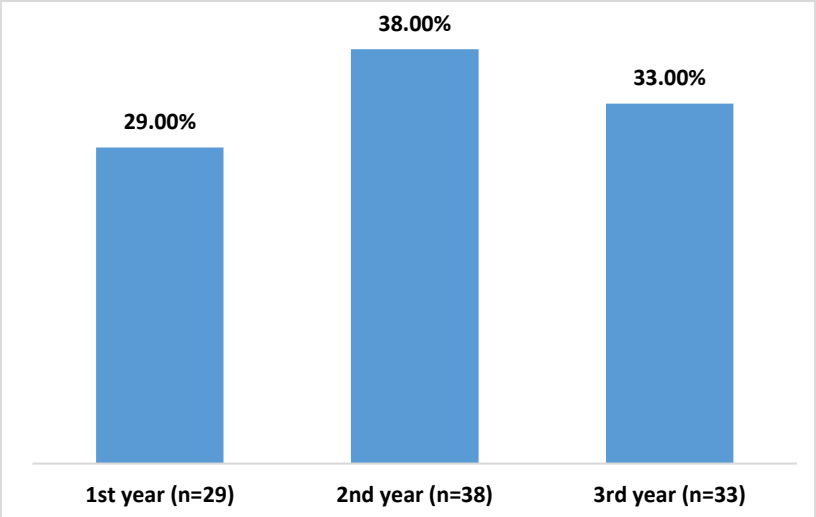

Figure 18. Distribution of respondents by college year of study

There was no statistically significant difference in the relative shares of first, second and third-year students ($\chi 2=1.220$, $p>0.05$). This indicates that the respondents are evenly distributed by years of study, with no subgroup statistically significantly outnumbering the others.

This suggests that the views expressed by the respondents in our survey reflect the views of students from all courses of study uniformly, without singling out any particular group.

2. Assessment of the extent to which the organisation of the learning process contributes to the acquisition of knowledge and competencies

Nearly 2/3 of the students surveyed (61.00%, n=61) said they are familiar with the legal framework in the Republic of Bulgaria that regulates the development of professionally competent specialists. 1/3 of them are partially familiar (33,00%, n=33), and the relative share of students unable to make a judgement or are not familiar is negligible for the purposes of this study (Fig. 19).

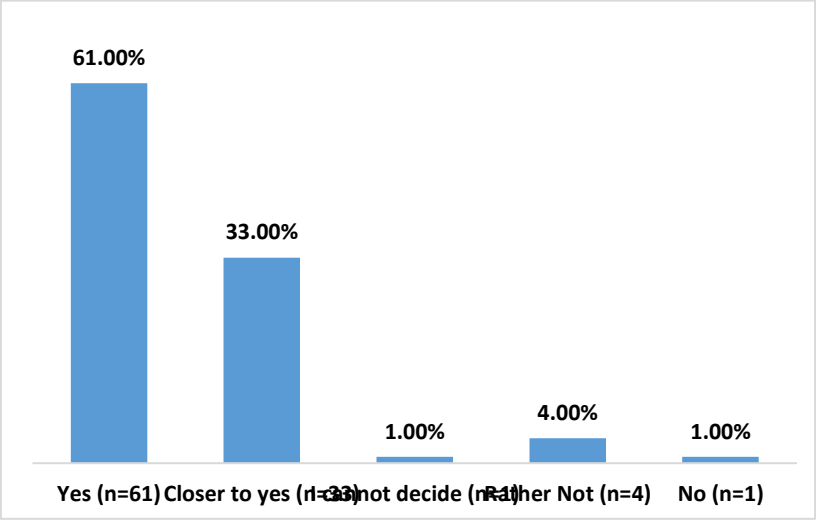

Figure 19. Familiarity with the regulatory framework governing the professional competencies of medical laboratory technicians

Data analysis indicates a positive tendency, indicating that almost all surveyed students of the Medical laboratory technician speciality are familiar with the regulatory framework in the Republic of Bulgaria. It ensures the training of qualified professionals. Positive answers to the research question are relatively high ($\chi 2=141,400$, $p<0,01$).

According to 80% (n=80) of the students surveyed in our study, Medical college facilities meet the requirements for a modern learning process, while 20% (n=20) expressed a negative opinion or were unable to make a judgement (Fig. 20).

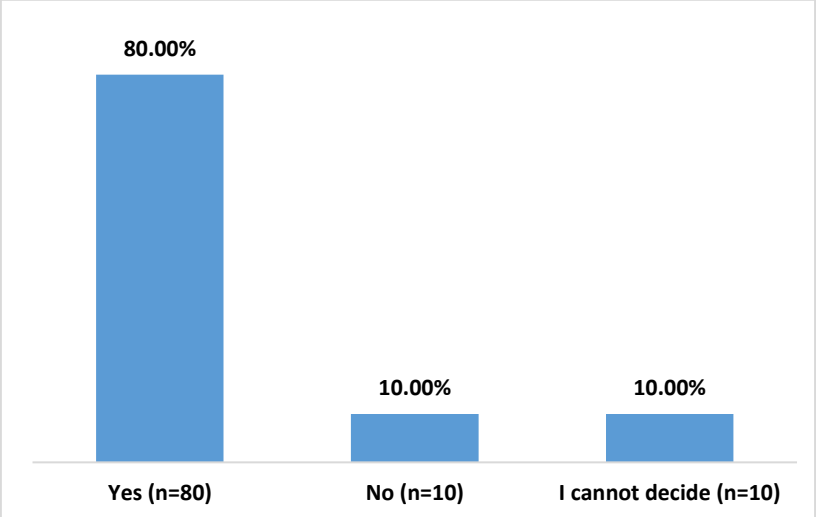

Figure 20. Respondents' opinions on the requirements for modern learning process and the facilities provided by the medical colleges

This difference in the relative shares is statistically significant ($\chi 2=157,680$, $p<0,05$). The high rating from the students indicates that the efforts made by the management of medical colleges to provide amenities and facilities meeting the current educational requirements are bearing fruit and are appreciated by the students to a very high degree. Consequently, this bolsters the student's motivation to acquire knowledge and competencies in an environment that stimulates their potential. It provides context to their future role as professionals meeting their goals in the labour market in the future and prepares them for their new social role.

According to 60% (n=60) of the respondents studying the Medical Laboratory Technician speciality, the management of the learning process contributes to a high degree to the acquisition of knowledge, skills and competencies essential for exercising the preferred occupation. This score was very high for 27% (n=27) of the students surveyed and average for 13% (n=13) of them (Figure 21).

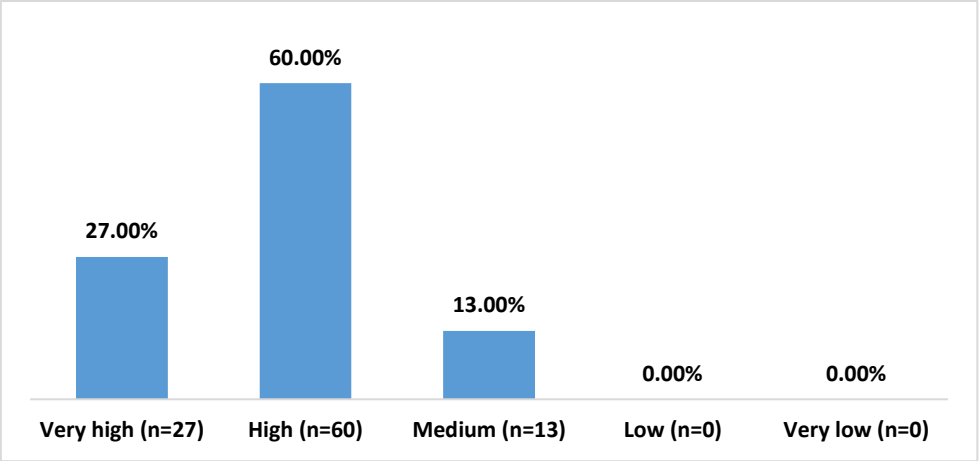

Figure 21. Assessment of the extent to which the organisation of the learning process contributes to the acquisition of knowledge and competencies

The absence of "low" and "very low" in the answers is a good attestation for the medical colleges where the students who participated in our survey are trained in the speciality of Medical Laboratory Technician. The management of the respective medical colleges should acknowledge the results of the students' survey in the pursuit of maintaining high standards in the organisation of the learning process. Students' opinions on the above should be an indicator for the future.

Almost all respondents (89.00%, n=89) highly appreciated the relevance of the lecture content during their studies. One of 10 students (10.00%, n=10) could not assess if the lecture contents aligned with the current scientific trends. One student expressed the opinion that the information discussed in lectures could be improved to meet current trends and scientific practice (Figure 22).

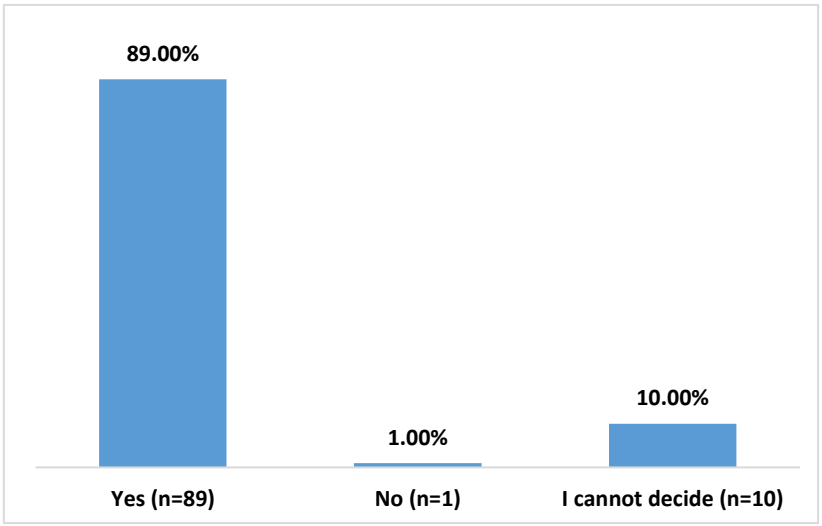

Figure 22. Relevance of information presented in lectures

Future medical laboratory technicians give high evaluations on the delivery of practical exercises in the disciplines they study as part of their education. A very high rating was given by 38% (n=38) of the respondents, a high rating was given by 55% (n=55), and those with a medium, low or very low rating did not influence the overall attitude found in the study cohort ($\chi 2=35.540$, $p<0.01$) (Fig. 23).

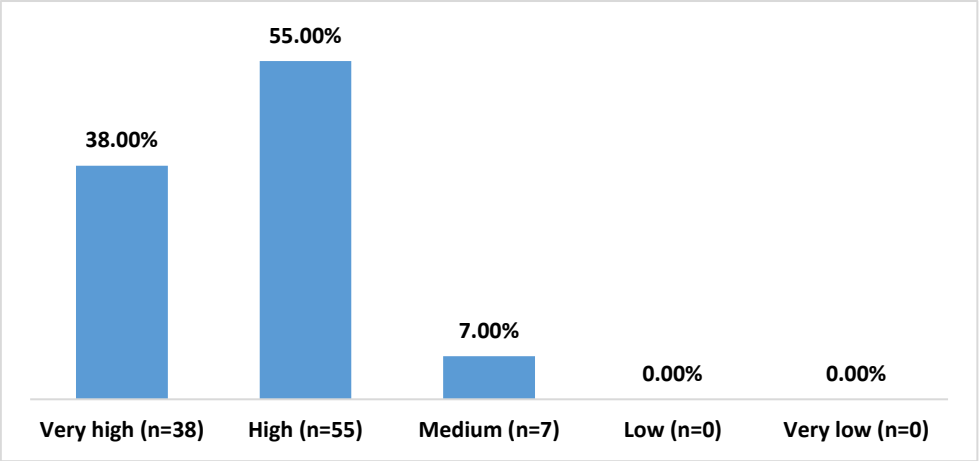

Figure 23. Evaluation of the conduct of the exercises

Students' appreciation of the organisation and conduct of the practical exercises is based on their mastery of the theoretical course material. They are satisfied with the practical training, which in turn adds to their overall professional training in a learning environment, shaping them as professionals with high levels of competence – a sought-after factor by their future employers.

The students who participated in our survey were given the opportunity to indicate recommendations in the context of improving the practical exercises conducted during their studies in the various disciplines. Different suggestions, recommendations and comments were received, the most frequent of which were related to *complementing the existing facilities with* ***equipment and amenities that come as close as possible to the real working environment****. Additional recommendations were made on options for solving practical cases related to the* ***interdisciplinary nature*** *of the studied topics. Responding students requested further possibilities to carry out* ***independent work*** *and, last but not least, increasing the number of practice hours or introducing a* ***summer internship***.

University libraries are a significant source of information for students during their overall theoretical learning. We were interested in finding out to what extent medical laboratory students use the libraries of the medical colleges where they are studying, including for lectures and exercises or for preparing for colloquia or semester exams. Almost all students had visited the library except for 29% (n=29) of them, who reported that they had not used the services of the university libraries during their studies. More often, students used the library to search for specific information on an assignment given by a professor or studying for a designated examination (47.00%, n=47) for which they could not find sufficient information online or a readily available literature source in a bookstore, online, or elsewhere. Just over 1/10 of the students surveyed reported using the library only on the recommendation of a professor or colleague (11.00%, n=11). The students for whom the library is a primary self-study aid were only 13.00% (n=13) of the student group surveyed ($\chi 2=35.540$, $p<0.01$) (Figure 24).

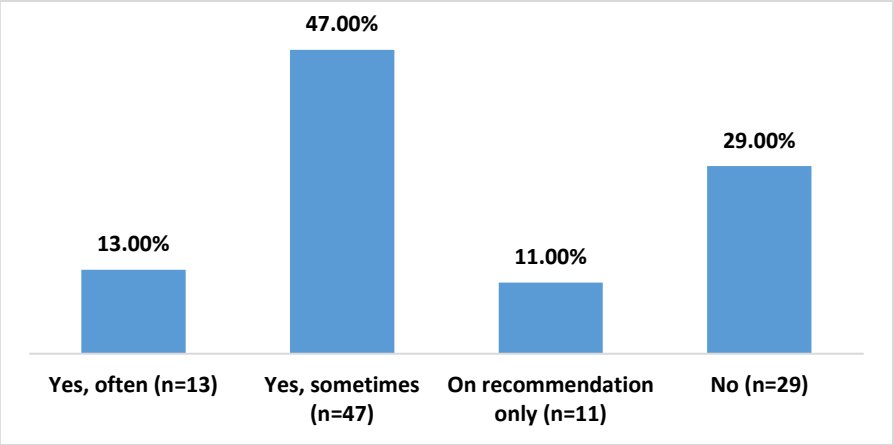

Figure 24. Use of the university library during studies

Theoretical training is at the heart of university education, and as such, its assessment by the students is fundamental in evaluating its effectiveness, relevance and accessibility. Medical laboratory students surveyed gave high (58.00%, n=58) and very high (19.00%, n=19) ratings to the theoretical training they received from their lecturers. Only 1% of respondents included in our study (23.00%, n=23) rated it as average or low. No student gave a very low rating of the theoretical training they received at their respective medical college ($\chi 2=68.400$, $p<0.01$) (Fig. 25).

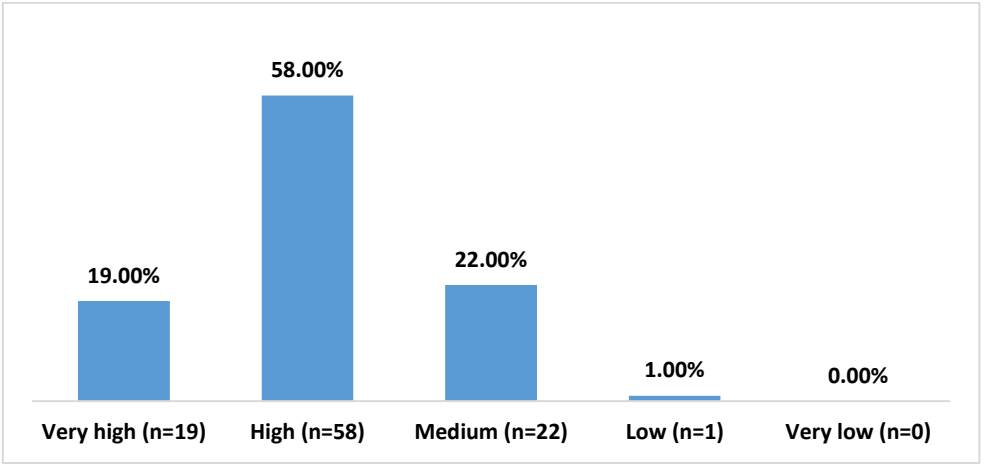

Figure 25. Assessment of the theoretical training

In addition to theoretical training, practical training is an essential element in students' education, which leads to acquiring skills directly related to their future professional employment. Slightly more than half (52.00%, n=52) of the students surveyed highly valued the practical training they received during their studies. This training was rated very highly by 37.00% (n=37) of the respondents, average – for 10% (n=10) of the respondents, and low or very low for one of them (Figure 26).

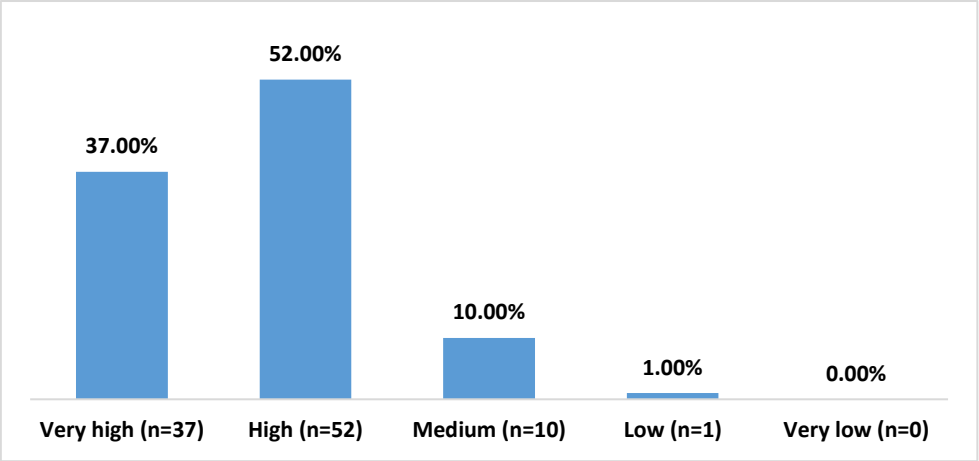

Figure 26. Assessment of the practical training

The global COVID-19 pandemic and the counter-epidemic measures put in place to contain the spread of the virus have necessitated a transformation of traditional forms of education for high school and college students. Distance learning and, later, hybrid (electronic/remote) and face-to-face learning were introduced in all higher education institutions throughout the country. The students confronted a new reality and the need to adapt to a changing learning environment in the context of the global epidemic. For the most part, the rating given by the respondents in our survey regarding the organisation in a pandemic setting is high (40.00%, n=40). The rating of 26.00% (n=26) of the students surveyed is average. The organisation of the educational process is rated very high by nearly ¼ of respondents (23.00%, n=23). One in 10 respondents gave a low or very low rating to hybrid learning during the COVID-19 pandemic (11.00%, n=11) (Figure 27).

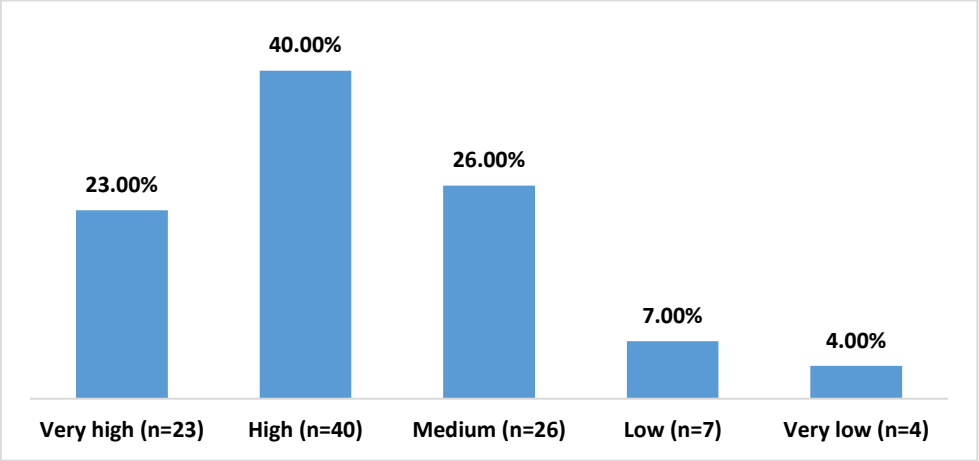

Figure 27. Evaluation of hybrid (e-learning and face-to-face) learning during the COVID-19 pandemic

Most medical colleges in the country organise research conferences for faculty and students, during which students can participate with their research papers and presentations supported by their professors. This is a kind of collaboration between students and faculty and an opportunity for students to create their scholarly output, understand the process of creating a scholarly publication, and, most notably, deepen their knowledge in an area of interest to them in a different than the traditional way – by research, organising and summarising available

literature or with their own research project. However, the relative share of students who had participated in some form of research activity was extremely low (17.00%, n=17) compared to the total number of students surveyed in our study ($p<0.05$) (Figure 28).

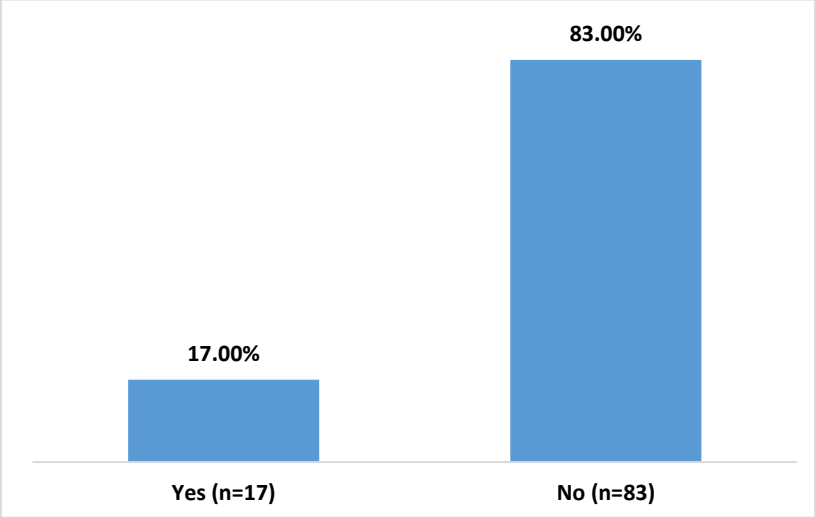

Figure 28. Participation in research activities

Data shows that we need to create activities for research opportunities that motivate students to participate independently or in collaboration with their professors. This would increase their motivation, independence and ability to critically analyse and systematise information gathered on the one hand and increase their knowledge in an area or topic of interest on the other.

Almost all of the students surveyed were satisfied with their choice of speciality and said they would choose the Medical Laboratory Technician speciality if they were to apply to the Medical College again (85.00%, n=85). Those who could not provide an answer and therefore feel hesitant about the soundness of their choice represent 10% (n=10) of the students surveyed. Respondents who strongly stated that they would not make this choice again represent only 5% (n=5) of the surveyed (Figure 29).

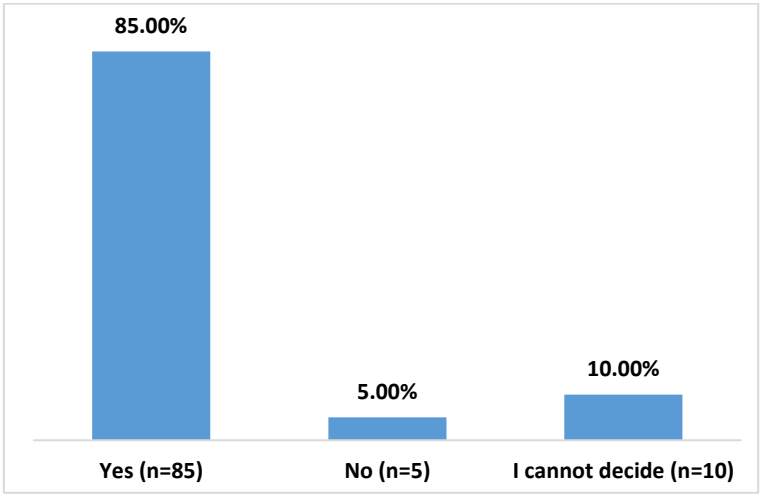

Figure 29. Choice of the same speciality if re-applying to Medical College

Statistical analysis of the data shows that students studying in the Medical Laboratory Technician speciality are satisfied with their choice at the time of their application and would reconfirm it if necessary ($\chi 2=120.500$, $p<0.01$). This means that students are highly motivated to pursue a career as medical laboratory technicians in various fields of laboratory medicine and to establish themselves as specialists with relevant expertise.

In recent years, students who have graduated as medical laboratory technicians have been offered more opportunities for further training after obtaining the Professional Bachelor's degree. Unfortunately, there is still a limited number of graduates who, after graduating from the Medical College, pursue opportunities to advance their education and qualifications. This prompted us to investigate whether the students currently studying for the degree of Medical Laboratory Technician are aware of the relevant career opportunities in terms of the continuing education offered by higher education institutions.

Not a single respondent was unaware of the presence of these options. The respondents who were fully aware and those who were partially informed represent almost equal relative share ($\chi 2=17.840$, $p>0.05$). This indicates that awareness is present, but not to a sufficient degree to make a statement that all students studying for medical laboratory technicians are aware of the opportunities after obtaining the Professional Bachelor's degree (Fig. 30).

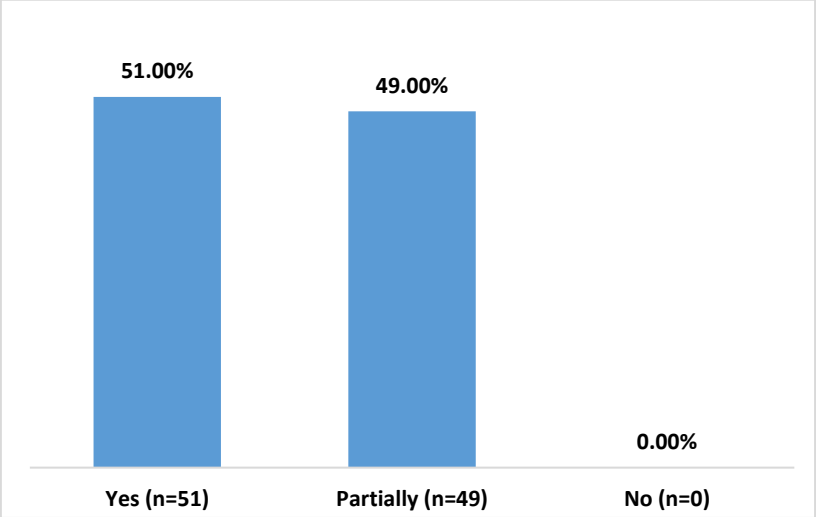

Figure 30. Awareness of continuing education after acquiring Professional Bachelor's degree

Data from our survey shows that students studying for the degree of Medical Laboratory Technician need to be aware of the opportunities for further education and qualification and to be motivated to continue their education and improve their qualifications and skills.

Slightly more than half of the respondents (52.00%, n=52) believe that the training and qualifications they acquire at the Medical Colleges in Bulgaria make them competitive with their counterparts who have received the same or similar education in EU member states or else. Of the opposite opinion were 18% (n=18) of the surveyed students, and the rest (30.00%, n=30) could not assess whether the education received in Bulgaria Impacts their competitiveness compared to their peers who graduated abroad ($\chi 2=17.840$, $p<0.01$) (Fig. 31).

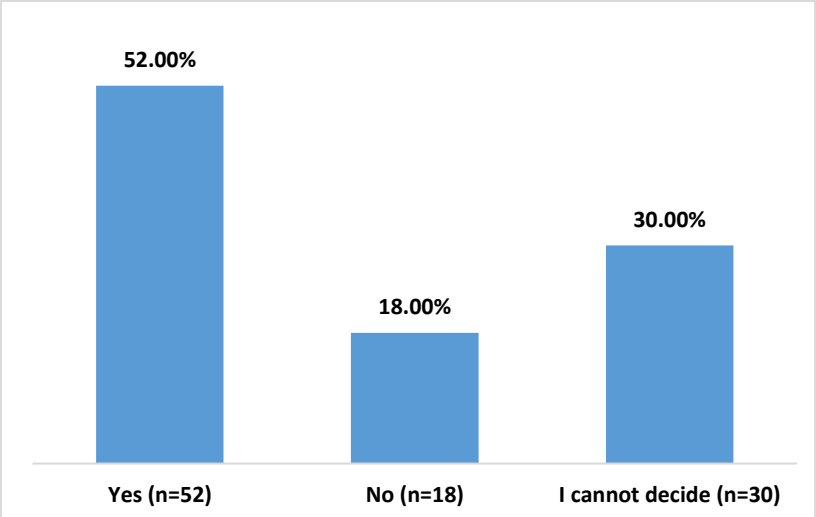

Figure 31. Sense of competitiveness compared to graduates abroad

As a strong positive signal, we can consider that more than half of the respondents believe their education in Bulgaria makes them competitive with their fellow graduates abroad. This reaffirms the already expressed opinion of students about satisfaction with practical and theoretical training in their chosen speciality.

We could define as strongly positive the trend that 92.00% (n=92) of the surveyed respondents in the group of students studying for medical laboratory technicians said that after completing their studies, they are willing to work in their chosen speciality. In comparison, 8.00% (n=8) of the students have not yet decided if they will opt for laboratory work ($\chi 2=70.560$, $p<0.05$) (Fig. 32).

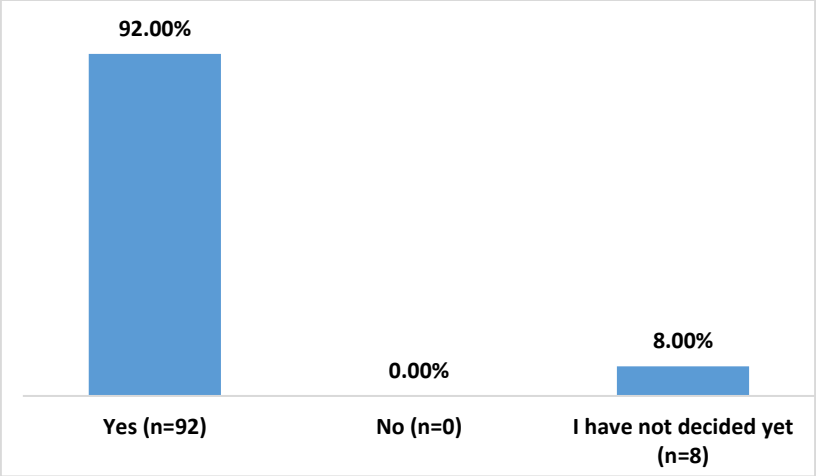

Figure 32. Decision to work in the chosen field of specialisation after graduation

Students currently studying in the Medical Laboratory Technician speciality in medical colleges in Bulgaria are motivated to pursue a career as a medical laboratory technician and are firmly convinced of their choice of expertise. This confirms their motivation for a successful future career.

The profession of medical laboratory technician has a practical core and implies the acquisition of good skills. Medical laboratory technicians improve their professional qualities and competencies while training in a real working environment at clinical practice facilities.

Students have excellent career prospects, with many having the opportunity to start in clinical laboratories as administrators even before graduation.

The results demonstrate the students' desire for continuing education and upgrading. Respondents expressed the opinion that they would like to continue their studies in a speciality closely related to laboratory sciences and new technologies in medical diagnostic laboratories. They are interested in increasing the hours of practice, summer internships, and good student mobility in countries of the European Union.

Conclusions from the quantitative study

- Data from the survey of the opinion of students studying in the Medical Laboratory Technician speciality show that 61% are well acquainted with the regulatory framework governing the professional competencies associated with the profession in Bulgaria.

- The Medical College – Varna provides a modern educational process with a high level of teaching and excellent facilities. A high percentage of respondents agree with this statement (80%). A high rating (89%) was given to the relevance of the lecture material.

- Practical skills are the most critical part of the competencies students need to build. They highly appreciate (55%) the teaching practice and pre-degree internships, which take place at the Medical University – Varna facilities.

- Competitiveness is a crucial factor in the training of medical laboratory technicians. Over half of the respondents (52%) believed they were ready to start working immediately in their country and abroad. In this day and age, wherein information is abundant, students are curious about employment prospects abroad.

IV. RESULTS AND DISCUSSION FROM THE INTERVIEW WITH MANAGERS OF MEDICAL DIAGNOSTIC LABORATORIES

In order to establish the attitudes and expectations of the users of health professionals, i.e. medical laboratory technicians, we conducted a semi-structured interview with ten owners and managers of medical diagnostic laboratories. The following issues were discussed:

1.Theoretical and practical proficiency of medical laboratory technicians.

2.Shortage of medical laboratory technicians.

3.Advantages and disadvantages of the Professional Bachelor's degree and the need for educational reform.

4.Skills and competencies of medical laboratory technicians acquired during their training.

5.Recommendations related to the learning process or demand for postgraduate training.

To preserve the anonymity of the interviewed participants, each of the respondents (R) are presented from R1 to R10.

The conversation with the users starts with a question about training medical laboratory technicians: ***"Do you think that the training of medical laboratory technicians meets the competencies required for the medical diagnostic laboratory?"***

In response to this question, the interviewed managers expressed a strong opinion that the medical laboratory technicians who start working for them immediately after completing their education, as well as those who have many years of experience in the laboratory they manage, have the necessary level of training that meets the requirements of the management. The managers are fully satisfied with their personnel's theoretical and practical training.

"Yes, the newly graduated medical laboratory technicians are fully prepared and are perfectly suited to work in a laboratory environment" (R2).

Other users: *"We have trained them during the pre-graduate internship, and now they are ready to work in a real environment" (R3, R4).*

Two of the respondents recommended: *"Consider increasing the number of hours of student practice or create summer internships along the lines of PROJECT BG05M2OP001-2.013-0001 "Student internships – Phase 1, 2" " (R8, R10).*

The next question focused on the turnover and shortage of medical laboratory technicians: ***"Is there a shortage of medical laboratory technicians in the medical diagnostic laboratory?"***

During the interviews with all managers of medical diagnostic laboratories, the main problem identified was the shortage of staff, as well as turnover related to internal and external factors that managers, as employers, could not influence. The first group **of factors** included interpersonal relationships within the team and the inability to secure higher wages due to financial and economic considerations. The second-factor group included the inability to adapt to a dynamically changing environment (the Covid-19 pandemic), employee relocation, planned maternity leave, etc. (R2, R4, R8, R10).

Interviewees expressed opinions such as: *" To help manage staff turnover, we can bind a student to a contract after the first year of studies and provide scholarships for the rest of the studies. This way, he or she will be employed after graduation and work according to the agreement, but unfortunately, our institution does not have such a policy..." (R1, R3, R9).*

Another user reasoned, *"Yes, the lab technicians are right to look for jobs in the private labs. The pay is better there. In the hospital, nothing depends on us..."(R3)*

The next question to the respondents was***: "Do retired practitioners work in the medical diagnostic laboratory you manage?"***

Almost all medical diagnostic laboratories whose managers participated in our interview said they employ retirees, and the numbers vary from laboratory to laboratory. In a single laboratory, the number of retired medical laboratory technicians who continue to practice their profession greatly exceeds the number of working-age lab technicians. The reasons why the owners of medical diagnostic laboratories employ retired medical laboratory technicians are associated with economic rationality – lower gross salaries and complex employment relations. Another perspective to consider is that this group of professionals shows higher levels of competence in terms of their years of experience. Only two of the laboratories did not employ retired laboratory technicians because of their managers' vision that their team should be comprised entirely of young people familiar with new technologies and their perception that young teams perform better relative to the targets set.

Two managers shared: *"I cannot afford to hire retirees as they have delayed reactions and thinking. We are constantly upgrading our labs and want technically trained lab technicians" (R5, R6, R8).*

We continued the interview with questions related to the educational degree of medical laboratory technicians: ***'Do you think that the Professional Bachelor's degree is a disadvantage for the career development of medical laboratory technicians in Bulgaria?'.***

For all the interviewed managers, the educational qualification that medical laboratory technicians receive upon graduation from the Medical Colleges is insufficient, and an upgrade is needed for their career development in Bulgaria. Acquiring a Master's degree in Healthcare Management provides opportunities for advancement and career development as a senior medical laboratory technician. On the other hand, it is a motivation to increase the monthly salary. The opinion of 4 of them is: *"In our company, one starts working according to the legal requirements for the given speciality. In our company, the position one holds is according to the qualification degree"(R1, R3, R4, R5).*

The next question to medical laboratory technician users was: ***"Do you consider that a Professional Bachelor's degree impedes the career development of medical laboratory technicians abroad?"***

It was the unanimous opinion of the interviewed respondents that the educational qualification of medical laboratory technicians at graduation is a disadvantage if they wish to pursue a career abroad. In this regard, the managers suggested considering the qualification degree. Alignment with the qualification degrees abroad is needed so that lab technicians who

wish to pursue careers abroad are on an equal footing. The opinion was also expressed that the training in Bulgaria is at the same level as in Western European countries.

One of the respondents expressed a dissatisfied opinion: *“It is imperative to take action to bring the educational qualification of the so-called secondary healthcare staff up to the same level as the European levels of education. This problem has been around for a while..." (R10).* Another user reasoned: *"...their training is the same" (R7).*

The next question stems from the previous two and relates to competitiveness: ***"Do you think a change in the educational qualification degree of medical laboratory technicians will make them professionally competitive in other countries?"***

Strongly positive opinions were expressed by all interviewees.

The following questions were intended to gain insight into the respondents' opinion on the training of medical laboratory technicians: ***"In your opinion, is the practical and theoretical training of the medical laboratory technicians who come to work for you sufficient?"***

The theoretical and practical training level of the students who subsequently start working in medical diagnostic laboratories managed by our interview respondents ranges from high to extremely high. It fully covers the labour market requirements in the field of laboratory services provided by the respective medical diagnostic laboratories.

One respondent suggested: *"You might consider summer internships to train lab technicians" (R8).*

Another interviewee: *"Consider training practice in private medical diagnostic laboratories as some of them are accredited to teach students” (R10).*

We asked the managers and physicians: ***"Do medical laboratory technicians take responsibility and make independent decisions in emergencies?"***

Managers said that they expect their employees to be able to think critically, appropriately react in cases of need, and make independent decisions within the scope of their competence or within the scope delegated to them by the management. For all managers, making independent decisions is a sought-after quality for all employees.

Three of them expressed a view that *"Young professionals are consulted at the beginning, but then they swiftly become proficient at making independent decisions according to their duties (R3, R5, R6).*

Another believed that: *“In our case, the lab technicians start with a probationary period and are supervised whether they cope with the duties assigned, their attitude towards the patient and their colleagues, making independent decisions. It has become apparent in recent years that everyone is holding onto their jobs and continuing to work after this period" (R7).*

Teamwork is a key requirement in laboratory practice, so our next question to respondents was: ***"Do the medical laboratory technicians in your laboratory have teamwork skills?"***

Regarding teamwork, supervisors say that each new lab technician acquires the necessary skills during their work experience. Inclusion in the team and successful collaboration between all members are essential. Sharing and solving daily tasks, sharing skills, and evaluating each other's work contribute to creativity and high-quality laboratory work.

Half of the respondents suggested *introducing performance assessment cards for the medical laboratory technicians and determining the remuneration according to the points obtained (R1, R2, R6, R8, R9).*

Another respondent's opinion was: *"In our laboratory, the senior laboratory technician is tasked with introducing and involving young colleagues to the work activities and the rest of the staff. It is important that the job description is provided and the typical activities that the lab performs are noted there" (R4).*

A third opinion was expressed on the issue: *'For teamwork, we use mentoring. In this way, new recruits learn from the experience of others. We do not tolerate single-mindedness and other such qualities. We want to create a big working family so that the work in the company (medical diagnostic laboratory) can be built on trust and sharing ideas (R10).*

Creativity is another quality for which we ask managers and laboratory physicians: ***"Do medical laboratory technicians show creativity in an emergency?"***

Managers expressed several opinions on this question. Three of them stressed that there are strict rules *in medical practice, which are challenging to break. Working with patients does not allow for novel ideas that have not been established as standard (R2, R5, R9).*

Two other respondents believed that *"Approaching the familiar from a different perspective always requires close scrutiny and is not tolerated in medical circles and teams" (R1, R6).*

The rest of the respondents answered: *"Creativity in an emergency should benefit the patient" (R3, R4, R7).*

"Novel ideas in laboratory practice are usually the old ones reworked" (R8, R10).

The users of laboratory services are not accepting of novel ideas, as evidenced by these responses. They believe it will lead to inaccurate patient results. The ability to think creatively is challenging to apply in medical laboratories because of the specific nature of the work.

One of the last questions we asked the respondents was about motivation and professional self-esteem: ***"In your opinion, do medical laboratory technicians have motivation and professional self-esteem as part of the medical community?"***

Most of the interviewed managers of medical diagnostic laboratories believe that medical laboratory technicians are motivated by professional careers, conscientious performance of tasks and professional improvement. Professional self-confidence is highly appreciated.

Three of the interviewees think that *this is not the case. They share the still prevailing opinion that medical laboratory technicians are secondary healthcare personnel without taking into account the change in the competence of laboratory technicians nowadays compared to those of the past times (R2, R5, R6).*

It is the opinion of the managers that *the qualification of laboratory technicians has been increasing in recent years, which is also related to the rapidly changing field of laboratory medicine, such as technology and new diagnostic methods that require specific skills primarily learned in a university environment (R1, R8, R9, R10).*

We ended the interview by asking: ***"Do you have any recommendations for medical college management to optimise the learning process?"***

The recommendations discussed can be presented as follows:

1. Increase the hours of teaching practice (R1, R3, R4, R5).

2. Introduction of summer internship (R8, R5, R10).

3. Teaching practice to take place in private medical diagnostic laboratories accredited for teaching (R2, R4, R8).

4. A new qualification degree meeting the European requirements (R6, R8, R9, R10).

5. Continuing education (Master's degree) with subjects closely profiled for medical laboratory technicians (R1, R5, R6, R7, R10).

6. Specialisation for the specific field (R2, R3, R7, R8, R9).

Introducing a summer internship will bring the student as close as possible to the real working environment. They will encounter different case scenarios requiring different skills for their successful resolution.

Three of the respondents mentioned that they have repeatedly received inquiries from students who are doing their pre-degree internship about the possibility of a concurrent internship in the respective medical diagnostic laboratory in order to build on what they have learned during their internship at the respective facility (R2, R4, R8).

Managers think that a new qualification degree should be introduced that builds on the education of the medical laboratory technician. For example, a Master's degree focusing on particular areas of study in the diagnostic laboratory field, thus avoiding the all-inclusive nature of the laboratory technician's work, and through specialisation to acquire specific skills and competencies.

V. MASTER PROGRAM MODEL

The worldwide impact of technology has resulted in a globalised and dynamic healthcare system providing greater access for the population to diagnosis and treatment. The quality of healthcare services, tracking morbidity, and obtaining faster and more effective data on public health are also related to the impact of technologies. This indicates a need for skilled medical laboratory technicians who need to adapt promptly to a dynamically changing environment. The results and recommendations in the study validate the need for establishing a Master's program focusing on laboratory diagnostics. This corresponds with the increased number of students interested in furthering their education.

1. SWOT analysis for the establishment of a Master's program in Medical Laboratory Management

Strengths:

1. The establishment of a Master's degree program in the field of medical laboratory management will provide an opportunity for medical laboratory technicians to expand their knowledge in the field of medical laboratory management, laboratory information systems, healthcare, work with specialised medical equipment, etc. and to upgrade their qualification degree.

2. Personnel with acquired qualifications to meet the criteria for accreditation of medical institutions and European regulations.

3. The medical universities in the Republic of Bulgaria have academic staff, modern technical facilities and excellent infrastructure to provide training in the Master's program.

4. Involvement of students and doctoral students in research activities and projects.

5. Digitalisation of the learning process and the use of E-learning systems, including the application of anti-plagiarism software for coursework papers and Master's theses.

Weaknesses:

1. Relatively low student and faculty mobility in EU countries due to differences in educational qualifications.

2. Need for intensive foreign language training – study of technical and medical English.

3. Introduction of new technical disciplines related to medical equipment.

4. Relatively low provision of the teaching process with textbooks and teaching aids due to the specificity of the taught disciplines.

5. Dynamics of software products.

Opportunities:

1. Providing new advancement opportunities for medical laboratory technicians who have graduated from the medical colleges in Bulgaria.

2. Attracting students from EU and non-EU countries to participate in international mobility programs (Erasmus+).

3. Modernisation in healthcare, new medical devices, and the changing environment that requires specialised training of students with software products and knowledge of technical medical English.

4. Participation in national and international projects for best practices in the medical diagnostic field.

Threats:

1. A decrease in the population of Bulgaria, hence, in the number of graduating medical laboratory technicians.

2. Continuous increase in the consumption of laboratory tests.

3. Inadequate remuneration in healthcare.

4. Stress, pandemics, busy schedules.

2. CURRICULUM MODEL FOR THE MEDICAL-LABORATORY MANAGEMENT SPECIALITY AFTER PROFESSIONAL BACHELOR'S DEGREE

The training in the speciality is multidisciplinary for specialists with:

- Bachelor's degree and Master's degree from all professional fields;
- Professional Bachelor's degree, Medical Laboratory Technician speciality.

Curriculum features

1. Students are required to complete two elective courses during the entire course of study. In addition to this compulsory choice, students may choose and complete additional elective or optional courses approved in the curriculum.

2. The discipline of Medical Laboratory Management is studied in four consecutive semesters - I, II, III and IV. It is completed by a state examination or a diploma thesis.

3. Students with an average grade in the first three semesters – "Very good" (5) and higher, choose how to complete their studies: with a state examination or a diploma thesis. Students who do not meet these requirements graduate with a state examination.

4. The grade of the state examination is calculated as the average of the grades of the selected questions. It is rounded to the second decimal place.

5. The thesis topic, grade, defence grade and the corresponding credits shall be entered in the thesis appendix.

6. The training shall have a minimum of 1035 hours of classroom time (including the compulsory and two elective courses), with a minimum of 126 credits (including the compulsory courses, two elective courses and the state examination/thesis defence) (Table 9).

MEDICAL-LABORATORY MANAGEMENT SPECIALITY, Master's degree, part-time studies

№	Study disciplines	STUDENT INVOLVEMENT (IN HOURS)				CREDITS	EXAMS SEMESTER	NUMBER OF CLASS HOURS			
		Uniform state requirements	Academic learning hours MU-Varna	Tutorials /practice	Hours of work outside of class			I	II	II	IV
1	2	3	4	5	6	7	8	9	10	11	12
A.	**Compulsory subjects**		**1140**	**610/605**	**1890**	**105**		**120/150**	**110/165**	**110/145**	**130/65**
1.	**Information systems in laboratory practice**		**90**	**60/30**	**120**	**12**					
1.1	Information Systems in Laboratory Practice - Part 1		45	30/15	60	6	1	20/10			
1.2	Information Systems in Laboratory Practice - Part 2		45	30/15	60	6	2		20/10		
2.	**Medical Diagnostic Laboratory Management**		**60**	**40/20**	**120**	**6**					
2.1	Medical Diagnostic Laboratory Management - Part 1		30	20/10	60	3	3			20/10	
2.2	Medical Diagnostic Laboratory Management - Part 2		30	20/10	60	3	4				20/10
3.	**New diagnostic methods in microbiology. Practice**		**60**	**40/20**	**120**	**6**					
3.1	New diagnostic methods in microbiology. Practice – Part 1		30	20/10	60	3	3			20/10	
3.2	New diagnostic methods in microbiology. Practice – Part 2		30	20/10	60	3	4				20/10
4.	**eHealthcare**		**60**	**20/40**	**120**	**6**					
4.1	eHealthcare – Part 1		30	10/20	60	3	2		10/20		
4.2	eHealthcare – Part 2		30	10/20	60	3	4				10/20
5.	**Fundamentals of Healthcare Management**		**60**	**40/20**	**120**	**6**					
5.1	Fundamentals of healthcare		30	20/10	60	3	3			20/10	

	management – Part 1										
5.2	Fundamentals of healthcare management – Part 2		30	20/10	60	3	4				20/10
6.	**Training practice**		**270**	**0/270**	**270**	**21**					
6.1	Training practice – Part 1		90	0/90	90	7	1	0/90			
6.2	Training practice – Part 2		90	0/90	90	7	2		0/90		
6.3	Training practice – Part 3		90	0/90	90	7	3			0/90	
7.	Research Methodology		45	30/15	120	6	1	20/10			
8.	Healthcare organisation		30	20/10	60	3	1	20/10			
9.	Healthcare project management		45	30/15	90	4	1	20/10			
10.	Healthcare projects		30	20/10	30	2	1	10/5			
11.	Environment, nutrition and health		45	30/15	60	6	2		10/5		
12.	Introduction to computer programming		45	30/15	90	4	2		20/10		
13.	Social Medicine		30	20/10	90	1	2		20/15		
14.	Terminology and communication in a foreign language		45	30/15	90	4	3			20/10	
15.	Health Databases		45	30/15	90	4	3			30/15	
16.	Labour and Administrative Law		45	30/15	30	2	4				30/15
17.	Technical safety in healthcare		45	30/15	90	4	4				30/15
18.	Infection control		45	30/15	90	4	4				30/15
19.	Occupational Medicine		45	30/15	90	4	4				30/15
Б.	**Electives**		**120**	**80/40**	**120**	**8**		**20/10**	**20/10**	**20/10**	**20/10**
1.	Introduction to computer programming		30	20/10	30	2	1	20/10			
2.	New histological practices		30	20/10	30	2	2		20/10		
3.	Modern software in clinical laboratory practice		30	20/10	30	2	3			20/10	
4.	English language - Medical Terminology		30	20/10	30	2	4				20/10
В.	**Optional subjects**		**45**	**45**	**90**	**6**		**15**	**15**	**15**	
1.	History of Medicine and Public Health		15	15	30	2	1	15			

2.	Socially significant diseases		15	15	30	2	2		15		
3.	Communication skills		15	15	30	2	3			15	
Г.	**Pre-diploma internship**		**90**	**90**	**90**	**6**					**90**
1.	Medical Diagnostic Laboratory Management		45	45	45	3	**4**				**45**
2.	eHealthcare		45	45	45	3	**4**				**45**
Д.	**State examination**										
	Diploma Thesis					15					
	State Examination in Medical Diagnostic Laboratory Management					15					

VI. CONCLUSIONS, RECOMMENDATIONS AND CONTRIBUTIONS

1. Conclusions

- The comparative analysis between the training in Bulgaria and European countries has shown a complete correspondence in the curriculum and the way of training, except for the acquisition of the professional qualification.
- The principal causes to change the educational qualification degree are factors related to job opportunities in European Union countries, career development and higher income.
- The survey results indicate a necessity for more cooperation options and mobility for students and faculty in European Union countries.
- Users of laboratory services declare support and willingness to assist in creating new courses and programs concerning the ever-changing medical technologies and software programs.
- The users of laboratory services think that it is necessary to offer a new educational qualification that would build on the education of the medical laboratory technician. For example, a Master's degree with the option of a focused area of study in the diagnostic laboratory field, thus avoiding the all-inclusive nature of the work of the laboratory technician.
- The main drivers behind the shortage of medical laboratory technicians in our country are low salaries, workplace stress and reaching retirement age.

2. Recommendations

Based on the literature reviewed and the results of our research, we make the following suggestions:

To the Ministry of Education and Science:

- To change the educational qualification degree from Professional Bachelor to Bachelor in line with European standards.
- To update the Regulation on uniform state requirements for the acquisition of higher education in the specialities of Healthcare (professional field) for the educational qualification degree Professional Bachelor for the Medical Laboratory Technician speciality by increasing the Study Practice hours under the form of summer internship.
- To implement in the National Qualification Framework for Lifelong Learning a Master's program related to perspectives and new technologies in laboratory practice for graduate medical laboratory technicians. This would lead to meeting the individual needs of professionals, improving the quality of healthcare services, and personal and professional self-esteem.

- ❖ It is appropriate to link these processes to adequate remuneration and career development prospects.

To the management of the Medical Laboratory Technician program in the medical colleges:

- ❖ To update the elective and credit courses for the Medical Laboratory Technician speciality related to specialised English, medical terminology, software and programs.
- ❖ To facilitate legal options for launching specialised courses for medical laboratory technicians in higher medical schools.

To the medical institutions:

- ❖ To stimulate postgraduate training and professional qualification of medical laboratory technicians.
- ❖ Introduce performance assessment cards for the medical laboratory technicians and assign salaries based on the points achieved.

3. Contributions

Several groups of contributions can be summarised:

Theoretical contributions

1. A historical review of the development of the speciality Medical Laboratory Technician in the Republic of Bulgaria is made.

2. A comparative analysis of the training in the speciality Medical Laboratory Technician in Bulgaria and other countries is presented.

3. The methodological approaches for training using electronic learning resources are described.

4. The scientific rationale for creating a specialised Master's program upgrading the professional Bachelor's degree of medical laboratory technician and Bachelor's degree and Master's degree from all professional fields of study in Bulgaria is presented.

Applied contributions

1. The opinion of students studying in the speciality and practising medical laboratory technicians on the level of satisfaction and professional development, as well as their willingness to acquire higher qualifications, was studied.

2. The opinion of Clinical Laboratory experts on the professional training of medical laboratory technicians working in medical diagnostic laboratories was studied.

3. A curriculum model for a Master's program aimed at increasing the educational qualification degree of medical laboratory technicians with a Professional Bachelor's degree is proposed.

4. Responsible institutions are presented with proposals and recommendations to upgrade the qualification degree of the Medical Laboratory Technician speciality or establish a specialised Master's program.

CONCLUSION

Laboratory medicine is an integral part of modern medicine and healthcare. Clinical laboratory diagnostics is a complex speciality involving different areas. In recent years, medicine has achieved considerable advances in technology and science. Respectively, this has been manifested in laboratory activities and diagnostic technologies, and the requirements for laboratory diagnostic services are constantly increasing.

Our research is aimed at the analysis of specific features, new approaches in training and prospects of medical laboratory technicians and their professional development. The comparative analysis of the information about the speciality in some EU member states outlines the best European practices facilitating prompt modifications to advance the profession and create the image of modern medical laboratory professionals.

Dynamic living conditions require a swift and appropriate professional response in the laboratory profession. Patients expect quality services, high professionalism and competence. All these changes are an essential requirement for a shift in the educational qualification degree of Medical Laboratory Technician. Such a change will enhance students' motivation and competitiveness in the European and other labour markets. This indicates the need to expand their knowledge of technology and new software products in laboratory practice. It will reinforce their confidence and generate options for mobility during their studies.

Upgrading and changing the educational qualification degree of the Medical Laboratory Technician speciality will help increase healthcare professionals' competencies and respond appropriately to the rapidly evolving environment and competitiveness of the job market.

THESIS-RELATED PUBLICATIONS AND PARTICIPATION IN PROJECTS

Publications:

1) Михайлова Й., Тодорова Т., „Историческо развитие и направления на специалността „Медицински лаборант“ в България.“ Журнал на медицински колеж – Варна, том 3, брой 1, 2020 г.

2) Mihaylova Y., Sarkisqn N., “Contemporary European practices-multidisciplinary models in the training of medical laboratory assistants”, Varna Medical Forum 10 (2), 50-5, 2021

3) Михайлова Й., Георгиева Е., “Обучение на студентите в динамична среда“, Издателски център МУ- Плевен, с. 215-219, ISBN 978-954-756-267-7(PDF), 2021

4) Михайлова Й., „Продължаващото обучение – нови възможности и перспективи“, Журнал на медицински колеж – Варна, Online first, 2023

Projects participation:

1) Project BG05M2OP001-2.013-0001 of the Ministry of Education and Science, "Student Practices – Phase 2", funded by the Operational Program Science and Education for Smart Growth – academic mentor of 20 students, 2019 – 2023.

2) PROJECT BG05M2OP001-2.016-0025-C02, "Creation of a multidisciplinary educational environment for the development of personnel with integral competencies in the field of biomedicine in healthcare", 22.05.2023 – 02.06.2023, Turin, Italy