A4L_ACTIONS

Alliance for Life Sciences: From Strategies to Actions in Central and Eastern Europe

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D3.2. WHITE PAPER ON COMBINING RESEARCH, TEACHING AND/OR MEDICAL PRACTICE

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Alliance4Life

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1   INTRODUCTION

The D3.2 White paper on combining research, teaching and/or medical practice (White paper) is the deliverable of the Alliance4Life_ACTION project work package WP3 Careers in Science and Beyond.

1.1   ALLIANCE FOR LIFE SCIENCES: FROM STRATEGIES TO ACTIONS IN CENTRAL AND EASTERN EUROPE

Alliance4Life (A4L) is a bottom-up initiative of twelve leading life science institutions from eleven EU*.*

Member States located in Central and Eastern Europe (CEE). The mission of A4L is to contribute to closing the divide in European health research and innovation (R&I), stimulating institutional change, and shaping research policy on the national and European levels. Research organizations in the CEE, A4L members, opened debate on modern human resources (HR) management and career systems at the beginning of the alliance in 2018. The debate started at the level of focus group HR and mobility (FG3) with defining HR-related indicators and identification of barriers at institutional, national, and EU level.

In the A4L White Paper (2020) (1) segment related to Modern Human Resource Management and Career System, the A4L stated that currently there are not any internationally recognized human resource management and science career system models in existence that could be applied across the CEE countries, modern career progression system reflecting the reality of current research careers is often absent. Efficient human resource management and career systems help maximize the creative potential of researchers and consequently enable them to carry out rich and impactful science. In the Alliance4Life _ACTIONS Work plan, the Work package 3 (WP3) Careers in Science and Beyond tackles this issue by innovating and implementing career systems.

As stated in the Alliance4Life_ACTIONS the WP3 Work Plan the Objectives are:

- Develop integrated career frameworks fostering global competitiveness of CEE researchers.
- Implement advanced training programmes on scientific, transferrable, and soft skills to support career development of talented researchers in CEE.
- Foster mobility as the key element in scientific careers.

In the Task 3.1 Career system innovation and implementation, the role of medical doctor scientist, their commitment to research, education and medical practice in a balanced manner was acknowledged; a deliverable D3.2. was proposed as the White paper on combining research, teaching, and/or medical practice, summarizing the recommendation to overcome obstacles for a combination of professional roles in medicine.

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[1] Available at: https://alliance4life.ceitec.cz/white-paper/

1.2   RESEARCH, EDUCATION AND MEDICAL PRACTICE IN ACADEMIC HOSPITALS

In many CEE countries acknowledgement of the role of medical doctors-scientists, their commitment to research, education and medical practice in a balanced manner is frequently hampered by national legislation. A particular systemic issue that needs to be addressed is the lack of harmonization of responsibilities in research, teaching, and medical practice in university hospitals and at medical faculties. Since clinical and translational research is typically organized in academic hospitals together with teaching and learning in a clinical context, our approach in the organization of the academic hospitals/university hospital centres in order to establish the academic environment will be defined. The specificities of research career systems, employment and work conditions of clinical teacher and researcher creating an attractive work environment for all employees should be emphasized. The role of mentors need to be reflected creating opportunities for mentors to educate through protected time. Clinical research opportunities should be increased, the institutional process for evaluation of the scientific performance implemented. Thus, in the A4L_ACTIONS project we present this White paper on combining research, teaching, and/or medical practice summarizing the recommendation to overcome obstacles for a combination of professional roles in medicine (research, teaching and clinic).

1.3   SYNERGIES BETWEEN EUROPEAN RESEARCH AREA AND EUROPEAN HIGHER EDUCATION AREA

The Council of European Union conclusions on the "New European Research Area" of December 2020 (2) defines the "New ERA" as a researchers-centred, value-based, excellence as well as impact-driven area, in which researchers, knowledge and technology are supported and can circulate freely. Linking European Research Area (ERA) and European Higher Education Area (EHEA), the document stresses that stronger synergies and interconnections between the ERA, the EHEA and the higher education related elements of the European Education Area (EEA), are to be developed; it identifies institutional transformations, research careers, science education, training, international cooperation and knowledge circulation as possible fields of a more determined cooperation; supports the further development of the 'European University Alliances' as a flagship example for modern and inclusive higher education institutions of the future in Europe; takes note of the Commission proposal to develop a roadmap of actions for creating synergies between higher education and research.

Council conclusions on „Deepening the European Research Area: Providing researchers with attractive and sustainable careers and working conditions and making brain circulation a reality" of May 2021(3) emphasizes synergies between the "New ERA" and the EEA that could possibly be realized through a comprehensive Higher Education Transformation Agenda, will enable empowering the European higher education sector in their education, research,

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[2] New European Research Area of December 2020 (https://data.consilium.europa.eu/doc/document/ST-13567-2020-INIT/en/pdf

[3] Deepening the European Research Area: Providing researchers with attractive and sustainable careers and working conditions and making brain circulation a reality of May 2021 (https://www.consilium.europa.eu/media/49980/st09138-en21.pdf)

innovation and service to society missions; strengthening research careers and reinforcing research links with learning and teaching and supporting research-based education; in designing policy measures for cooperation between higher education institutions in Europe notably in the area of academic and research careers which are often intertwined, promoting inclusiveness, leveraging excellence and raising the international competitiveness of Europe's higher education sector. European Universities Initiative and alliances are suitable platforms to test possible models fostering interoperability of research careers, and to explore possibilities for joint recruitment schemes, training and career development systems accommodating both research and teaching aspects, as well as for testing new reward and assessment systems, including for research-based teaching. In this context the White Paper document explores the relation between research, medical education and in CEE countries and presents the recommendation to overcome obstacles for a successful combination of three professional roles in the academic health care environment.

2   EXECUTIVE SUMMARY

In many CEE countries there is a lack of harmonization in research, teaching, and medical practice in university hospitals and medical faculties. In line with European documents related to the "New European Research Area", which emphasize the Synergies between ERA and EHEA, White Paper explores the relation between research, education and medical practice in the academic health care system in CEE countries and presents the recommendation to overcome obstacles for a successful combination of three professional roles and creation of an attractive academic environment.

Following **objectives** of D.3.3. were agreed upon:
- Selection of topics relevant for relation between university and academic hospital and position of research and teaching
- Creation of a questionnaire
- Analysis of the answers received from all completed questionnaires
- Elaboration of the topics highlighted in the results of the analysis of completed questionnaires
- Formulation of recommendations for the institutional, national and European level

Selected were thirteen topics relevant for investigation of relations between university and healthcare academic institution and position of research and education in associated health care institution that made up the content of the questionnaires. Results of completed questionnaires revealed ten topics for integration of science, academia and medical practice and indicated major areas of necessary improvement: institutional integration, defining and improving protected time for research and education, and especially research mobility through the Academia-Hospital-Industry (AHI) pipeline.

Topics relevant for integration of science and academia and health care:
1. Position of science in relation of academic hospital with the university
2. Relation between medical school and hospital in academic workforce planning and career development
3. Protected time for research in healthcare working time
4. Protected time for teaching in healthcare working time
5. Position of residents / PhD students in academic hospital
6. Integration of research related content in specialty training programmes
7. Relation between medical school and hospital research offices
8. Opportunities for mobility across academia-hospital-industry
9. Role of patients not only as study participants, but also as patient group members
10. Relation between ministries for Science/education and Health related to academic hospital

Position of science in relation of academic hospital with the university

University and academic hospital administrations have responsibility for supporting and promoting research in the academic hospital, to create research and learning environment, increase research capacity in healthcare institutions. Scientists and academic teachers should be encouraged to play essential role in institutional management and leadership together with healthcare professionals.

Relation between medical school and hospital in academic workforce planning and career development

Universities with their associated academic hospitals need to establish the most advanced application of effective strategic workforce planning, support establishment of teams capable to make responsible decisions, improve recruiting, retention and retirement policy, establish mutual approach and responsibility towards the employment policy and salary distribution between university and hospital, create the workforce capable to establish and deliver future strategic approaches. HR career development must be planned for all members involved in research, education and medical practice. Training in core competences/transferable skills in the career development of young, but also experienced scientists to enhance their competencies should be supported.

Protected time for research in healthcare working time

Researcher members of the healthcare workforce should have part of their time dedicated to research, developing and spreading innovations, strengthening the research culture in health system and increasing capacities. This is essential for successful research, enhancement of recruitment, careers development, increased job satisfaction, potential for employee retention, teams and networks for conducting and leading research. It influences the improvement of patient outcomes and wider societal benefits, attracts research funding.

Protected time for teaching in healthcare working time

Organizational goal in an academic hospital is to achieve clinical learning environment (CLE) that allows trainers to have sufficient time for educational tasks combined with hospital duties. CLE is the overlapping space between the "work environment" and the "educational context". Accomplishment of the CLE requires definition and realization of valid dedicated

time for teaching and learning, mentoring both PhD students and trainees with impact on positive changes and improvements in institutional responsibilities.

Position of residents / PhD students in academic hospital

Resident/PhD student must coordinate schedule for the clinical and administrative duties, teaching, studying and research, possibly leadership roles. In order to foster adequate results from young PhD students, while pursuing a meaningful, time-effective residency programme, it is necessary to integrate medical and research training, obtain institutional support in career development, enhancement of mentoring and supervision. Essential is to integrate scientific methods in undergraduate medical education and postgraduate specialty training. The defined scientific content in specialty training programmes should be implemented.

Relation between medical school and hospital research offices: increase in innovation

Integration of academic and hospital research offices functions and joint collaborative research projects should be promoted and facilitated aiming to create joint office which will be concentrated on increase in innovation capacity which is very much based on new medical and digital technologies, relation with patients and mobility across academia – hospital – industry. New strategies should be developed.

Role of patients as study participants, but also as patient group members

Significant part of the research in a medical university should be developed under the idea of evidence-based medicine and principles of good designed clinical trials. Universities and academic hospitals must use this experience to tide to basic sciences, PhD programmes and build research capacities. Important is the role of patient organizations with legal requirements enabling valid opinion sharing, participation of patients in the decision-making of regulatory organs and healthcare providers; they are also taking the role of scientific liaison providing the translation of research in medical practice.

Opportunities for mobility across academia-hospital-industry

Close and continuous collaboration through the AHI Pipeline is highly recommended. Systemic foundations should be laid and necessary regulations made to make transfers as seamless as possible yet safe for parties and individuals providing tools and frameworks that will stimulate and encourage collaboration and make progress. Results of the collaborations should be widely used within society and become foundations for further expansions. University programmes should be modified to reflect industrial progress and new treatments and tools available to increase medical process efficiency and patient lifespan and wellbeing.

3 OBJECTIVES

The working group for White paper on combining research, teaching, and/or medical practice was formed by representatives of nine A4L partner institutions - universities, which have an academic hospital in their organization.

Institutional representatives for each institution were one member of the A4L FG3 HR and mobility and one university representative clinician researcher who is close to the White Paper topic.

The White paper working group was established within the A4L FG3 Human Resources & Mobility and WP3 Careers in Science and Beyond, Lead Beneficiary: University of Zagreb School of medicine (UZSM), Lead: Nada Čikeš

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The following objectives were agreed upon:

- Selection of topics relevant for relation between university and academic hospital and position of research and teaching

- Creation of a questionnaire

- Analysis of the answers received from all completed questionnaires

- Elaboration of the topics highlighted in the results of the analysis of completed questionnaires

- Formulation of recommendations for the institutional, national and European level

4 METHODS

To investigate the specifics of clinical and academic interactions in nine partner institutions selected were thirteen topics relevant for investigation of relations between university and healthcare academic institution and position of research and education in associated health institution. The questionnaire was created and agreed by members of the WG:

Questionnaire

Institutional data for the preparation of White Paper on Combining Research, Teaching and/or Medical Practice

Name of your institution	
Status of your institution: part of the university or independent institution/university	
Position of your academic hospital(s) within university	
Relation between ministries for Science/education and Health related to academic hospital (education and teaching)	
Employment status of academics in the university / hospital	
Salary distribution from healthcare/education	
Protected time for research in healthcare working time	
Protected time for teaching in healthcare working time	
Relation between medical school and hospital in academic workforce planning	
Relation between medical school and hospital in recruitment of academics in hospital	
Position of residents PhD students in academic hospital	
Integration of research related content in specialty training programmes	
Relation between medical school and hospital research offices (joint offices?)	

Opportunities for mobility across academia-hospital – industry	

All nine partners of the A4L, members of the Working group did a self-assessment in thirteen areas as defined above and the filled in questionnaires were submitted for evaluation and analysis, some with additional written description.

The results were received as free text input, and then converted into semi quantitative data by adding a three-point Likert scale to every category in the questionnaire. In such a way, every partner institution could be directly compared within a single category, and a total sum of Likert points for all categories could be calculated.

A higher number of points (one to three) indicated a more favorable result in that specific category.

5   RESULTS

5.1.   RESULTS OF THE QUESTIONNAIRES IN NINE INSTITUTIONS

Results of the filed in questionnaire and analysis of the obtained data are presented in Appendix I and Appendix II.

Results of completed questionnaires revealed ten topics for integration of science, academia and medical practice and clearly indicate that the major areas of improvement identified in virtually all institutions focus on improving institutional integration, defining and improving protected time for research and education, and especially research mobility through the AHI pipeline.

Results also show that after starting an academic career as a clinician, time management becomes the most difficult task in pursuing a meaningful academic environment. In order to foster adequate results from young researchers, while enabling them to pursue a meaningful, time-effective clinical practice, questionnaires have highlighted: integrating medical and research training, sharing best practices, monitoring outcomes and obtaining institutional support, as well as centralizing mentoring and supervision through using career offices for physician-scientists as the most important topics. (Figure 1)
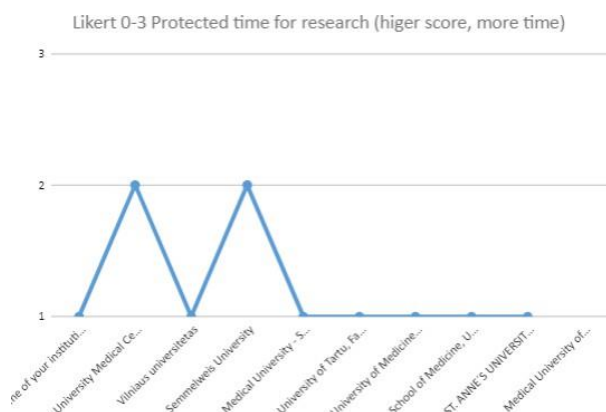

Figure 1. Likert points graph showing questionnaire results concerning protected time for research

The second highlight is formal scientific training in combined MD-PhD programs, regarding incorporation of scientific method application and results interpretation in clinical training. The issues point toward defining board exams and PhD requirements, and habilitation criteria where applicable, with clear gradual staging of scientific proficiency as a goal. (Figure 2)
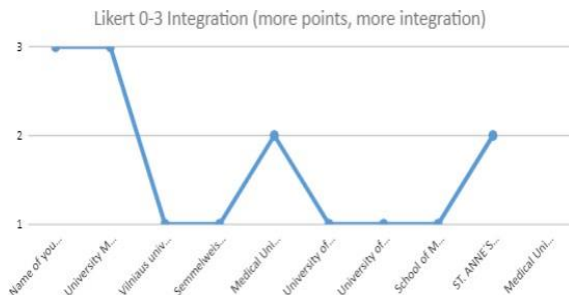
Figure 2. Likert points graph showing questionnaire results concerning research integration.

The third highlight is the incorporation of mobility and integration that provides for multi-directional mobility of medical professionals through the AHI pipeline. Such a transfer is a huge opportunity for building strong bonds between organizations resulting in an effective exchange of information that is essential for unstoppable growth on the R&D field. (Figure 3)

Figure 3. Likert points graph showing questionnaire results concerning mobility of medical professionals through the AHI pipeline.

After analyzing the data obtained, following topics relevant for integration of science and academia and health care were selected for further elaboration and formulation of policy recommendation:

1.   Position of science in relation of academic hospital with the university
2.   Relation between medical school and hospital in academic workforce planning and career development
3.   Protected time for research in healthcare working time
4.   Protected time for teaching in healthcare working time
5.   Position of residents / PhD students in academic hospital
6.   Integration of research related content in specialty training programmes
7.   Relation between medical school and hospital research offices
8.   Opportunities for mobility across academia-hospital-industry
9.   Role of patients not only as study participants, but also patient groups
10.   Relation between ministries for Science/education and Health related to academic hospital

5.2 TOPICS RELEVANT FOR INTEGRATION OF SCIENCE AND ACADEMIA IN HEALTHCARE

5.2.1 Position of science in relation of academic hospital with the university

Administration of academic hospital has responsibility for supporting and promoting research in the institution, to create research and learning environment. Scientists and academic teacher should be encouraged to play essential role in institutional management and leadership together with healthcare professionals.

Relation between healthcare institution and higher education institution should assure inclusion of research in job plans, to provide integration of healthcare professionals inresearch groups capable to incorporate clinical expertise in biomedical research teams, to create multidisciplinary teams together with experts in engineering and social sciences

Medical schools should carefully plan that undergraduate curricula include contents that enable medical students to be exposed to research and informed about clinical and translational research, their role in progress of diagnosis and treatment of patients. They should be informed and invited to participate in research provided for medical students that medical schools need to promote and also informed on possibilities of future career in biomedical science. A commitment from universities is required to increase research capacity in healthcare institutions, also in general practice and public health. Clinical academic leaders should be skillful in cross-sectoral and interdisciplinary expertise in technology-driven research to enhance the beneficial influences of research for patient health outcomes (4).

5.2.2 Relation between medical school and hospital in academicworkforce planning and career development

5.2.2.1 Academic workforce planning

Adequate cooperation between medical schools and hospitals is crucial for a satisfactory academic activity and hospital functioning. Although both medical schools and hospitals have much in common, the relationships between them is influenced by a number of factors including differences in administrative and management structures, lack of clear roles for each, the differing responsibilities and expectations, different financial sources and needs, and inadequate human resources. Inappropriate cooperation may lead to a rather competitive approach without an adequate responsibility of teaching, research and patient care. Therefore, this relationship should be elaborated in detail with a particular attention to well-planned academic workforce. It seems that the key to an adequate academic workforce planning is a close collaboration between the medical schools and hospitals based on a mutual teamwork with a clearly identified leadership. However, there is no universal solution for all countries as worldwide several types of relationships between health centres and medical schools exist (5).

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[4] Transforming health through innovation: Integrating the NHS and academia. UK Academy of Medical Sciences

Leading role of the hospitals in that relationship is rather obvious as they play the role of the connector between Academic and Industry grounds as described in AHI pipeline model in Chapter 5.2.8. of this paper. Hospital by its nature is a place where students master practical skills and obtain competencies of healthcare employing theoretical knowledge acquiredduring university lectures into solving real life problems and helping patients. Hospitals shouldown the process of future workforce demand planning by having a deep understanding of a real market need for particular medical specialties in a given, predictable time interval.

Another side is shaping a program of studies to make them adequate match to the evolving body of modern medical science and practice. While constant progress of computer and visual technologies stimulate significant progress of the simulation methods that include Virtual and Augmented reality, 3D modelling and printing and finally common and easy access to large portfolio of video materials presenting real life cases. However, none of these will replace real experience gathered during facing a health problem of real patients.

Deep values of accountability, engagement and empathy can be shaped only when patient health is in the hands of a doctor who has a chance to make a significant impact on someone's life and wellbeing – this cannot be learned from the book or even in the most sophisticated lab. This is a clear mark of enormous importance of hospitals in the educational chain of future generations of healthcare professionals.

Universities and academic hospitals should find best ways to improve recruiting, retention and retirement and use this data to refine the workforce. Recruitment should be based on open, transparent and merit-based policy and procedures, including proactive open international recruitment.

There is an increasing emphasis on importance of retainment, the need to know the grounds of leaving and create a retainment policy. Being a part of AHI pipeline is an exhausting experience that may lead to burnout and frustration that ends in leaving the pipeline in fields like collaboration, innovation or knowledge sharing.
Retaining skilled personnel inside the pipeline should be a key objective for those who establish its participants' organizational capabilities, to ensure the wheel of scientific progress is in constant motion allowing industry to turn discoveries into practical solutions, serving patients and the whole societies and preparing successors to accept the accountability for the future.

Having in mind the wider impact AHI Pipeline has on the shape of the medical ecosystem, states should also participate in that process enabling it through appropriate legislation and systemic support reflected in tools like centralized digital systems helping to navigate through bureaucracy and process nuances making them easier and less exhausting.

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[5] Ogden E. A How-To Guide for Effective Workforce Planning in the Higher Education Sector.
https://sums.org.uk/a-how-to-guide-for-effective-workforce-planning-in-the-higher-education-sector/

Healthcare professionals should feel less stress and more engagement, seeing encouragement from the overall system that both may have a strong impact on their ability to stay in the AHI pipeline cells for longer and perform their duties better (6,7).

Professional medical organizations, regulatory bodies and research institutions together with medical schools and universities should work on strategies for manpower planning, clinical academic career development and sustainable infrastructure for research in order to advance position of research in health care institutions. Clinical academics should have essential role in planning and organizing successful and functional combination of research, teaching and hospital practice. Coordination at the institutional level, professional organizations and national level will be required and should be recognized and developed.

Workforce planning is essential for universities while effective strategical workforce planning, which is in line with institutional strategy and objectives, is critical for successful performance. In the same time necessity for efficient workforce planning models for health care organizations is critical, since health care system faces growing challenges and shortage in numbers of trained health care professionals is expected.

Thus, universities with their associated academic hospitals need to establish the most advanced application of effective strategic workforce planning, which will empower institutions to be able to:

- Create environment of mutual understanding and responsibilities to both healthcare and academic workforce needs
- Develop assessment tool that will help the effective workforce need to deliver excellent patient care in academic hospital environment
- Better define assessment tools for workforce need in both research and teaching.
- Create systems that meet the developing students' and teachers' expectations in healthcare environment
- Support establishment of teams capable to make responsible decisions
- Find best ways to improve recruiting, retention and retirement and use this data to refine the workforce
- Implement open, transparent and merit-based recruitment policy and procedures, including proactive open international recruitment.
- Enable empowerment and coordination on the central and regional level to build a framework for AHI pipeline collaboration through covering appropriate legislation and tools
- Encourage AHI pipeline members for proactive co-creation of the culture of inclusive collaboration enabling their personnel to seek for engagements crossing through the

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[6] Wisener KM, Eva KV. Incentivizing Medical Teachers: Exploring the Role of Incentives in Influencing Motivations Acad Med. 2018 Nov;93(11S Association of American Medical Colleges Learn Serve Lead: Proceedings of the 57th Annual Research in Medical Education Sessions):S52-S59. doi: 10.1097/ACM.0000000000002383
[7] Wisener KM, Driessen EW, Cuncic C, Hesse CL, Eva KV. Incentives for clinical teachers: On why their complex influences should lead us to proceed with caution. Med Educ 2021 May;55(5):614-624. doi: 10.1111/medu.14422. Epub 2020 Dec 9.

layers of the pipeline and becoming a knowledge transfer catalysts for the whole medical ecosystem

- Carefully elaborate and develop the retirement policy related to scientists involved in clinical and translational research in hospital setting
- Support the development of reverse mentoring system with establishment of collaboration between experienced senior scientist and young researchers
- Create the workforce capable to establish and deliver future strategic approaches
- Create relationship and system that will establish mutual approach and responsibility towards the employment policy and salary distribution between university and academic hospital

5.2.2.2 Human resources career development

HR career development must be planned in concert for all members of research groups involved in research, education and hospital practice, research career development for clinical researchers.

Same possibilities must be provided in the process of education for both PhD students and trainees in the postgraduate specialty training programmes with emphasis on generic competences/ transferable/ soft skills teaching to enhance their competencies to undertake complex research projects and confront diverse and complex health challenges. The development of leaders capable of operating and driving cultural and system change across sectors will be increasingly required and could be delivered through Continuous Professional Development (CPD) (4).

- **Training in principal core competences**

Training should be guided in the career development of young scientists, PhD students and trainees, but also more experienced scientists should be supported:

It has long been known that communication is the most important skill in medical practice, and it is gaining more and more importance in medical education and research; in clinical research prominent are interdisciplinary and inter-professional communication. Scientists need to be aware that communication skills are essential for presenting their discoveries and expertise, learn from others, and expand cooperation to other groups and sectors. Without the acquisition of communication skills, there is no successful teamwork. Science communicationtoday has an imperative role.

Team work is *conditio sine qua non* in academic hospitals in all medical, scientific and educational aspects. Today biomedical research in academic hospitals involves teams of interdisciplinary collaborative researchers working together on complex biomedical questions towards common goals, usually in the areas of translational and clinical research, in the health care environment. All members of the team need to understand principles of effective collaborative research, individual responsibility to the project, respect other team members, be aware of own responsibilities and limitations, have clear understanding of the overall goal(s) and the research projects.

All participants in academic and health care environment must learn and become familiar with their position in leadership and management system. The awareness about challenges that

managers face and need to be supported by explaining the content of different role in leadership: interpersonal, informational and decisional. Scientists may be exposed to various challenges in time management: e.g. getting the data in time, respecting the grant deadline; they need to learn how to prioritize urgent tasks above other important ones and how ignore irrelevant interferences and distractions.

Decision making is an essential skill well known in medical practice. Scientists may also be faced with decisions to choose between multiple possible solutions to a problem, during their careers, especially to decide whether to continue with a particular project or clear goals are not being met. Experience may help in early decision, and teaching to acquiring competences on decision making, especially shared decision making is recommended. In multidisciplinary clinical research shared decision making is emphasized.

Lifelong learning is imperative for all participants in research in academic hospitals. PhD students, residents and all other early researcher need to acquire scholarly approach to their future professional tasks and challenges.

In academic hospitals professionalism of clinician-scientists and other researchers is shared within their competencies in areas of research, education and medical practice. Professional behaviour along with knowledge and specific skills characterizes their competences. The dominant elements of professionalism are orientation towards excellence, humanism, empathy and altruism, commitment to work and a range of responsibilities aiming to achieve personal and professional integrity, based in ethical and legal frameworks.

Fig. 4. Temple of professionalism From Dewey & Swiggart. Vanderbilt University School of Medicine, 2009; Adopted from Stern, 2006

Emphasis should particularly be given to the education of professionalism in research, teaching and health practice. Mandatory modules and/or various forms of continuing professional developments should be designed and especially offered to young researchers. Contents dedicated to relevant research should also be planned in continuous medical education/continuous professional development for medical specialists. Senior scientists and

mentors should be supported for participation as well. Enhancement of quality of mentoring process in doctoral studies and specialty training is needed (5).

5.2.2.3   Work-life balance and professional burnout

Having in mind our considerations about interactions between academic, medical, and business worlds with all the opportunities coming from that collaboration, we must also get a closer look at risks that may emerge because of dynamic and multi-layer nature of that relationship.

Those who propel that collaboration-clinicians, academic teachers and students- are the most exposed to the risk of severe symptoms that include, but are not limited to anxiety, disengagement and professional and life burnout that may develop into full scale depression and significantly limit abilities of individuals to continue their mission of further expansion of medical knowledge for the good of their patients (8).

Dynamics of the surrounding environment that include recent pandemic situation, geopolitical instabilities all around the world, growing financial pressure caused by inflation and job insecurity are all factors that may dramatically speed up processes that under other circumstances might need decades to develop- now we may talk about years instead.

The question is what can we do to reverse the tide and eliminate or at least significantly reduce these risks and prolong the time our professionals can perform their duties in uninterrupted way with increasing quality and freshness of mind allowing further innovation and pushing the limits of medicine far beyond current horizon?

The best way of avoiding work overload and stress related symptoms is to build and maintain an environment that promotes healthy work-life balance and provides an organic psychological safety to those who create that environment. We can achieve that by streamlining work processes and ensuring full understanding of rationales standing behind the process to those who are impacted. If we also engage them into co-creation of that process, we may achieve additional benefit of deepened engagement into organization by giving up part of the control and transferring the impact to the individual contributor level. Alltogether this will lead to reduced anxiety and frustration that are mostly caused by low level of understanding of the work environment and lack of faith in ability to improve it (9).

Another opportunity comes with time to unwind and recharge batteries of the employees. Knowledge workers may need to pay special attention to the time their brains can disconnect from running, work related topics and focus on something else giving brain time to reorganize information and get some freshness that fertilize creativity and boost brain processing power. Brakes for students and sabbatical leaves for teachers and medical professionals seems to be a good way of doing that. The length of these breaks should be adequate and allow full mental reset (weekend escape may not be enough).

The problem we face here is the fact that according to AHI Pipeline theory single individual may be engaged in more than one organization at the same time and sabbatical obtained in one place may be accompanied by full scale work in another that will at least reduce the final effect and in worst case scenario may neutralize it completely.

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[8] Garraio C, Freitas J, Magalhães SJ, Matias M. Work-Life Conflict Among Higher Education Institution Workers' During COVID-19: A Demands-Resources Approach Front Sociol 2022 Mar 23;7:856613. doi: 10.3389/fsoc.2022.856613. eCollection 2022.

[9] Shanafelt TD, Noseworthy JH. Executive Leadership and Physician Well-being: Nine Organizational Strategies to Promote Engagement and Reduce Burnout Mayo Clin Proc. 2017 Jan;92(1):129-146. doi: 10.1016/j.mayocp.2016.10.004. Epub 2016 Nov 18.

Solution to that problem may be a full transparency of the jobs undertaken in medical ecosystem and alignment between hiring organizations allowing them to measure and monitor the overall level of work-related stress absorber by individual. This might lead to creation of Integrated Industrial/Medical?/Healthcare? Sabbatical Leave Register (IISL Reg) to track sabbaticals and to ensure they are applied in the way that guarantees its efficiency.

Such a register might be also a good indicator for additional measures like a periodic well-being scan or include unexpected activities like military duties or exposure to trauma that may become a real experience in current uncertain times.

All these recommendations are just the initial thoughts outlining the problem of the growing importance in the era of aging societies and reduced number of doctors per patient requiring attention. Our mission should be to provide those on the first line of battle for the health of our communities the best possible conditions to maintain their motivation and build skills allowing all of us to win.

University and hospital administration should plan together to:

- Build a life-long career model based on evaluation of scientific and other outputs and following general research policies (research ethics and integrity, open access etc.)
- Create conditions for the establishment of talented young researchers as research group leaders and enable them to develop their ideas as principal investigators of ambitious projects while fulfilling principles of research excellence
- Create an attractive work environment for all employees
- Reward industry-academia cooperation (creating spin-offs, advising companies, performing contract research etc) and contribution to society (science communication, developing clinical treatment guidelines, participation in policymaking and governance etc.)
- Create centralized register of Healthcare Professionals (HCP) workload
- Establish recommended levels of load for HCPs between recovery breaks together with recommended length of such breaks (additional research may be needed to optimize the process)
- Implement national register allowing easy integration with HR systems of in country healthcare organizations i.e., through exposed API's
- Develop and implement regulations on national level allowing HCPs to take a recovery break in all engaged organizations at the same time window that should lead to creation of IISL Reg.

5.2.3 Protected time for research in healthcare working time

Protected time for research is essential for successful research programmes, enhancement of recruitment, research careers development within the healthcare institution, increased job satisfaction and the potential for better employee retention, also developing supportive infrastructure, teams and networks for conducting and leading research. It influences overall improvement of patient outcomes and wider societal benefits, it also attracts research funding, including funding from biomedical companies.

Researcher members of the healthcare workforce should have part of their time dedicated to undertaking research and developing and spreading new and transformative innovations, strengthening the research culture in health system and increasing capacities in priority areas. Universities/medical schools should support healthcare institution in establishing dedicated time for research. The research areas need to be adequately resourced (7).

Young clinician-academics and academic-clinicians form the basis of an organization's vital research-oriented core and are the pool for recruiting higher-level experts later on. However, many fine young colleagues with high potential willingly reduce their workload and aims since they don't perceive any direct benefit in pursuing a three-fold simultaneous path, encompassing three main development areas:

1. clinical excellence,
2. research-oriented excellence and productivity
3. teaching excellence (10).

In addition, given the specific timeline of a young researcher's career development, two additional, crucial areas need to be considered:

4. personal and familial excellence
5. private practice/commercial/applied research excellence (11).

In order to encourage young researchers to continue along this difficult developmental pathway, objective benchmarks may help with career development, especially for early-level researchers that are also clinicians.

Talent recognition and support are crucial in fostering clinical and academic excellence. As all academic clinicians know from personal experience, young researchers often have a very stressful professional and personal schedule, and once they become productive in their fields of expertise and research, time management becomes the most significant issue affecting their productivity. In addition, real benefits following their time investment are often claimed in later career stages, if at all.

5.2.4 Protected time for teaching in health care working time

One of the organizational goals in an academic hospital is to achieve clinical learning environment (CLE) that allows trainers to have sufficient time for educational tasks combined with hospital duties. CLE is the overlapping space between the "work environment" (the clinical context in which trainees learn and participate in patient care) and the "educational context" (the syllabi, curricula and goals that define methods for learning, expected learning outcomes and assessment practices) (12,5). Implementation of the European Working Time

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[10] Huffman EM, Anderson TN, Choi JN, Smith BK. Why the Lab? What is Really Motivating General Surgery Residents to Take Time for Dedicated Research. J Surg Educ. 2020;77(6):e39-e46. doi:10.1016/j.jsurg.2020.07.034

[11] Gail Neely J, Smith RJ, Graboyes EM, Paniello RC, Paul Gubbels S. Guide to Academic Research Career Development. Laryngoscope Investig Otolaryngol. 2016;1(1):19-24. Published 2016 Feb 24. doi:10.1002/lio2.5

[12] Sampat A, Larson D, Culler G, Bega D. Formalizing a Residency Mentorship Program with a "Business of Medicine" Curriculum. J Med Educ Curric Dev. 2020;7:2382120520959685. Published 2020 Sep 24. doi:10.1177/2382120520959685

Directive severely reduced the working hours of physicians in training, indications of a negative impact on training and little evidence of improvement in trainee working conditions and wellbeing. Interest in CLE include challenges to the quality and hours, bullying and suppressing learning culture, stress and burnout all with serious effect on health care and health professions training (3,13). This also has impact on the practice of graduates in the hospital setting, which could require further positive change in the CLE. Thus, there is the need for valid and actionable assessment of the CLE to assess the impact of these changes and to facilitate improvements (3).

While clinical career models are many, an academic teaching career seldomly provides ample clear career planning possibilities. When starting an academic career as a clinician, time management becomes the most difficult task in pursuing a meaningful teaching environment.

The following guiding principles may offer valuable assistance in planning a teaching career:

1. To thine own self be true: The fundamental motivation for teaching needs to be teaching itself. It encompasses a desire and drive for investigation, knowledge distribution and paidagogy, for one's own satisfaction, not external reward. This primary drive must be coupled with an intrinsic orientation toward excellence. Without this, the entire effort is useless.
2. Expert guidance: Forming a relationship with a mentor in becoming proficient in the metacognitive process of educating future educators is crucial in progressing as an educator.
3. Dedicated time: Beside allotted lecture schedules, teaching requires establishing consultation time slots, being and remaining available to students. Guarding this protected time against other enterprise incursions is crucial in developing as a teacher.
4. Seek inspiration everywhere: an often overlooked point - the educator must be one step ahead of the students in identifying new avenues of education and utilizing the well-known in order to bring novelty and inspire students to innovate.
5. Persistence: Failure is not a possibility, it is a certainty. But, the fundamental point in maintaining and advancing a teaching position is to withstand disappointment and seek mentors, associates and avenues of providing meaningful education.

As clinical teaching and learning environments involve three key elements: clinical work; learning; and environment, they all necessarily overlap. This overlap is especially obvious in early-level academic clinicians, who themselves still pursue their own studies, and start educating others simultaneously (5,14).

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[13] Nordquist J, Hall J, Caverzagie K, et al. The clinical learning environment. Med Teach. 2019;41(4):366-372. doi:10.1080/0142159X.2019.1566601

[14] Childs E, Remein CD, Bhasin RM, et al. How to Launch and Continually Enhance an Effective Medical Campus Faculty Development Program: Steps for Implementation and Lessons Learned. J Healthc Leadersh. 2021;13:147-156. Published 2021 Jul 5. doi:10.2147/JHL.S308608

5.2.5 Position of residents / PhD students in academic hospital

While a young clinical scientist may publish a number of relevant clinical papers, on many different subjects, any long-lasting scientific career should also encompass a dimension of systematically structuring their research efforts to follow a certain theme or series of hypotheses.

A typical resident/PhD student must coordinate a weekly schedule for the clinic, surgical duties, administrative duties, teaching, studying and research. If possible, leadership roles are also available, such as chief resident duties or institutional administrative duties. There is also a growing concern about the future of the medical workforce, with additional dedicated research time being pursued by one third of the total number of residents, further extending their residency training.

It is clear that the learning environment is changing significantly in real-time, including the implementation of duty hour restrictions, an increasing number of residents interested in clinical fellowships, and the number and demographics of residents pursuing an academic career.

In order to foster adequate results from young PhD students, while enabling them to pursue a meaningful, time-effective residency program, several principles need to take precedence above the rest:

1. Integrating medical and research training
2. Share best practices, monitor outcomes and obtain institutional support
3. Shortening the time required to achieve an independent research position through fast-tracking students with results.
4. Centralize mentoring and supervision, using career offices for physician-scientists.

To enable talent recognition, besides benchmarking, PhD students must have access to and achieve several key highlights:

1. Complete formal research training
2. Produce a steady stream of publications linked by a common theme
3. Have a skilled mentor or several of them (15).

Establishing time-specific mentor and mentee arrangements are the basis of achieving a time-efficient and theme-focused integrated resident and scientific PhD programme that works for both the student and the academic/clinical community. Therefore, it is necessary to subordinate their medical education to university faculty, as the residents need mentorship specifically from individuals who lead medical education activities, and who understand the necessity of correlating clinical aspects with research.

Often the residents are subordinated from a financial and organizational point of view to the Ministry of Health, and their education is partially organized at the university as well. This dichotomy affects the quality of their education, mostly when private medical hospitals are

[15] Robel S. Building Leadership Skills in Research Groups. Curr Protoc. 2022;2(6):e451. doi:10.1002/cpz1.451

involved, where some private institutions use their residents to cover additional, non-residency-related administrative work.

The residency should be considered the postgraduate step of education, because PhD candidates and future researchers are mostly recruited from residents, and they are much closer to the goal of completing the triad of clinic, education, and research duties specific to the university environment.

Therefore it is especially important to ensure that all responsible participants and decision-makers in both educational processes: PhD study programme and postgraduate specialty training are well-educated, well informed and capable of excellent cooperation with the strong and joint support of both the university and academic hospital. These are hospital director, dean of the medical school and their deputies/vice deans (responsible for PhD study with relevant research projects and specialty training programmes), PhD study mentor, and programme directors of the specialty trainings, specialty training mentors and supervisors.[16] The necessary cooperation of all those responsible is recommended in their commitment to success, professional development, and wellbeing of postgraduates aiming to create research and learning environment.
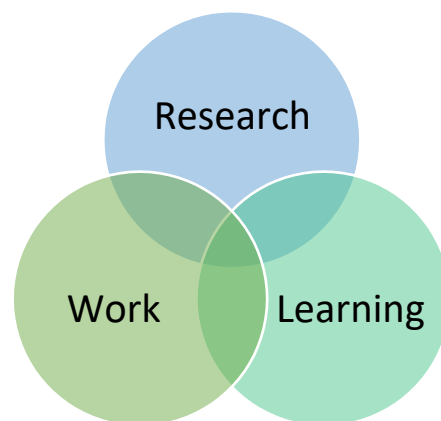

Fig. 5. Overlapping spaces between work, research and learning

Mobility projects for young medical residents, including fellowships, should be treated as student mobility programmes from the point of view of education and research mobility, in order to harmonise and broaden the knowledge and technological progress in medicine across Europe, with higher access to medical practice under the university umbrella. Internal and external research grants, including scientific publications, quality improvement initiatives, and curricular innovations should take into account the residents and not only advanced-level researchers.

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[16] Lee TC, Reyna C, Shah SA, Lewis JD. The road to academic surgical leadership: Characteristics and experiences of surgical chairpersons. Surgery. 2020;168(4):707-713. doi:10.1016/j.surg.2020.05.022

5.2.6 Integration of research related content in postgraduate specialty training programmes

Although physicians' medical practice is not itself science, it is based on science and on training that is supposed to teach physicians to apply scientific knowledge to people in a rational way. Medicine as practiced today is applied science (17). Therefore it is essential and often seen as good practice to integrate understanding an application of scientific methods in routine undergraduate education of medical students (18). Despite the well-perceived idea of science and medicine, the experience of many balances heavily in favour of practical performance, traditionally the apprenticeship system of teaching at the bedside does not need to be radically changed but rather extended to naturally involve also active scientific work (19). It also applies to today's approach of Competence Based Medical Education (CBME) at all levels of medical education.

MD-PhD program graduates follow career paths generally consistent with their training as physician-scientists. There is over 70 MD-PhD programs in North America, representing about 6% of graduated MD title holders (20,21). MD-PhD program graduates in the United States still comprise only a small proportion of all MD-degree graduates and of all biomedical PhD-degree graduates, out of these 80% find their employment in the academic sphere, not excluding teaching hospitals (21).

The conditions essential for MDs pursuing PhD. stated earlier (5.3.5.) are fully applicable also to MDs in need of a sound scientific background, especially research-protected time and need for proper and stable mentoring (22). The formal role and content of scientific involvement varies among specialty training programmes and is defined in line with the relevant UEMS documents: European Training Requirements for Specialty X". European Standards of Postgraduate Medical Specialists Training (23). These programmes should be implemented. Formal scientific training is reserved for MD-PhD, nevertheless formal and standardized incorporation of scientific method application and results interpretation is essential for clinical training. Final requirements in the equivalent of board exams should not exceed the requirements for Ph.D. programmes in the specialization, nor habilitation criteria where applicable, despite the board exams, are often conducted on academic grounds, clear gradual staging of scientific proficiency shall be defined.

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[18] Ng, Enoch MD, PhD; Jones, Andrea A.; Sivapragasam, Milani; Nath, Siddharth; Mak, Lauren E. MSc; Rosenblum, Norman D. MD, FRCPC. The Integration of Clinical and Research Training: How and Why MD–PhD Programs Work. Academic Medicine: May 2019 - Volume 94 - Issue 5 - p 664-670 doi: 10.1097/ACM.0000000000002467

[19] Polanyi M. Personal Knowledge: Towards a Post-Critical Philosophy. London: Routledge & Kegan Paul; 1958.

[20] https://premedplug.com/md-phd/

[21] Brass LF, Akabas MH, Burnley LD, Engman DM, Wiley CA, Andersen OS. Are MD–PhD programs meeting their goals? An analysis of career choices made by graduates of 24 MD–PhD programs. Acad Med. 2010;85:692–701.

[22] Jeffe DB, Andriole DA, Wathington HD, Tai RH. The emerging physician-scientist workforce: demographic, experiential, and attitudinal predictors of MD-PhD program enrollment. Acad Med. 2014 Oct;89(10):1398-407. doi: 10.1097/ACM.0000000000000400. PMID: 25006709; PMCID: PMC4175019.

[23] UEMS European Standards in Medical Training. https://www.uems.eu/areas-of- expertise/postgraduate-training/european-standards-in-medical-training

5.2.7 Relation between medical school and hospital research offices: Increase in innovation capacity

Integration of academic and hospital research offices functions should be promoted and facilitated. Universities and hospitals need to work more intensively aiming to introduce better interconnection between the medical school research office and hospital research/R&D office and achieve joint working and integration. In these developments the bureaucratic processes should be significantly reduced, and collaborative research projects promoted and undertaken. New healthcare environment should be built that is accessible to research and innovations, which will better consider and address clinical needs in collaboration with other healthcare professionals and patients.
New strategies should be developed and include: reducing barriers within healthcare and developing sustainable collaborations with partner institutions, increasing revenue generated from grants and contracts, providing grant development support, identifying and joint using of external resources.

A healthcare environment more receptive to research and innovation is expected to result in greater patient outcomes, production of innovations and possible resultingcommercialization. Barriers to adoption and innovation in the academic healthcare system may include a lack of funds as a main barrier, low capacity in innovation skills and a misalignment between health and public health with other sectors. To support increased innovation capacity, there is a need to educate clinicians academics and other healthcare professionals in innovation skills. Intensive effort is needed to retain expert scientists with a career combining both innovation and medicine in healthcare, since their number is limited, to better harness their skills for the benefit of the health service and potential commercialization opportunities within existing translational research. The collaboration in research between academia, healthcare and industry, exchange of people between these sectors should be intensified to encourage early discoveries, identify potential innovations and possible commercial exploitation. Clinicians undertaking a secondment in industry would provide invaluable clinical insight into the industry's discovery science, while acquiring important knowledge and experience of translational research and commercialization to enhance their performance as a clinician and future interactions with industry.

Medical school and hospital research offices should strive to create a joint office which will be concentrated on increase in innovation capacity which is very much based on new medical and digital technologies, relation with patients (clinical trials and collaborations with patients' organizations) and mobility across academia – hospital – industry.

5.2.7.1   New medical and digital technologies

Undoubtedly with the evolution of technology medicine is now gaining new opportunities. The progression of chemical, biological and material engineering is now closely involved with medical research as medicine in its core is a multi-disciplinary science. In the area of diagnostics new biomarkers, novel contrast materials and other medical devices aim towards precision and personalized medicine. Therapeutic procedures are also on the spotlight. From 3D printing and modelling of surgical procedures to medical implants or drug delivery systems biomedical research is on the rise.

Information technology is dominating our world. Due to the pandemic, telemedicine and digital technologies have been pushed forward to fill the gaps we faced in the past. In addition, big data, machine and deep learning are all contributing towards innovative digital health system creation. Dermatology, radiology, internal medicine even public health are all areas where implantation of digital systems can make a huge impact (24).

- **Digital technologies in contemporary teaching process in medical environment**

Contemporary medicine moved towards total immersion of their patients into a variety of digital tools that support diagnostic and treatment processes. Management of patient health records, individualized therapies with patient-centric approach, IT tools supporting medical decisions, common access to tele-medicine and online consultations are just first steps into the model where part of current duties of the doctor will be fulfilled by digitalization. It is furthermore foreseen, that artificial intelligence (AI) providing access to data analysis correlated with patient individual health profile and anonymized databases containing millions of cases as a learning baseline will play a substantial role in healthcare system and medical teaching. Medical universities stand in front of the mission of preparing their students to effectively use what technology has to offer to better care about patients. Proficiency in usage of modern technological tools will complement "hard" medical skills and may define a student value on the work market (25).

To be able to fulfil their mission academic teachers cannot stay behind. They have to face the challenge and continuously learn and practice as doctors to keep their knowledge up to date and to be able to teach their students the most current medical protocols and diagnostic methods ([26]). The way we teach should also change, adopting new digitized learning platforms, and making the teaching process engaging and visually attractive to follow changing trends in the way our brains absorb information. Today's generation of students is used to short, condensed and often visual information, and whether we like it or not, traditional ways of gathering knowledge like reading books, articles or slide decks become less attractive losing battle with video clips, podcasts and gamified apps. Covid-19 Pandemic clearly showed that the change in attitude is happening in front of us and medical universities easily implemented online teaching which was quickly accepted by students. Virtual collaboration tools like sharepoint allow parallel work on a single document for many people. Virtual auditorium platforms and meeting rooms like Zoom or MS Teams allow students and postgraduates to participate in classes, courses and congresses without leaving a desk, giving easy access to up to date medical knowledge.

Virtual workshops, experimentation labs and simulation centres allow gathering practical knowledge in a safe environment under guidance of experts. Rapid growth of virtual and augmented reality devices allows virtual surgeries or exploration of human body secrets in the

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[24] Mitchell M, Kan L. Digital Technology and the Future of Health Systems. Health Syst Reform. 2019;5(2):113-120. doi: 10.1080/23288604.2019.1583040. Epub 2019 Mar 25. PMID: 30908111.

[25] Varma N, Cygankiewicz I, Turakhia M, et al. 2021 ISHNE/ HRS/ EHRA/ APHRS collaborative statement on mHealth in Arrhythmia Management: Digital Medical Tools for Heart Rhythm Professionals: From the International Society for Holter and Noninvasive Electrocardiology/Heart Rhythm Society/European Heart Rhythm Association/Asia Pacific Heart Rhythm Society. Ann Noninvasive Electrocardiol. 2021;26(2):e12795. doi: 10.1111/anec.12795.

[26] Hare AJ, Soegaard Ballester JM, Gabriel PE, Adusumalli S, C William Hanson WC. Training digital natives to transform healthcare: a 5-tiered approach for integrating clinical informatics into undergraduate medical education J Am Med Inform Assoc. 2022 Nov 2;ocac209. doi: 10.1093/jamia/ocac209. Online ahead of print.

way never seen before and what is important without a need for corpses nor live animals to enable the process that also corresponds well to the changing ethical approach of many students (27). Post-graduate doctors gain access to unique opportunities in elevating their skills to a much higher level as well. Teachers need closely collaborate with engineers and programmers on co-creation of the new technologies and products to ensure they meet their needs and that they understand the way they work and capacities they enable. On the other hand, nothing can replace contact with the live patient and in most of the cases AI and digital tools are only a support tool to the human doctor interacting with the human patient. That is a process that is way too complex and full of nuances to be left under ultimate control of the algorithm so we have to prepare students for such interactions and give them opportunities to practice it (28).

Social media has become one of the key channels of exchanging information (29,30). Most scientific facts, research results, university-students interaction and general medical information become available on commonly shared SM platforms (31). Teachers, students, scientists, patients and business representatives as well as large parts of the society meet on these platforms and use them effectively, every day to build a global healthcare community. On the top of that there are also ordinary administrative systems that support university staff in the day to day student management process, allowing easy access to common services and reducing drastically overhead and time needed to get many daily problems resolved without a need to engage with a live human being, significantly reducing the pressure on Dean's offices (32).

Technology and digitalization in healthcare is the future, however, in the clinical world a persona of the mentor who is a doctor with large, practical experience still stands fast and cannot be easily replaced by any technological novelty in a Master-Student relationship.

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[27] Arruzza E, Chau M. A scoping review of randomised controlled trials to assess the value of gamification in the higher education of health science students J Med Imaging Radiat Sci. 2021 Mar;52(1):137-146. doi: 10.1016/j.jmir.2020.10.003.

[28] Gentry SV, Gauthier A, L'Estrade Ehrstrom B, Wortley D, Lilienthal A, Tudor Car L, Dauwels-Okutsu S, Nikolaou CK, Zary N, Campbell J, Car J. Serious Gaming and Gamification Education in Health Professions: Systematic Review. J Med Internet Res. 2019 Mar 28;21(3):e12994. doi: 10.2196/12994.

[29] Farsi D.Social Media and Health Care, Part I: Literature Review of Social Media Use by Health Care Providers. J Med Internet Res. 2021 Apr 5;23(4):e23205. doi: 10.2196/23205

[30] Sivaramalingam J, Rajendiran KS, Mohan M, Premlal KS, Yadhav SK, Satyamurthy GDV, Rangasamy S, Diravyaseelan M, Jamir L, Pandey DMU, Mohan SK, VA. Effect of webinars in teaching-learning process in medical and allied health science students during COVID-19 pandemic: A cross-sectional study. J Educ Health Promot 2022 Aug 25;11:274. doi: 10.4103/jehp.jehp_1450_21. eCollection 2022.

[31] Bughrara MS, Stephanie M Swanberg SM, Lucia VC, Schmitz K, Jung D, Wunderlic Barillas T. Beyond COVID-19: the impact of recent pandemics on medical students and their education: a scoping review. Med Educ Online 2023;28(1):2139657. doi: 10.1080/10872981.2022.2139657.

[32] Bialy SE, Jalali A. Go Where the Students Are: A Comparison of the Use of Social Networking Sites Between Medical Students and Medical Educators. JMIR Med Educ 2015 Sep 8;1(2):e7.doi: 10.2196/mededu.4908.

Figure. mHealth tools for the individual. Sensors can be embedded in a variety of wearables. IoT indicates Internet of things—connects from any location to hospital or cloud

Figure 5. mHealth tools for the individual (Varma N. Cygankiewicz I, Turakhia M et al. 2021)

5.2.7.2 Clinical Trials and Evidence-Based Medicine (EBM)

An important part of the research in a medical university should be developed under the idea of evidence-based medicine (EBM) and principle of good designed clinical trials.

There is increasing concern that most current published research findings might be false. The probability that a research claim is true may depend on study power and bias, the number of other studies on the same question, and, importantly, the ratio of true to no relationships among the relationships probed in each scientific field. In this framework, a research finding is less likely to be true when the studies conducted in a field are smaller; when effect sizes are smaller; when there is a greater number and lesser preselection of tested relationships; where there is greater flexibility in designs, definitions, outcomes, and analytical mode; when there is greater financial and other interest and prejudice; and when more teams are involved in a scientific field in chase of statistical significance (33).

Evidence-based medicine (EBM) is the care of patients using the best available research evidence to guide clinical decision-making. The focus is upon applying the results of research involving patients and important clinical outcomes (e.g., death, symptoms). EBM is meant to complement, not replace, clinical judgement tailored to individual patients. Similarly, EBM and the delivery of culturally, socially, and individually sensitive and effective care are complementary, not contradictory.

The basic elements of EBM are (34):

● Formulating a clinical question
● Finding the best available evidence
● Assessing the validity of the evidence (including internal and external validity)
● Applying the evidence in practice, in conjunction with clinical expertise and patient preferences

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[33] Ioannidis JP. Why most published research findings are false. PLoS Med 2005; 2:e124.
[34] Sackett DL, Rosenberg WM, Gray JA, et al. Evidence based medicine: what it is and what it isn't. BMJ 1996; 312:71 .

The focus is upon applying the results of research involving patients and clinical outcomes, such as death, disease, symptoms, and loss of function. Other kinds of evidence, such as those obtained by personal experience and laboratory studies of the pathogenesis of disease, are also useful in the care of patients but are not usually included under "evidence-based medicine".

In this aim, a University has the best potential to be examples of good practice due to the access of the large high educated medical staff – national and international recognized professor and researchers to be a Principal Investigator (PI) and large variety of patients in university hospitals, young doctors, from students, but mostly residents in training and PHD candidates who are during educational process and easier to be included in good quality clinical trial. To a better research and to scale clinical trials large enough, a medical university have the means and capacity to build an administrative staff dedicated to clinical trials evaluation, design and include these principles in contracts between universities and university hospitals, in the societies where the university has external hospital as teaching and research capacities, because the patients are usually followed up in medical facilities.

A clinical trial is a research study that tries to find new ways to improve health. Clinical trials can:

- Test new treatments for a certain disease or condition to see if they work better than the current treatments
- Test treatments or lifestyle changes to see if they prevent or lower the chance of getting certain diseases
- Test new ways of finding out if people have certain diseases.

In practice there are many ways to organize good quality clinical trials as collaboration with eternal companies who are running industry clinical trials, but mostly to encourage research in clinical trials PI initiated tide to medical clinical and basic sciences, PhD programs and built research capacities. At this point come, as an important pillar – access to internal and external, national and international funds competitions in a systematic and organized manner.

All of these ways to approach good quality research, design large scale research base is a part in the capacity building of a modern medical university, a source of revenues, a support to continue integrate education both medical skills and research skills, in the effort to integrate education, clinical and research, extremely important for best approach to organize good quality clinical trials:

- secure time of the medical staff for research within the clinic and university
- design large scale research and educational buildings – under the concept of green labs, or have access and partnerships with other medical and research capacities
- human resources are the utmost importance, and the age of the researcher who acts at PI, recognized as expert is at the end stage of the carrier, and that's why each university should have a very good policy in preserving the research potential, in balance with the national legislation, to keep active the collaboration with university staff for good quality professor who are conducting quality research, act as reviews and represents university at national and international level.

5.2.7.3 Greater interest for Investigator Initiated Trials

In recent decades, the focus of research in the pharmaceutical industry and the medical products industry has increasingly been directed towards academic research institutions, especially towards clinical and translational departments of medical faculties. Various forms of cooperation are emerging, and academic trials conducted at the initiative of investigators called "Investigator initiated trials" (IIT) are developing very intensively (also known as Investigator-Initiated Studies, Investigator-Sponsored Trials, Noncommercial Trials, Academic Clinical Trials, Physician-Led Studies).

The examiner proposes the topic and design of the research and submits the study proposal for support to the pharmaceutical company in whose therapeutic area the potential research is located. Support for the study is based on the importance of the research objectives, knowledge of scientific methodology and the researcher's ability to conduct a high-quality and ethical study; it can consist in the form of products, financing or combined support. Many leading pharmaceutical companies today have permanently open opportunities to support such research programs. Investigator-initiated clinical studies may be initiated and managed by individual investigators, institutions, or collaborative study groups (non-pharmaceutical companies). The sponsor, i.e. the client of the research, is the academic institution where the research is conducted (medical school).

IIT can play a key role in answering important medical and scientific questions regarding pharmaceutical products, their appropriate use, and related therapeutic areas. Such clinical studies can also contribute to improving knowledge about the pathophysiology of the disease they are investigating, thus improving patient care and stimulating new ideas for further research with the aim of improved treatment outcomes. Due to the high standards of clinical trial preparation and implementation, IIT represents a challenge for medical school services and contributes to the improvement of administrative capacities in the academic institution. For the investigator, the process of achieving IIT begins with the submission of a project proposal, and in the case of confirmation of an industry partner for interest and financial support for a clinical trial, conditions are negotiated, including the harmonization of legal requirements of all stakeholders, data protection, intellectual property, data ownership and other details are defined required to conduct the test.

Thus, the IITs provide excellent opportunities for increasing the quality of cooperation with industry and it is recommended that medical schools and academic hospitals support clinical researchers for such an initiative (35).

5.2.7.4 Role of patients not only as study participants, but also patient groups

Patient involvement in treatment is crucial, nevertheless, family consultation and direct participation are essential also in clinical study participation (36). Activation of individuals interested in their own well-being has therapeutic effects in patient-centered healthcare

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35 Konwar M, Bose D, Gogtay NJ, Thatte UM. Investigator-initiated studies: challenges and solutions. Perspect Clin Res. 2018;9(4):179–183. doi: 10.4103/picr.PICR_106_18

36 Dipankui et al. (2015) "Evaluation of patient involvement in a health technology assessment", Int J Technol Assess Health Care. 2015 Jan;31(3):166-70.

aimed at addressing the needs and preferences of each individual (37). Recognition of more complex "group effects" encompassing similarly affected patients and extended families of patients led to political recognition and a growing number of invited patient organizations (POs) to participate in healthcare policymaking. By inviting POs that claim to represent patients, representation comes into being (38). There are legal requirements enabling valid opinion sharing, eg. in Austria and Germany, often leading to the direct participation of patients in the decision-making of regulatory organs and healthcare providers (39,40). The non-political role is a mutual exchange of experiences among those affected within POs, considered to be "key mediating structures" between patients and the healthcare system (41,42). Gradually POs has taken also the role of scientific liaison, e.g. in the Czech Republic providing the translation of up-to-date research articles and research navigation for patients and families. This has wide potential for the recruitment of informed patients, on the other hand, poses a risk of "hype or hope" and overestimation of desired effects of treatment.

- the motivation of the activity, meeting expectation
- Independent feedback on provided healthcare, bias reduced by multiple opinions in the group
- Financial background of POs
- Extending PO-MD/ PO-" specialization guaranteeing board" cooperation

Patients in health care systems also may participate in clinical studies, which are performed in hospitals and/or outpatient clinics. Usually, study of new drugs give additional possibility of better therapy outcome as compared to already approved medicines. Always their will and formal agreement is needed. Advantages of the involvement on such study encompass very precise diagnosis, intensified medical control and diagnostic tests.

Patients that suffer from chronic illnesses very often set up support groups – informal or formal as patients associations. Their role is to gather patients with the same disease that may feel alone, lost and afraid because of their bad condition. In such groups, they may introduce basic problems, share feelings, worries, and expectations, seek for mental and physical help and support. They often solve many problems together and support each other. As a society they may influence and lobby decision makers, health care representatives for systemic improvement of their situations. They may also affect "healthy" society to increase its awareness and knowledge about the reality of their lives and burden that they are to carry each day for many years (37).

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[38] Rojatz D, Fischer J, Van de Bovenkamp H. Legislating Patient Representation: A Comparison Between Austrian and German Regulations on Self-Help Organizations as Patient Representatives. J Bioeth Inq. 2018 Sep;15(3):351-358. doi: 10.1007/s11673-018-9864-7. Epub 2018 Jul 2. PMID: 29968017.

[39] https://www.eu-patient.eu/globalassets/library/publications/epf_added_value_report_final.pdf

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[41] Branckaerts, J., and A. Richardson. 1988. Politics and policies on self-help: Notes on the international scene. Health Promotion International 2(3): 276–282.

[42] Chaudhary, S., M. Avis, and C. Munn-Giddings. 2013. Beyond the therapeutic: A Habermasian view of self-help groups' place in the public sphere. Social Theory & Health 11(1): 59–80.

5.2.8 Opportunities for mobility across academia-hospital-industry (AHI)

The world in XXI century became a highly integrated organism where science, business and individual contributors got an enormous opportunity to freely exchange information, knowledge and collaborate together, unified in creation of integrated value streams that bring benefits to all engaged parties (43).

Bi-directional transfers between academic circles, hospitals and pharma industry are a very natural ground to fertilize innovation and stimulate discovery and improvements of treatment methods available to patients and as a result increasing quality of life and extending lifespan on individuals as well as improving overall health condition of societies (44,45).

University hospitals are a logical place where science meets business allowing exchange of innovative scientific concepts and practical results of clinical trials with new tools and medicines coming from industry (46). This practical collaboration has also another layer – powerful opportunity to build networks of highly motivated individuals who collaborate with each other building an environment of trust and high mental stimulus where new ideas may emerge freely being a source of inspiration and starting point for new breakthrough discoveries (47).

Universities have a foundational role in the whole process being a source of highly qualified professionals who then gain practical knowledge through experience of hospital reality where they fight on the frontline collecting experience, observing potential gaps in medical processes and developing idea show to remediate them. On the other side industry has a potential to develop tools that are instrumental in resolving problems doctors face in their daily routines. Also industry may be a great source of inspiration for academic people formulating tough conceptual problems that require the power of joint scientific networks to be resolved (48). University educational profiles may be also modified to suit the needs of evolving industries and allow students better preparation for professional challenges after completion of their educational paths.

University Hospital being an interface between Academic and Industry worlds has a vital role in providing a ground where science meets practice and where Labs from University and R&D departments meet the actual end users- medical practitioners and patients. This pivotal role of consumer and feedback giver is essential in propelling the informational highway and also

[43] Mobility of researchers between academia and industry. 12 practical recommendations https://op.europa.eu/en/publication-detail/-/publication/be2d9d3f-1d43-4a7f-afb8-ce1c3c3ab31b

[44] https://www.ncub.co.uk/solutions/analytics/researcher-mobility-between-industry-and-academia/

[45] https://www.baltic-science.org/wp-content/uploads/2020/04/18-overview-of-the-best-practices-mobility.pdf [46] Developing the next generation of biomedical talent: a snapshot of UK support for early career researchers https://acmedsci.ac.uk/file-download/16005221

[47] Career Development and Mobility Fellowships in Medical Device Research and Development: A CÚRAM Industry-Academia Training Initiative. Doi 10.3030/713690. https://cordis.europa.eu/project/id/713690

[48] Health Professional Mobility and Health Systems. Evidence from 17 European countries Edited by Matthias Wismar Claudia B. Maier Irene A. Glinos Gilles Dussault Josep Figueras https://www.euro.who.int/_data/assets/pdf_file/0017/152324/Health-Professional-Mobility-Health-Systems.pdf

in validation of ideas and solutions on the practical ground ensuring science is not only an aetheric discipline (49).

The question is how to build an environment that allows easy and efficient exchange of the ideas and solutions where all engaged parties benefit equally, avoiding traps and allowing this model to be sustainable over long period of time.

It seems that one of the most natural answers to that questions is to provide ways for multi-directional mobility of medical professionals through the AHI pipeline. Such a transfer is a huge opportunity for building strong bonds between organizations resulting in an effective exchange of information that is essential for unstoppable growth on the R&D field (50).

Tools that may be employed to create such mobility opportunities are:
- Temporary industry assignments
- Joint research activities
- Parallel employments (different mixtures are possible here)
- Co-owned start-up companies
- Innovation incubators

These examples of collaboration look promising, however they are also linked with some risks that should be taken into consideration and mitigated when collaboration is being established.

Some of the risks are:
- Conflict of interest
- Protection of intellectual property and trade secrets
- Ownership of results and patents
- Fair time distribution
- Lack of transparency and erosion of trust

Remediation of risks is essential to build healthy environment where parties secure their vital interests protecting at the same time engaged professionals reducing potential stress and ensuring psychological safety that is crucial to inspire empiricism and willingness to take risk being an unavoidable component of every innovative and experimental activity (51). What is equally important appropriate measures and processes in place are crucial to provide compliance with regulations and creating legal safety net. Measures that can be taken into considerations are (52):
- Frame collaboration agreements
- Non-disclosure agreements
- Policies

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[49] Filippo Pesapane How scientific mobility can help current and future radiology research: a radiology trainee's perspective. Insights Imaging. 2019 Dec; 10: 85.Published online 2019 Aug 27. doi: 10.1186/s13244-019-0773-z

[50] Göran Melin Amanda Bengtsson Jallow Sam Kuritzén Kristian Sundgren. Analysis of Intersectoral Mobility. https://www.technopolis-group.com/wp-content/uploads/2020/06/SSF_Intersectoral-Mobility_Final-Report-191002.pdf

[51] Stephen Bach. International Mobility of Health Professionals: Brain Drain or Brain Exchange? Published: Oxford academic, 2008, pages 202-235 https://doi.org/10.1093/acprof:oso/9780199532605.003.0008

[52] The International Mobility of Talent: Types, Causes, and Development Impact. Andrés Solimano (ed.) https://academic.oup.com/book/6015/chapter-abstract/149415217?redirectedFrom=fulltext

- Standard Operating Procedures
- Patents and Trademarks
- Appropriate statements in work contracts

Today we can say that this collaboration and exchange is already present and bring measurable fruits that benefit multiple parties and finally impact those who need it the most – Patients. However, there is a lot to do and making an effort to expand the level of collaboration and making a transfer between all three stages of AHI pipeline as seamless as possible is the only way to keep the pace of medical progress steady or growing.
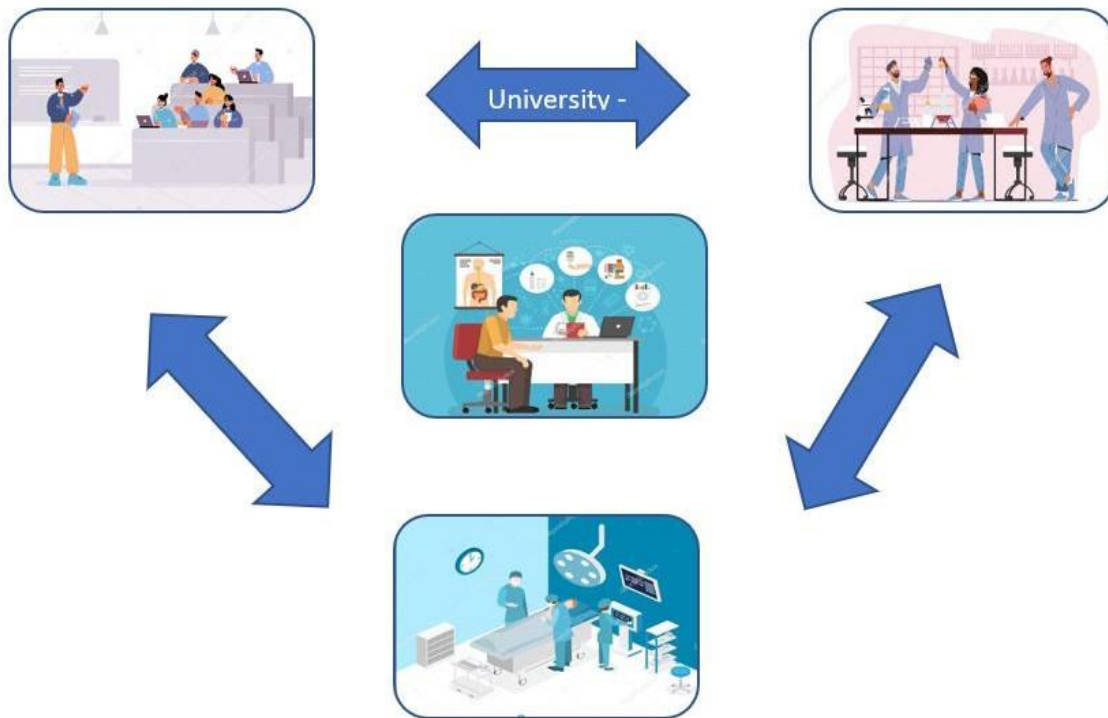

Figure 8. Academia – Hospital – Industry (AHI) pipeline

Close and continuous collaboration through all AHI Pipeline is highly recommended. Systemic foundations should be laid and necessary regulations made to make transfers as seamless as possible yet safe for parties and individuals providing tools and frameworks that will stimulate and encourage rather than add unnecessary bureaucratic burden that will slow down collaboration and make progress more difficult and expensive for the whole ecosystem (53). Results of the collaborations should be widely used within society and become foundations for further expansions.

University programmes should be modified to reflect industrial progress and new treatments and tools available to increase medical process efficiency and patient lifespan and wellbeing.

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[53] Charalambakis NE, Ambulos NP Jr, Hockberger P, Meyn SM, Bowen SK, Constable S, Fisher NC, Fletcher L, Kigenyi J, Mundoma C, Ramirez-Aguilar KA, Vinard A, Winn ME, Mische SM. Establishing a national strategy for shared research resources in biomedical sciences. FASEB J. 2021 Nov;35(11):e21973. doi: 10.1096/fj.202101393.

6   POLICY RECOMMENDATIONS

The recommendations below, have been developed during the work on the document White paper on combining research, teaching and/ medical practice and partly on the previous achievements of the project "Alliance4Life". The recommendations are addressed at three levels that have the largest impact on participation in Framework programmes: institutional (universities and academic hospitals), national and EU level. It is expected that institutions, national administrations and the EU institutions support synergies between research and education in academic healthcare institution, open new opportunities and create the environment that facilitates this cooperation to finally improve public health outcomes.

6.1   RECOMMENDATIONS TO UNIVERSITIES AND ACADEMIC HOSPITALS

Position of science in relation of academic hospital and the university
1. Focus on responsibility of academic hospitals for supporting and promoting research in the institution, to create research and learning environment.
2. Encourage scientists and academic teacher to play essential role in institutional management and leadership together with healthcare professionals.
3. Create undergraduate curricula that expose medical students to research, inform them about clinical and translational research, their role in progress of diagnosis and treatment of patients and motivates for research activities.
4. Create system that meet students' and teachers' expectations in healthcare environment.
5. Encourage clinical academic leaders to develop skills in cross-sectoral and interdisciplinary expertise in technology-driven research to enhance the beneficial influences of research for patient health outcomes.
6. Develop synergies between research area and higher education area in academic hospital environment and establish firmer collaboration between university and hospital authorities aiming to integration.

Relation between medical school and hospital in academic workforce planning and career development
1. Create environment of mutual understanding and responsibilities to both healthcare and academic workforce needs
2. Encourage/stimulate common approach of healthcare institution and higher education institution to assure inclusion of research in job plans, to provide integration of healthcare professionals in research groups capable to incorporate clinical expertise in biomedical research teams, to create multidisciplinary teams together with experts in engineering and social sciences
3. Find best ways to improve recruiting, retention and retirement and use this data to refine the workforce. Implement open, transparent and merit-based recruitment policy and procedures, including proactive open international recruitment. Formulate measures to prevent brain drain, concentrate on retainment of scientists and brain circulation. Carefully elaborate and develop the retirement policy related to scientists involved in clinical and translational research in hospital setting. Support the

development of reverse mentoring system with establishment of collaboration between experienced senior scientist and young researchers.

4. Support establishment of teams capable to make responsible decisions and the workforce capable to establish and deliver future strategic approaches.

5. Create relationship and system that will establish mutual approach and responsibility towards the employment policy and salary distribution between university and academic hospital.

6. Build a life-long career model based on evaluation of scientific and other outputs and following general research policies (research ethics and integrity, open access etc.) Create conditions for the establishment of talented young researchers as research group leaders and enable them to develop their ideas as principal investigators of ambitious projects while fulfilling principles of research excellence. Create plan for teaching generic competences/transferable skills young scientists, PhD students and residents

7. Create an attractive work environment for all employees

8. Reward industry-academia cooperation (creating spin-offs, advising companies, performing contract research etc) and contribution to society (science communication, developing clinical treatment guidelines, participation in policymaking and governance).

Protected time for research in healthcare working time
1. Accelerate the creation of protected time for research, which is essential for successful research programmes, enhancement of recruitment, research careers development within the healthcare institution, increased job satisfaction and the potential for better employee retention, also developing supportive infrastructure, teams and networks for conducting and leading research.

2. Increase awareness that protected time for research influences overall improvement of patient outcomes and wider societal benefits, also attracts research funding, including funding from biomedical companies

3. Invite universities/medical schools to support healthcare institution in establishing dedicated time for research and assure that researchers members of the healthcare workforce have part of their time dedicated to undertaking research and developing and spreading new and transformative innovations, strengthening the research culture in health system and increasing capacities in priority areas

Protected time for teaching in healthcare working time
1. Assure that all participants understand CLE as the overlapping space between the "work environment" (the clinical context in which trainees learn and participate in patient care) and the "educational context" (the syllabi, curricula and goals that define methods for learning, expected learning outcomes and assessment practices).

2. Formulate requirements and create realization of protected time for teaching to enable development of the CLE in academic hospitals, that allows trainers to have sufficient time for educational tasks combined with hospital duties.

3. Assure that responsible administration prevents situations in which implementation of the European Working Time Directive severely influences the working hours of physicians in training, with indications of a negative impact on training and little evidence of improvement in trainee working conditions and wellbeing, may suppress

learning culture, may cause stress and burnout all with serious effect on health care and health professions training

4. Invite responsible university and healthcare administrations for valid and actionable assessment of the CLE to assess the impact of these changes and to facilitate improvements.

Position of residents /PhD students in academic hospital
1. Assure that all responsible participants and decision-makers in both educational processes: PhD study programme and postgraduate specialty training are well-educated, well informed and capable of excellent cooperation with the strong and joint support of both the university and academic hospital. These are hospital director,dean of the medical school and their deputies/vice deans (responsible for both PhD study with relevant research projects and specialty traning programmes), PhD study mentor, and specialty trainings Programme directors mentors and supervisors.
2. Assure that necessary cooperation of all those responsible is oriented towards their commitment to success, professional development, and wellbeing of postgraduates aiming to create research and learning environment
3. Support young colleagues in pursuing a three-fold simultaneous path, encompassing three main development areas: clinical excellence, research-oriented excellence and productivity teaching excellence
4. Support early level researcher-clinician's career development, considering additional, crucial areas: personal and familial excellence together with private practice/commercial/applied research excellence.
5. Emphasize the importance of talent recognition and support, crucial in fostering clinical and academic excellence.
6. Assure that research content of specialty training programmes (UEMS European Training Requirements) is defined and organized as required.
7. Create plan and organize education of both PhD mentors and mentors in postgraduate specialty training.

Relation between medical school and academic hospital research offices
1. Improve relation between medical school and academic hospital research offices aiming to create joined offices.
2. Support joint effort of research offices to
   a. Increase innovation capacity and jointly support a need to educate clinicians academics and other healthcare professionals in innovation skills.
   b. Motivate the collaboration in research between academia, healthcare and industry, exchange of people between these sectors to encourage early discoveries, identification of potential innovations and possible commercial exploitation
   c. Engage clinicians in industry to acquire important knowledge and experience of translational research and commercialization and enhance their performance as a clinician and future interactions with industry.
   d. Intensify efforts to retain experts scientists with a career combining both innovation and medicine in healthcare.

New medical and digital technologies

1. Increase efforts on development and implementation standardized augmented reality (AR) and virtual Reality (VR) tools that allow medical training following the same standards around the globe and utilize cost effective and available platforms.
2. Teach students effective collaboration in geographically dispersed, virtualized environment by establishing a network of partner's universities that may collaborate on scientific projects using virtual collaboration tools.
3. Include modern, digital era tools into educational programmes of medical universities; tune learning materials used at universities to match modern ways of effective knowledge transfer and utilize proper tools in the educational process
4. Leverage Social media platforms in a structured way opening standard and validated channels that deliver knowledge of proved quality
5. Make universities paperless reducing bureaucratic burden and transferring all administrative processes into digital space

Role of patients as study participants, but also as patient group members
1. Support medical schools and hospitals to build capacities for good quality clinical trials, to build an administrative staff dedicated to clinical trials evaluation, design and include these principles in contracts between universities and university hospitals
2. Support universities and academic hospitals to use experience with clinical trials to tide to basic sciences, PhD programmes and build research capacities.
3. Support collaboration with patient organizations and encourage them to take the role of scientific liaison providing the translation of research in medical practice
4. Support clinical trials PI to tide medical clinical and basic sciences, PhD programs and building research capacities
5. Support clinical researchers to initiate and organize the IIT sponsored by medical school and academic hospital to further develop research capacities and find opportunities for increasing the quality of cooperation with industry

Mobility across Academia – Hospital – Industry (AHI)
1. Intensify close and continuous collaboration through AHI pipeline
2. Laid systemic foundations and make necessary regulations to make transfers as seamless as possible yet safe for parties and individuals providing tools and frameworks that will stimulate and encourage rather than add unnecessary bureaucratic burden that will slow down collaboration and make progress more difficult and expensive for the whole ecosystem.
3. Stimulate wide usage of the results of collaborations within society in order to become foundations for further expansions.
4. Modify university programmes to reflect industrial progress and new treatments and tools available to increase medical process efficiency and patient lifespan and wellbeing
5. Develop a public database of standardized legal clauses that may be used to protect organizations and individuals entering collaboration compatible with legislation of the member country where collaboration takes place. Build a platform that allows matching of medical research initiatives with interested participants and make it public allowing wider audience also to access the results of the initiatives that are registered on the platform (MedRes)

Relation between ministries for science/education and health

1. Intensify relation between university and academic hospital with ministries for science/education and health, elaborate and present them all benefits that could be achieved by combining research, teaching and/or medical practice in line with topics presented above.
2. Invite ministers for science/education and health to support advancements of clinical and translational research explaining the benefits for biomedical science and patients' outcomes.
3. Invite ministers for science/education and health to coordinate employment policy between science/higher education and healthcare

6.2   RECOMMENDATIONS TO NATIONAL GOVERNMENTS

Position of science in relation of academic hospital and the university
1. Promote research in academic hospitals, stimulate synergies between research area and higher education area in academic hospital environment and support creation of research and learning environment in academic hospitals.
2. Stimulate medical schools to carefully plan that undergraduate curricula include contents that enable medical students to be exposed to research and informed about clinical and translational research, their role in progress of diagnosis and treatment of patients
3. Evaluate impact of firmer collaboration on a range of factors – including research activity, staff recruitment and retention, and patient outcomes – to inform decisions about wider implementation of the achieved results.

Relation between medical school and hospital in academic workforce planning and career development
1. Develop assessment tool that will help the effective workforce to deliver excellent patient care in academic hospital environment and better define assessment tools for workforce need in both research and teaching.
2. Create measures at national level to improve recruiting, retention and retirement, formulate measures to prevent brain drain, concentrate on retainment of scientists and brain circulation. Carefully elaborate and develop the retirement policy related to scientists involved in clinical and translational research in hospital setting.
3. Create conditions for the establishment of talented young researchers as research group leaders and enable them to develop their ideas as principal investigators of ambitious projects while fulfilling principles of research excellence. Support the development of reverse mentoring system with establishment of collaboration between experienced senior scientist and young researchers.
4. Encourage/stimulate common approach of healthcare institution and higher education institution to assure inclusion of research in job plans, to provide integration of healthcare professionals in research groups capable to incorporate clinical expertise in biomedical research teams, to create multidisciplinary teams together with experts in engineering and social sciences.

Protected time for research in healthcare working time
1. Increase efforts in collaboration between science/education and health ministries to jointly develop strategies, which will promote protected time for research, because it is essential for successful research programmes, research careers development within the healthcare institution, increased job satisfaction and the potential for better employee retention, also developing supportive infrastructure, teams and networks for conducting and leading research; protected time for research influences overall improvement of patient outcomes and wider societal benefits, also attracts research funding, including funding from biomedical companies
2. Develop measures to support universities/medical schools and healthcare institution in establishing dedicated time for research and assure that researchers members of the healthcare workforce have part of their time dedicated to undertaking research and developing and spreading new and transformative innovations, strengthening the research culture in health system and increasing capacities in priority areas

Protected time for teaching in healthcare working time
1. Increase efforts in collaboration between ministries responsible for education and healthcare to create measures supporting academic hospitals, in collaboration with universities to organize protected time for teaching within health care work environment in which trainees learn and participate in patient care; can achieve expected learning outcomes and competences with relevant assessment practices. Assure that protected time for teaching enables all teachers, mentors, supervisors etc. to implement the required educational contents.
2. Assure that responsible administration prevents situations in which implementation of the European Working Time Directive severely influences the working hours of physicians in training, with indications of a negative impact on training and little evidence of improvement in trainee working conditions and wellbeing, may suppress learning culture, may cause stress and burnout all with serious effect on health care and health professions training.
3. Incite responsible university and healthcare administrations for valid and actionable assessment of the clinical learning environment to evaluate implementation of agreed measures, assess the impact of these changes and to facilitate improvements.

Position of residents /PhD students in academic hospital
1. Ensure that all responsible decision-makers in both educational processes PhD study and postgraduate specialty training are well-educated, well informed and capable of excellent cooperation with the strong and joint support of both the university and academic hospital. These are hospital director, dean of the medical school and their deputies/vice deans (responsible for PhD study with relevant research projects and specialty training programmes), PhD study mentor and Programme directors of the specialty trainings, specialty training mentors and supervisors.
2. Assure that necessary cooperation of all those responsible is oriented towards their commitment to success, professional development, and wellbeing of postgraduates aiming to create research and learning environment.
3. Develop measures to support young colleagues in pursuing a three-fold simultaneous path, encompassing three main development areas: clinical excellence, research-oriented excellence and productivity teaching excellence; support early level researcher-clinician's career development, considering additional, crucial areas:

~~personal and familial excellence together with private practice/commercial/applied~~ research excellence.

4. Emphasize the importance of talent recognition and support, crucial in fosteringclinical and academic excellence.
5. Assure that research content of specialty training programmes (UEMS European Training Requirements) is defined and organized as required
6. Create legal and administrative requirements for education of both PhD mentors and mentors in postgraduate specialty training.

Relation between medical school and academic hospital research offices
1. Support joint effort of university and hospital research offices to increase innovation capacity, motivate the collaboration in research between academia, healthcare and industry, intensify efforts to retain experts scientists with a career combining both innovation and medicine in healthcare.
2. Initiate the collaboration in research between academia, healthcare and industry, exchange of people between these sectors should be intensified to encourage early discoveries, support the identification of potential innovations and possible commercial exploitation.
3. Promote clinicians' engagement in industry to acquire important knowledge and experience of translational research and commercialization and enhance their performance as a clinician and future interactions with industry. Increase efforts to retain experts scientists with a career combining both innovation and medicine in healthcare.

New medical and digital technologies
1. Increase efforts on development and implementation of standardized augmented reality (AR) and virtual reality (VR) tools that allow medical training following the same standards around the globe and utilize cost effective and available platforms.
2. Promote and stimulate effective collaboration of students in geographically dispersed, virtualized environment by establishing a network of partner's universities that may collaborate on scientific projects using virtual collaboration tools.
3. Support tuning of learning materials used at universities to match modern ways of effective knowledge transfer and utilize proper tools in the educational process, leverage social media platforms in a structured way opening standard and validated channels that deliver knowledge of proved quality.
4. Increase efforts to make universities paperless reducing bureaucratic burden and transferring all administrative processes into digital space.

Role of patients as study participants, but also as patient group members
1. Support medical schools to build capacities for good quality clinical trials, to build an administrative staff dedicated to clinical trials evaluation, design and include these principles in contracts between universities and university hospitals, to use experience with clinical trials to tide to basic sciences, PhD programmes and build research capacities.
2. Support collaboration with patient organizations and encourage them to take the role of scientific liaison providing the translation of research in medical practice

Mobility across Academia – Hospital – Industry (AHI)

1. Intensify close and continuous collaboration through AHI Pipeline at national level and stimulate wide usage of the results of collaborations within society in order to become foundations for further expansions.
2. Laid systemic foundations and make necessary regulations to make transfers as seamless as possible yet safe for parties and individuals providing tools and frameworks that will stimulate and encourage rather than add unnecessary bureaucratic burden that will slow down collaboration and make progress more difficult and expensive for the whole ecosystem.
3. Initiate modification of university programmes to reflect industrial progress and new treatments and tools available to increase medical process efficiency and patient lifespan and wellbeing.
4. Enable empowerment and coordination on the central and regional level to build a framework for AHI pipeline collaboration through covering appropriate legislation and tools and encourage proactive co-creation of the culture of inclusive collaboration and engagements to becoming a knowledge transfer catalysts for the whole medical ecosystem.
5. Reward industry-academia cooperation (creating spin-offs, advising companies, performing contract research etc) and contribution to society (science communication, developing clinical treatment guidelines, participation in policymaking and governance etc.).
6. Develop a public database of standardized legal clauses that may be used to protect organizations and individuals entering collaboration compatible with legislation of the member country where collaboration takes place.
7. Expand COI Alert by adding option for manual enter of identified risks beyond IISL Reg. Employ AI into matching COI Alert records with adequate legal clauses and recommending it to the collaborating parties and make it part of COI Alert.
8. Build a platform that allows matching of medical research initiatives with interested participants and make it public allowing wider audience also to access the results of the initiatives that are registered on the platform (e.g. MedRes).
9. Make medical universities mandatory members of MedRes and expand it by the statistical tools allowing prediction of trends in demand for specific medical specialities based on the initiatives registered on the platform as well as tools/technologies that may be treatments of the future to allow them to modify their educational programmes and make them futureproof.

Relation between ministries for science/education and health
1. Intensify relation between ministries for science/education and health related to academic hospitals to coordinate and support measures in line with all topics described above.
2. Support advancements of clinical and translational research
3. Coordinate employment policy between science, higher education and healthcare

6.3 RECOMMENDATIONS TO EUROPEAN COMMISSION

1. Promote research in academic hospitals, stimulate synergies between research area and higher education area in academic hospital environment and support creation of research and learning environment in academic hospitals.

2. Stimulate medical schools to carefully plan that undergraduate curricula include contents that enable medical students to be exposed to research and informed about clinical and translational research, their role in progress of diagnosis and treatment of patients

3. Coordinate creation of measures at national level to improve recruiting, retention and retirement, formulate measures to prevent brain drain, concentrate on retainment of scientists and brain circulation.

4. Coordinate common approach of healthcare institution and higher education institution to assure inclusion of research in job plans, to provide integration of healthcare professionals in research groups capable to incorporate clinical expertise in biomedical research teams, to create multidisciplinary teams together with experts in engineering and social sciences.

5. Coordinate work of responsible ministries to create joint employment and salary strategies related to research, teaching and hospital duties in university hospitals.

6. Coordinate efforts in collaboration between science/education and health ministries to jointly develop strategies, which will promote protected time for research, because it is essential for successful research programmes, developing and spreading new and transformative innovations, strengthening the research culture in health system and increasing capacities in priority areas research careers development within the healthcare institution, increased job satisfaction and the potential for better employee retention, also developing supportive infrastructure, teams and networks for conducting and leading research; protected time for research influences overall improvement of patient outcomes and wider societal benefits, also attracts research funding, including funding from biomedical companies.

7. Coordinate efforts in collaboration between ministries responsible for research, education and healthcare to create measures supporting academic hospitals in collaboration with universities to organize protected time for teaching within health care work environment in which trainees learn and participate in patient care; can achieve expected learning outcomes and competences with relevant assessment practices, enabling all teachers, mentors, supervisors etc. to implement the required educational contents.

8. Harmonize responsibilities of ministries of health and education to implement the European training requirements – European standards of specialty training including defined research content in the training programmes.

9. Coordinate responsible ministries that all responsible decision-makers in both educational processes PhD study and postgraduate specialty training are capable of excellent cooperation with the strong and joint support of both the university and academic hospital, oriented towards their commitment to success, professional development, and wellbeing of postgraduates aiming to create research and learning environment.

10. Coordinate measures to support young colleagues in pursuing a three-fold simultaneous path, encompassing three main development areas: clinical excellence, research-oriented excellence and productivity teaching excellence; support early level researcher-clinician's career development, considering additional, crucial areas: personal and familial excellence together with private practice/commercial/applied research excellence.

11. Coordinate support to joint effort of university and hospital research offices to increase innovation capacity, motivate the collaboration in research between academia, healthcare and industry, intensify efforts to retain experts scientists with a career combining both innovation and medicine in healthcare.

12. Initiate the collaboration in research between academia, healthcare and industry, exchange of people between these sectors should be intensified to encourage early discoveries, support the identification of potential innovations and possible commercial exploitation.

13. Stimulate efforts on development and implementation of standardized augmented reality (AR) and virtual reality (VR) tools that allow medical education following the same standards around the globe and utilize cost effective and available platforms.

14. Promote and stimulate effective collaboration of students in geographically dispersed, virtualized environment by establishing a network of partner's universities that may collaborate on scientific projects using virtual collaboration tools; support tuning of learning materials used at universities to match modern ways of effective knowledge transfer and utilize proper tools in the educational process.

15. Stimulate relevant ministries to support universities and academic hospitals to build capacities for good quality clinical trials, to build an administrative staff dedicated to clinical trials evaluation, design and include these principles in contracts between universities and university hospitals, to use experience with clinical trials to tide to basic sciences, PhD programmes and build research capacities.

16. Support collaboration with patient organizations and encourage them to take the role of scientific liaison providing the translation of research in medical practice

17. Coordinate and stimulate close and continuous collaboration through all AHI Pipeline at national level, make necessary regulations to make transfers as seamless as possible yet safe for parties and individuals providing tools and frameworks that will stimulate and encourage wide usage of the results of collaborations within society in order to become foundations for further expansions.

18. Advise modification of university programmes to reflect industrial progress and new treatments and tools available to increase medical process efficiency and patient lifespan and wellbeing.

19. Enable empowerment and coordination on the central and regional level to build a framework for AHI pipeline collaboration through covering appropriate legislation and tools and encourage proactive co-creation of the culture of inclusive collaboration and engagements.

7   LIST OF ABBREVIATIONS

A4L	Alliance4Life
AHI	Academia – Hospital – Industry
AI	Artificial intelligence
CEE	Central and East European
CLE	Clinical learning environment
COI	Conflict of interest
EBM	Evidence based medicine
EEA	European Education Area
EHEA	European Higher Education Area
ERA	European Research Area
EU	European Union
HR	Human resources
IIT	Investigator initiated trials
IT	Information technology
PI	Principal investigator
R&D	Research and development
PO	Patient organization
WP	Work package

8 APPENDIX I

Data based on a three-point Likert scale encompassing all 9 partner institutions contributing to the questionnaire, expressed as category total scores and institution-related total scores.

Institutional data for the preparation of a White Paper on Combining Research, Teaching, and /or Medical Practice

Name of your institution	University Medical Centre Ljubljana and University of Ljubljana (UL)	Vilniaus universitetas (Vilnius University, VU)	Semmelweis University (SU)	Medical University - Sofia (MUS)	University of Tartu, Faculty of Medicine (UT)	University of Medicine and Pharmacy Carol Davila – Bucharest (UMFCD)	University Hospital Centre and University of Zagreb School of Medicine, Zagreb (UZSM)	ST. ANNE´S UNIVERSITY HOSPITAL BRNO – International Clinical Research Center (FNUSA-ICRC)	Medical University of Lodz (MUL)	Total score
Likert 0-3 Administrative position (more points – higher administrative independence)	3	2	1	2	2	2	2(	2	3	**19/27**
Likert 0-3 Relationship with State/Ministry (more points – higher independence)	2	2	2	1	2	2	3	2	2	**18/27**
Likert 0-3 Employme	1	3	1	1	2	2	1	2	2	**15/27**

nt (more points – more independence for faculty)										
Likert 0-3 Salary (more points, higher income)	1	2	1	1	1	1	1	2	3	**13/27**
Likert 0-3 Protected time for research (higer score, more time)	1	2	1	2	1	1	1	1	1	**11/27**
Likert 0-3 Protected time for teaching (higer score, more time)	2	1	1	2	1	2	1	1	1	**12/27**
Likert 0-3 Collaboration (higher score – more collaboration)	1	1	2	2	2	1	1	2	2	**14/27**
Likert 0-3 Relations Hospital - University (higher score – more collaboration)	1	2	2	2	2	1	1	1	1	**13/27**
Likert 0-3 PhD/Residents (more	1	3	2	2	2	1	1	2	1	**15/27**

points, better position)										
Likert 0-3 Integration (more points, more integration)	3	3	1	1	2	1	1	1	2	**15/27**
Likert 0-3 Research Office (more points, better collaborati on)	2	2	3	1	1	1	1	2	1	**14/27**
Likert 0-3 Mobility (more points, more mobility)	1	2	2	1	1	1	1	1	2	**12/27**
Total Likert Independe nce Score	**19/36**	**25/36**	**19/36**	**18/36**	**19/36**	**16/36**	**15/36**	**19/36**	**21/36**	

APPENDIX II

Data presented as linear graphs, displaying a three-point Likert scale, highlighting questionnaire categories.

| Name of your institution	University of Ljubljana (UL)	Vilniaus university (VU)	Semmelweis University (SU)	Medical University - Sofia (MUS)	University of Tartu, Faculty of Medicine (UT)	University of Medicine and Pharmacy Carol Davila - UMFCD	University of Zagreb, Croatia School of Medicine, (UZSM)	ST. ANNE´S UNIVERSITY HOSPITAL BRNO – International Clinical Research Center (FNUSA ICRC)	Medical University of Lodz (MUL)	Total score out of 29
Likert 0-3 Administrative position (more points – higher administrative independence)	3	2	1	2	2	2	2	2	3	19
Likert 0-3 Relationship with State/Ministry (more points – higher independence)	2	2	2	1	2	2	3	2	2	18
Likert 0-3 Employment (more points – more independence for faculty)	1	1	1	2	2	1	1	2	2	15
Likert 0-3 Salary (more points, higher income)	1	2	1	1	1	1	1	2	3	13
Likert 0-3 Protected time for research (higer score, more time)	1	1	1	2	1	1	1	1	1	12
Likert 0-3 Protected time for teaching (higer score, more time)	2	1	1	2	1	2	1	1	1	12
Likert 0-3 Collaboration (higher score – more collaboration)	1	1	2	2	2	1	1	2	2	14
Likert 0-3 Relations Hospital - University (higher score – more collaboration)	1	2	2	2	2	1	1	1	1	13
Likert 0-3 PhD/Residents (more points, better position)	1	2	2	2	2	1	1	2	1	15
Likert 0-3 Integration (more points, more integration)	3	3	1	1	2	1	1	1	2	15
Likert 0-3 Research Office (more points, better collaboration)	2	2	3	1	1	1	1	2	1	14
Likert 0-3 Mobility (more points, more mobility)	1	2	2	1	1	1	1	1	2	12
Total Likert Independence Score out of 36	19	25	19	18	19	16	15	19	21	

Likert 0-3 Administrative position (more points – higher administrative independence)
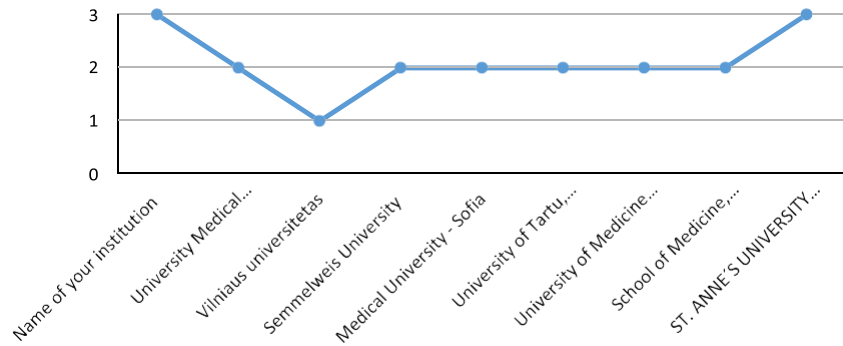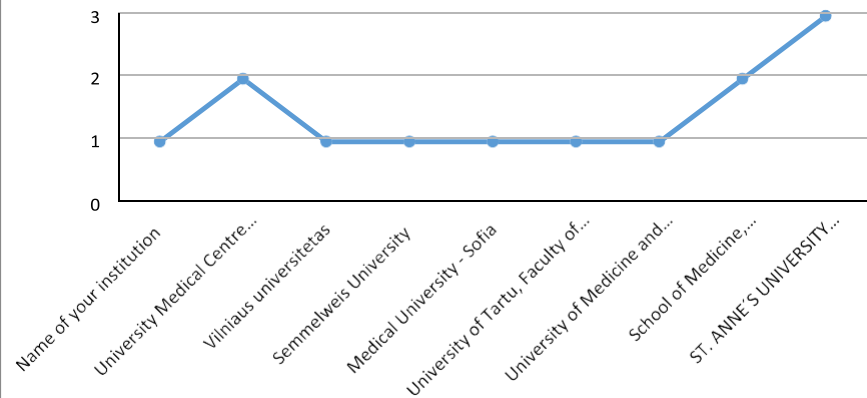

Likert 0-3 Relationship with State/Ministry (more points – higher independence)
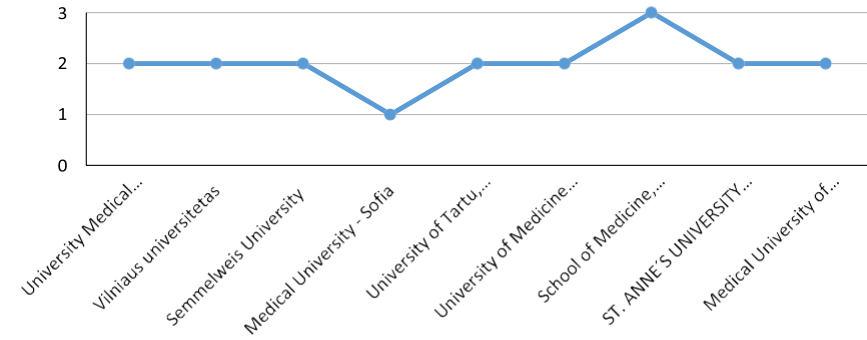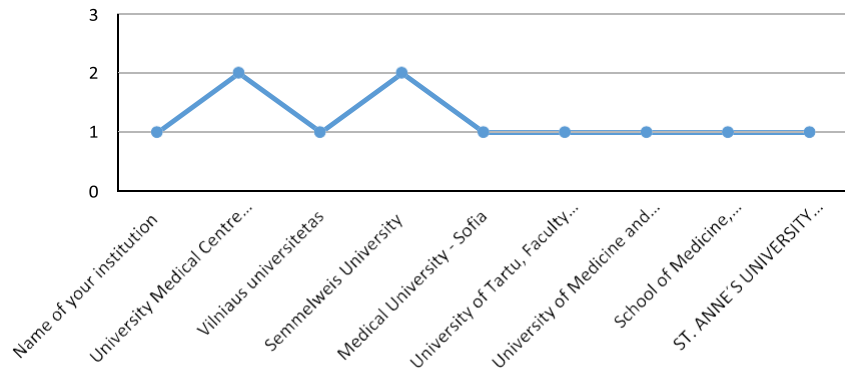

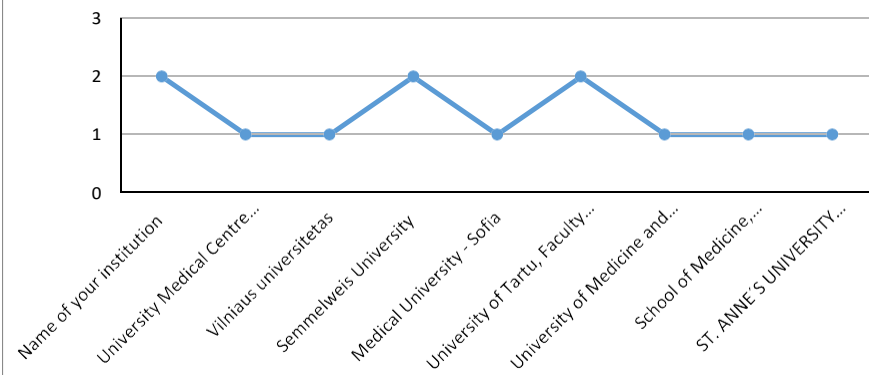Likert 0-3 Employment (more points – more independence for faculty)
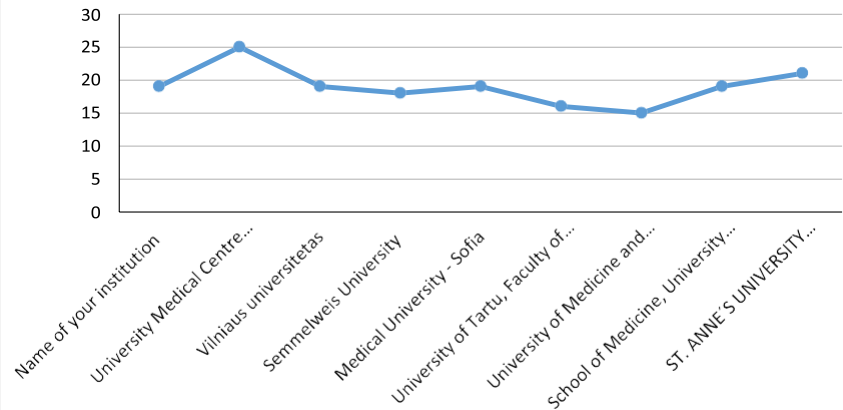
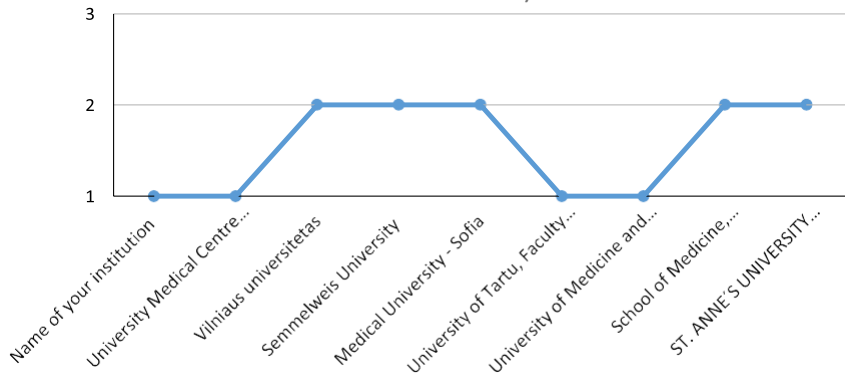Likert 0-3 Salary (more points, higher income)

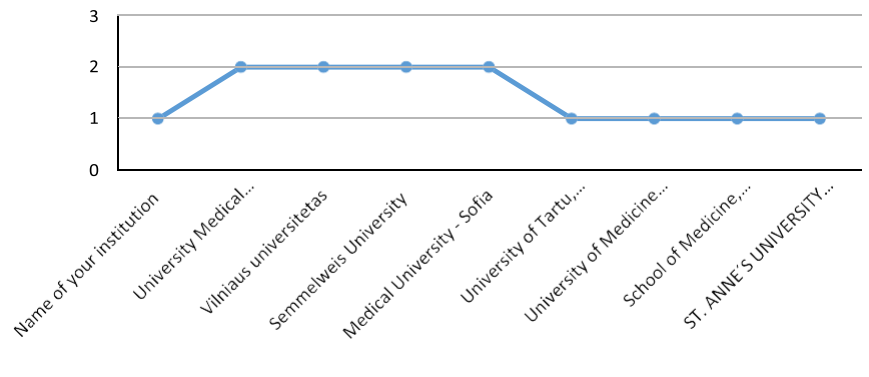Likert 0-3 Protected time for research (higer score, more time)

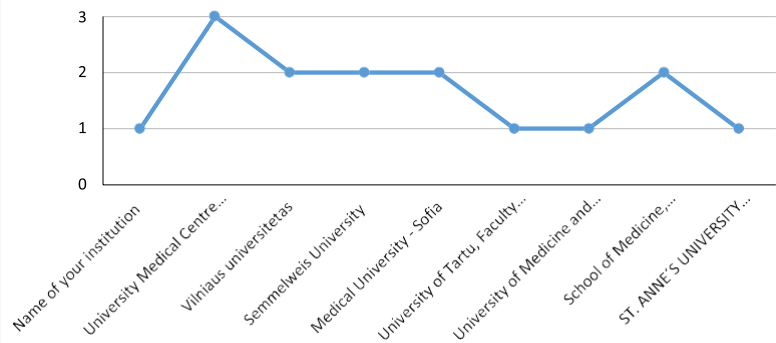Likert 0-3 Protected time for teaching (higer score, more time)

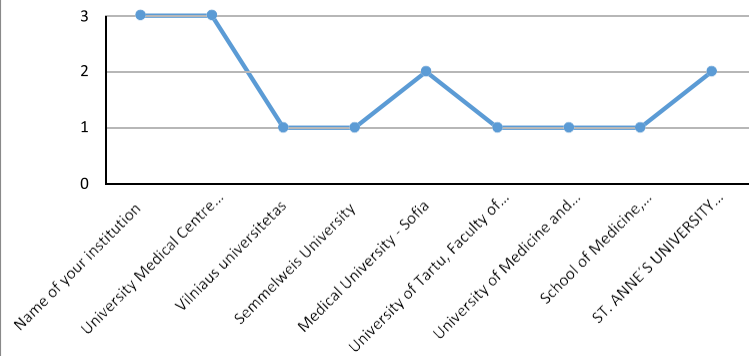Likert 0-3 Collaboration (higher score – more collaboration)

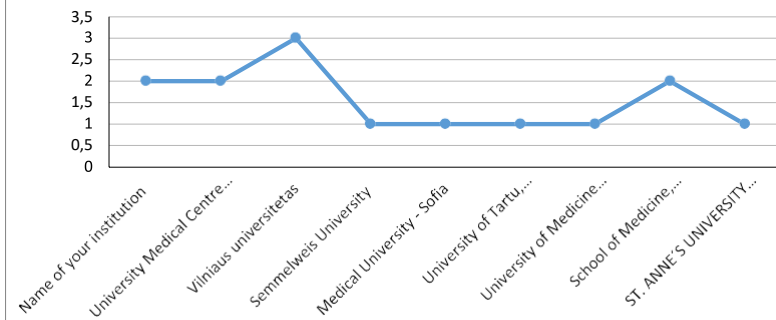Likert 0-3 Relations Hospital - University (higher score – more collaboration)

Likert 0-3 PhD/Residents (more points, better position)

Likert 0-3 Integration (more points, more integration)

Likert 0-3 Research Office (more points, better collaboration)

Likert 0-3 Mobility (more points, more mobility)