CURATIO INTERNATIONAL FOUNDATION

30 Years for Better Health Systems

The Informatics and Data Science for Public Health: Sustainment Plan for Skilled Labor Force Development

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Disclaimer

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Acronyms

ANACEC	National Agency for Quality Assurance in Education and Research, Moldova
CIF	Curatio International Foundation
CPD	Continuous Professional Development
EECA	Eastern Europe and Central Asia
EHEA	European Higher Education Area
EQAR	European Quality Assurance Register for Higher Education
FGD	Focus Group Discussions
GDP	Gross Domestic Product
HEI	Higher Educational Institution
HR	Human Resources
I-LEAD	Inter-Governmental Learning Exchange to Advance Data-Driven Decision – Making
I4L	Informatics for Leaders
IAAR	Independent Agency for Accreditation and Rating
ICT	Information and Communication Technologies
IDASH	Informatics and Data Science for Health
IRB	Institutional Review Board
ISCED	International Standard Classification of Education
IT	Information Technology
KII	Key Informant Interviews
MPH	Master of Public Health
NCEQE	National Agencies National Center for Educational Quality Enhancement, Georgia
ToT	Training of Trainers
US CDC	The United States Centers for Disease Control and Prevention
UW	The University of Washington
VET	Vocational Education Training
WHO-EURO	The World Health Organization European Regional Office

Introduction

The United States Centers for Disease Control and Prevention's (CDC) Eastern Europe and Central Asia (EECA) Regional Office, the World Health Organization European Regional Office (WHO-EURO), and the University of Washington (UW) have partnered to launch a fellowship in countries of EECA to improve **public health informatics**[1] and **data science in public health**[2]. For this purpose, UW has developed the *Informatics and Data Science for Health* (IDASH) fellowship program, which is an in-service training program designed to advance education in innovative and compelling data science methods and tools, increase public health informatics using multi-sectoral, multidisciplinary approaches tailored to country-specific needs, and build long-term, sustainable regional capacity.

While IDASH fellowship is important in improving regional capacity in critical areas, in-service training has a limited reach. It can be challenging to sustain the program without external funding or linkage to a continuous professional development scheme. Thus, the IDASH content must be embedded into pre-service settings within a degree-granting program(s) and/or integrated into continuous professional development (CPD) programs to sustainably respond to public health informatics and data science needs in the EECA region. In-service and pre-service training pathways for competency strengthening of the individuals involved in public health should be designed to meet public health workforce needs and demands. Therefore, supporting EECA countries in establishing an enabling environment and clear pathways encompassing policy, legislative/regulatory changes, domestic and donor resource mobilization, and developing relevant and sustainable training programs is vital.

To understand what sustainment pathways for the IDASH program might be, UW contracted Curatio International Foundation to evaluate the context in three countries (Georgia, Kazakhstan, and Moldova)[3].

To operationalize the term "**sustainment pathways,"** the authors of the report used the following approach – the pathways should identify the steps required over the short, medium, and long term to reach the ultimate objective, i.e., local/national educational institutions in each jurisdiction deliver pre-service and/or in-service training on public health informatics and data science in public health without dependency on external (donor) funding and/or extensive externally funded technical support. Therefore, sustainment pathways detailed in this report elaborate on steps required in each jurisdiction to reach sustainability over a defined time in the future.

This document provides the results of this evaluation, which are organized into three distinct sections. The first section briefly describes the methodology used for this assignment; the

[1] Public health informatics is an interdisciplinary field that combines knowledge of public health, information technology, and data science to develop, apply, and manage information systems that enhance public health practices and outcomes. Magnuson, J. A., & Dixon, B. E. (Eds.). (2020). *Public Health Informatics and Information Systems* (3rd ed.). Springer. https://doi.org/10.1007/978-3-030-41215-9

[2] Data science practice in public health involves systematically applying data analysis, machine learning, and statistical methods to extract actionable insights from diverse health-related data sources. This practice aims to improve public health outcomes through data-driven decision-making, prediction of health trends, and development of targeted interventions. It encompasses collecting, processing, and analyzing large and complex datasets to address public health challenges, enhance disease surveillance, and inform policy development. Goldsmith, J., Sun, Y., Fried, L. P., Wing, J., Miller, G. W., & Berhane, K. (2021). The Emergence and Future of Public Health Data Science. *Public Health Reviews*, 42. https://doi.org/10.3389/phrs.2021.1604023

[3] Listed in alphabetical order

second section presents cross-country findings. The final section concludes with the proposal/recommendations for sustainment pathways, which the US CDC, UW, and, most importantly, country governments and stakeholders could consider.

Methodology

The study used a mixed-method approach comprising a desk review of documents available in the public domain, including legal, regulatory, and analytical reports, key informant interviews (KII), focus group discussions (FGD), validation and co-production workshop(s), and secondary quantitative data analysis, to derive findings and develop recommendations. After identifying the initial set of informants with the help of an internet search and pre-defined criteria, the study used the snowball sampling approach that helped identify and access KII respondents and FGD participants.[4] Respondents were identified and interviewed until no new meaningful information was acquired, i.e., saturation was achieved.

Initially, interviews were conducted online before the workshop in Tbilisi[5] and were followed by face-to-face KII and FGD during the country visits. On average, KIIs lasted 45-60 minutes and FGDs 80-100 minutes. When selecting respondents, researchers focused on representatives of public sector organizations, educational institutions, and the private sector (healthcare providers, insurance and software development/analytics companies). Preliminary findings emerging from initial desk research and online KIIs were presented and validated during the Tbilisi workshop on April 29-30, 2024, that brought together all three country participants - 23 individuals. After that, researchers conducted country visits to Moldova and Kazakhstan[6] during June-July 2024 to fill information gaps and conduct in-country KIIs and FGDs. In total, 111 documents and 147 individuals informed the results and contributed to the selection of solutions reflected in the recommendations section.

Initial desk research also informed the FGD and interview guides. The study methodology was submitted to the *Institutional Review Board* (IRB) of the Health Research Union in Tbilisi, Georgia, and obtained formal approval – Protocol # 2024-02 from March 11th, 2024.

To comprehensively evaluate the country context and organize the findings, the study used the framework detailed in Figure 1, which included looking at the overall country context, i.e., market factors influencing demand and supply for the trained labor force in these professions. The framework schematically reveals high-level elements for each of the three domains (market, supply, and demand), though more nuanced details are included in the findings section. Upon securing the written consent, interviews were audio recorded and transcribed verbatim. The written notes were produced where respondents did not consent to audio recording. Transcripts were coded using Nvivo (Release 1.7.2) ™ software, deductive and

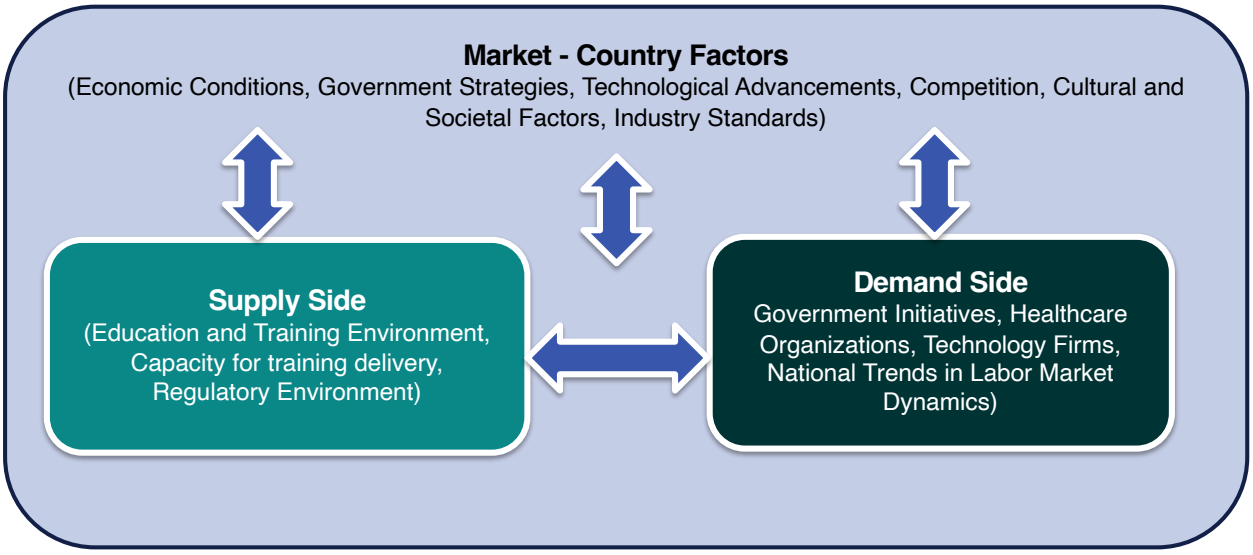
[4] For more details on respondent selection and methodology used for KIIs and FGDs, please refer to methodological note that is available in a separate document upon request.

[5] The workshop in Tbilisi in March 2024 brought together those individuals who were deemed to become champions in their respective countries to lead the development of the needed education programs.

[6] All researchers were Georgia based and there was no need to undertake country visit.

inductive approaches were used to develop coding conventions, and emerging themes were coded and organized using the framework presented in Figure 1. For robustness purposes, the first researchers independently coded the transcripts and notes, compared the coding, and alleviated differences, if any; after that, the findings were triangulated (a) across the information sources within the country and (b) across the countries to arrive at robust, reliable and generalizable conclusions. Finally, the solutions revealed in the sustainment pathways were first suggested by interviewees and then validated using a modified Delphi[7] approach, where 29 experts (including colleagues from the US) during the workshop (1st round) in Tbilisi and 20 experts in an online survey (2nd round) provided inputs for priority intervention selection, which was eventually triangulated with the findings of KII and FGDs and again presented, validated and disseminated during the September 23-24 workshop, 2024, which took place in Tbilisi. All findings and sustainment pathway-related recommendations formulated in this report were confirmed by workshop participants using quantitative validation methods with the help of the Slido™ survey tool incorporated in the workshop presentations[8].

Figure 1 Conceptual and Organizing Framework for Sustainment Plan Development



Findings

Following the framework depicted in Figure 1, this chapter begins by examining the overarching market factors within each country's context that influence both the supply and demand sides for the educated labor force. These factors can either facilitate or hinder the production and deployment of individuals acquiring new skills and knowledge in public health informatics and data science, playing a crucial role in shaping the workforce landscape.

[7] Nasa, P., Jain, R., & Juneja, D. (2021). Delphi methodology in healthcare research: How to decide its appropriateness. *World journal of methodology*, *11*(4), 116–129. https://doi.org/10.5662/wjm.v11.i4.116

[8] The workshop participants included representatives of the three countries covered in this report and individuals from Armenia, Azerbaijan, Kyrgyzstan, Ukraine and Uzbekistan. The study findings and recommendations strongly resonated with these country participants (based on the Slido survey), indicating the generalizability of the study results to the broader region of the Former Soviet Union.

Broader country-specific conditions that impact both sides of the labor market explore economic stability/prospects, government policies, and the maturity of the healthcare and technology sectors. These conditions are instrumental in determining whether the market can effectively absorb and utilize professionals with specialized public health informatics and data science skills.

Next, the chapter delves into the factors influencing the supply side, focusing on existing educational institutions and programs. These include the legal and regulatory frameworks governing academic program development and delivery, the capacity of local institutions to create and sustain degree programs or in-service training courses, and the availability of educators/faculty resources for high-quality education. We also consider the ability of these institutions to stay abreast of global trends and incorporate cutting-edge knowledge into their curricula, ensuring that graduates are well-equipped to meet the demands of the evolving job market.

The final chapter addresses demand-side factors by exploring the diverse array of potential employers for this trained workforce. These employers range from government organizations, which require data analysis for public health intervention planning, to healthcare establishments—whether public or private, depending on the country's health system structure—as well as medical insurance companies and technology firms in the private sector. We discuss the specific characteristics of the labor market for these professionals, including current employment trends and possible future expectations, and how these factors may influence the absorption of graduates into the workforce.

While the framework in Figure 1 uses arrows to represent schematically interactions within these three domains, the actual influences are far more complex, involving significant feedback loops and reciprocal dependencies. These complexities are carefully considered in the recommendations section of the report, where we provide strategic insights on how these interdependencies can be (best) managed to support the growth and sustainability of educational programs for workforce production in public health informatics and data science.

Market Factors

Although Georgia, Kazakhstan, and Moldova differ in population size, land area, and levels of economic development, all three countries have experienced significant economic growth over the past decade, as evidenced by their rising Gross Domestic Product (GDP). On the path of economic development, these **countries have strategically prioritized digital transformation as a key driver for further economic advancement**, recognizing the critical role that innovation ecosystems play in fostering knowledge-based economies. Their national strategies reflect a solid commitment to harnessing digital technologies to fuel economic growth and enhance societal well-being[9].

[9] Government of Georgia. (2023). Country Basic Data and Directions 2024-2027. https://www.mof.ge/en/4543
Government of the Republic of Moldova. (2023) *Republic of Moldova Digital Transformation Strategy 2023–2030. https://mded.gov.md/wp-content/uploads/2023/11/STD_EN.pdf*
Government of the Republic of Moldova. (2018). *Strategy for the Development of IT Industry and Ecosystem for Digital Innovation for 2018 – 2023. https://eufordigital.eu/wp-content/uploads/2020/01/2018-2023_strategie_aprobata_hg_904_24.09.2018.pdf*
Government of the Republic of Kazakhstan. (2017). State program "Digital Kazakhstan" 2017-2022. https://online.zakon.kz/Document/?doc_id=37168057&pos=5;-106#pos=5;-106

However, **the focus on digitalization has been more pronounced in the productive sectors of the economy than in the healthcare sector**, which has lagged in adopting advanced digital solutions. Despite the widespread acknowledgment of the importance of digital transformation, the development of human resources with digital skills specific to the health sector remains underemphasized in health sector strategies[10]. While Kazakhstan has made more visible state budget allocations to support digital transformation[11], including human resource development, these investments are still primarily directed toward the productive sectors rather than the social sphere, which includes healthcare.

This imbalance highlights a significant gap between the countries' visions for digital transformation in healthcare and the prioritization and investment in developing a skilled labor force equipped to lead these changes. **Without aligning digital health initiatives with strategic investments in workforce development, the potential for digital transformation to improve healthcare outcomes remains limited.**

Another **factor that negatively impacts the demand for a skilled labor force in the health sector is the fragmented nature of digital health and information systems**. In Georgia and Moldova, respondents frequently emphasized that the current digital systems are fragmented and have multiple siloed modules that lack interoperability. These systems often fail to generate usable data efficiently, challenging data analysis for decision-making and making it time-consuming and costly. Given the limited availability of resources in these countries, this situation further diminishes the demand for data-driven decisions, leading to a lower demand for skilled professionals in data analysis and public health informatics.

Moreover, while new approaches and methods for processing clinical and public health data are still poorly established, traditional statistical processing is better understood and predominantly applied for financial purposes, such as budget planning. Tools like Excel and SPSS are the most commonly used software for these tasks, reflecting a reliance on familiar, albeit limited, methodologies and tools.

In summary, the **findings indicate a disconnect between healthcare aspirations for digital transformation and the practical investments needed to build a capable and skilled workforce**. To bridge this gap, it is crucial for national strategies to integrate a stronger focus

[10] Government of Georgia. (2022). National Healthcare Strategy for 2022-2030. https://matsne.gov.ge/ka/document/view/5453716?publication=0
Government of the Republic of Moldova. (2023). National health strategy "Health 2030". https://leap.unep.org/en/countries/md/national-legislation/government-decree-no-387-validating-national-health-strategy#:~:text=The%20national%20health%20strategy%20(NHS,period%20until%20the%20year%202030.
Government of the Republic of Kazakhstan. (2022). Concept for the development of healthcare of the Republic of Kazakhstan until 2026. *https://adilet.zan.kz/rus/docs/P2200000945#z617*

[11] Parliament of Georgia. (2023). State Budget Priorities and Programs 2024. https://matsne.gov.ge/ka/document/view/6020661?publication=0
Government of the Republic of Kazakhstan. (2023). On the republican budget for 2024 – 2026. (2023). https://adilet.zan.kz/rus/docs/P2300001108
Government of the Republic of Moldova. (2023). The state budget for 2024. https://www.parlament.md/ProcesulLegislativ/Proiectedeactenormative/tabid/61/LegislativId/6767/language/ro-RO/Default.aspx

on digital skills development within the health sector, ensuring that the workforce is equipped to meet the demands of an increasingly digitalized world.

> *"In terms of clinical data, at the moment, in Moldova, there is no such thing as taking this data from somewhere and processing some information. Not at any level, not in any specialty." Respondent from Moldova*

> *"Descriptive [analysis]? Yes. Inside the hospital, we produce it frequently. [Interviewer] What about the predictive? No. Only XXX makes predictive forecasts [outside of the organization]. But we needed to have someone do it. But so far, no one can." Respondent from Moldova*

> *"We are far from a predictive analysis, although some organizations that work on international projects may have some specific interest, although I don't think there is any prospect for this at this stage," Respondent from Georgia.*

Out of three countries, Kazakhstan stood out as relatively the most advanced in this area (although, by far, the system is not perfect in Kazakhstan). The country made significant progress in establishing the Republican Center for Electronic Healthcare in 2013[12]. In partnership with various development partners, this center is responsible for developing digital health infrastructure that ensures higher interoperability across various digital modules. Nonetheless, Kazakhstan's capacity to apply new analytical approaches and inform decisions is also limited.

Overall, most respondents across all three countries demonstrated a **limited understanding of health informatics** and **data science in the context of public health**. Many equated data sciences with producing statistical tables and reports while associating public health informatics with information and communication technologies (ICT), software engineering, or cybernetics[13]. Public health informaticians were often mislabeled with titles such as developer, IT manager, programmer, or IT specialist; in some cases, their roles were described solely by their duties without any specific title.

The absence of precise terminology in local languages further complicates discussions, often necessitating lengthy descriptions and explanations of these specialties. Among the two terms, **"data science" resonates more** effectively with stakeholders, likely because the role of "*Doctor Statistician*" was established during the Soviet era, making concepts of analytics and statistics more familiar. To address potential challenges in the development of public health informatics and data science, there is a need for standardized terminology and increased awareness, possibly supported by organizations like the WHO:

> *"Awareness [about public health informatics and data science for public health] is the first to be raised in this direction. They must understand the importance of these specialties. Today, it is less understood." Respondent from Georgia*

> *"There is generally a lack of knowledge. To tell the truth, they don't know much about that topic [about public health informatics and data science for public health], nor do*

[12] the Republican Center for Electronic Healthcare, Kazakhstan https://rcez.kz/aboutcompany

[13] Cybernetics, widely used in the Soviet Union, is an interdisciplinary science that studies the general laws of receiving, storing, transforming, and transmitting information in complex control systems, whether they are machines, living organisms, or society.

they have a vision of how it should happen and what should happen [to develop a skilled labor force]." Respondent from Georgia

"There should be a clear understanding of the profession [public health informatics and data science for public health]." Respondent from Kazakhstan

Supply Factors

Higher educational intuitions are well-represented in all countries, with 54 (19 state and 35 private) in Georgia or 1.4 establishments per 100,000 population, 119 (11 National, 29 State, 14 non-civil, 1 autonomic, 1 international, 16 Joint Stock Companies and 47 Private) or 0.59 per 100,000 population in Kazakhstan and 21 (13 public institutions and 8 private) in Moldova or 0.7 per 100,000. Furthermore, all countries have accredited undergraduate and graduate education programs in public health and informatics/data science. However, doctoral programs in public health are only offered in Georgia and Kazakhstan (see Table 1 for more details).

Table 1 Accredited Programs in Public Health and Informatics/Data Science

Accredited Programs in Public Health	**Bachelor**	**Master**	**PhD**
Georgia	6	19	4
Moldova	1	1	0
Kazakhstan	7	15	10
Accredited Programs in Informatics/Data Science	**Bachelor**	**Master**	**PhD**
Georgia	17 – in Informatics and Information systems, 20 – Computer Science, 1 – Data Sciences	12 in Informatics and Information Technologies, 7 in Computer Sciences; 1 in Data Science/Data Analysis	3 - in Informatics; 2 - in Computer Science
Moldova	16 Programs in Information Technologies	6 Programs in Information Technologies	3- Computer Science, 3 - in Information Technologies
Kazakhstan	187 – in Informatics and Information systems	35 in Informatics (1 – in English); 4 in Data Science/Data Analysis	12 - in Informatics; 2 - in Data Science/Big Data Analysis

All three countries participate in the Bologna Process[14], an initiative launched in 1999 to reform and harmonize higher education across Europe[15]. The main goal is to create a European Higher Education Area (EHEA) that enhances mobility, employability, and international competitiveness. Key objectives of the Bologna process include:

- **Three-cycle system**: Higher education is organized into bachelor's, master's, and doctoral levels, making it easier to compare qualifications across countries.
- **Mutual recognition**: Degrees and study periods obtained in one country are recognized in others, promoting student and staff mobility within the EHEA.
- **Quality assurance**: A standardized system ensures the quality and relevance of education, aiding the international recognition of qualifications.

[14] https://ehea.info/page-full_members (Accessed on August 22, 2024)
[15] https://ehea.info/page-ministerial-conference-bologna-1999 (Accessed on August 22, 2024)

Therefore, a broader educational environment, with Bologna processes in place, offers a conducive context in all three countries, although other shortcomings will be discussed later.

Pre-Service Training Programs

The Bologna process mandates that all educational institutions obtain accreditation to conduct academic activities and issue state-recognized diplomas. Only accredited entities have the authority to:

- Develop field-specific benchmark statements, setting the core requirements for academic programs and the minimum competencies for graduates.
- Design curricula and academic programs.
- Participate in international programs and confer joint or double degrees.

Following the Bologna process, all countries standardized the delivery of educational programs, specifying the required credit hours for different degrees and establishing minimum qualifications for faculty, including the necessity for a certain number of faculty members to hold doctoral degrees. They also dictate program content requirements. While these standards are largely uniform across countries, there are some country-specific variations. However, these variations are of minor relevance here, as local educational institutions that will be involved in developing programs for public health informatics and data science for public health are already well-versed in these standards and are ideally positioned to lead these initiatives.

Accreditation in Georgia and Kazakhstan is required for new and already operatic programs, while in Moldova, it is necessary even for programs that already have graduates. In Georgia and Moldova, the principal accrediting bodies for programs are the National Agencies National Center for Educational Quality Enhancement (NCEQE) and National Agency for Quality Assurance in Education and Research (ANACEC)[16], respectively, while in Kazakhstan, 12 different agencies are entrusted accreditation rights[17]. Also, all countries have procedures for joint/double/dual degree accreditation and recognize foreign accredited programs when transferred into the National Educational System. All countries have a *National Qualifications Framework* and *National Classifier of Qualifications*. These documents regulate the degree awarding for undergraduate and graduate programs. The degree awarded by completing the new program should be in the *National Classifier of Qualification*.

To avoid lengthy and bureaucratic procedures for new program accreditation and additional registration (in the case of Kazakhstan), KIIs have suggested modifying existing Master Programs in Public Health instead of developing new ones. For this, the following steps would be required: subjects in advanced data science and/or informatics (with relevant prerequisites) can be added to the existing programs as electives or compulsory modules/concentrations. Relevant learning outcomes should be described and added to the existing program's learning outcomes. The updated learning outcomes and the revised program must be shared with an accrediting body (and the National Registry of Educational Programs in Kazakhstan).

[16] Both agencies are members of European Association for Quality Assurance in Higher Education (ENQA)

[17] While twelve agencies are allowed to accredit the educational programs Non-profit institution "Independent Agency for Accreditation and Rating" (IAAR) has the highest market share in Kazakhstan.

Table 2 Accreditation Fees, Timelines and Rules for Pre-Service Training Programs

	Georgia	Kazakhstan	Moldova
Fee	Approx. 4500 USD	15000 USD	From 1500 USD
Maximum period from application to decision	6 months	6 months	6 months
Validity of accreditation license	7 years	3-5 years	5 years
Cluster accreditation possibility[18]	Yes	Yes	No
Allowed teaching formats for master level	Only face-to-face but new regulations are prepared for hybrid programs in public health	Only face-to-face	Face-to-face. In absentia. Remote-online
Maximum term of recognition procedure of foreign accredited programs	60 days	Up to 3 months	60 days
Register of Programs	European Quality Assurance Register for Higher Education (EQAR)[19]	National Educational Register[20]	EQAR

Requirements for master's degree programs

Graduate degree programs across these countries share similar requirements, with some differences outlined below. Georgia and Kazakhstan require a two-year full degree program (120 ECTS) culminating in a mandatory master's thesis. In Kazakhstan, 120 ECTS programs include a pedagogical component to prepare students for a teaching career. Additionally, Kazakhstan offers a one-year Professional Master's Degree program (permitted in healthcare). While graduates of this program are not initially eligible to teach, they can pursue additional pedagogical training after graduation to obtain a full master's degree.

In Moldova, graduate programs offer flexible duration options: 1.5 years (90 ECTS) or 2 years (120 ECTS), depending on the volume of the completed bachelor's program (240 or 180 ECTS, respectively). The programs are categorized into three types: **in-depth programs**, which focus on developing specialized competencies in the field studied during the first step of education; **interdisciplinary or multidisciplinary** programs, which aim to cultivate overlapping competencies across two or more professional training areas; and **complementary programs**, which enhance and expand the competencies acquired during the bachelor's program to increase professional opportunities in the labor market.

Unfortunately, none of the countries currently offer courses (or degrees) in public health informatics and data science for public health. Neither of these professions/occupations is

[18] Cluster accreditation of educational programs is a specific approach to accrediting multiple academic programs simultaneously, usually within a related field or discipline allowing accrediting bodies to evaluate several programs at once, streamlining the process and ensuring that programs within a similar cluster meet quality standards effectively and efficiently.

[19] https://www.eqar.eu/register/agencies/agency/?id=59 (Accessed August 26, 2024)

[20] https://enic-kazakhstan.edu.kz/ru/registry_education_programs - Program information should be renewed annually. If for 3 consecutive years no students is admitted to the program it gets removed from the national Register

part of the current *National Classifier of Qualifications* based on the *International Standard Classification of Education* (ISCED), which governs educational degree awards. ISCED, being a broader and general framework, does not typically have specific codes for niche fields such as Public Health Informatics or Data Science in Public Health. Both are specialized areas within public health and informatics and would likely fall under broader ISCED categories related to health or information technology (IT). Institutions may use detailed internal classifications for specific educational programs that align with these broader ISCED categories. However, a particular ISCED code applicable to Public Health Informatics and Data Science in Public Health seems necessary for statistical, educational policy, or curriculum development purposes.

Thus, ISCED provides spaces for interdisciplinary fields that could be used to develop relevant codes for these professions. Countries have not done so and cannot award degrees for this specialization. All countries have regulated procedures for improving classifiers that suggest adding new ones. Thus, before such codes are developed and added to the national classification, which is well regulated but with a lengthy process in each country and involves multiple players from educational, science, health, economic, and labor sectors, an alternative solution could be to use codes for awarded degrees that exist in the National Qualifications' Classifier either from public health or from informatics and data science.

- **Health and Welfare** (Broad field 09): This category encompasses all health-related fields, including public health. Public Health Informatics would be grouped here as it pertains directly to health sciences and public health practice.
- **Information and Communication Technologies** (Broad field 06): Given the informatics and data management aspect of Public Health Informatics, this field might also be relevant, especially if the program is heavily focused on the technological or informatics aspects.
- **Natural Sciences, Mathematics and Statistics** (Broad field 05): This field could apply to aspects specifically related to Data Science for Public Health, which may include extensive use of statistics and mathematical modeling.

In summary, the lack of specific codes for qualifications/occupations in national classifications poses significant challenges for developing pre-service programs. This issue is compounded by lengthy bureaucratic procedures required to add new qualifications or occupations to the national classification, which can take twelve to eighteen months. In Kazakhstan, government recognition and inclusion in the National Register of Programs are essential for securing state funding in addition to accreditation. However, information technology programs face less regulation than those in the health sector, including public health. Therefore, as a practical and immediate solution, it was suggested that the existing Master of Public Health (MPH) programs be modified by incorporating additional public health informatics and data science modules. This approach offers a more straightforward path to integrating these training pieces at the pre-service level, ahead of other regulatory adjustments noted above.

In-service training programs

Vocational Education and Training (VET) programs are permitted and regulated in all countries, and state bodies issue certificates of completion for training or retraining programs. These programs include diverse modalities such as certificate and advanced courses (depending on credit requirements). In-service programs can also be carried out in the form of short courses and workshops, detailed in Table 3.

Table 3 Permitted Vocational Education Training

Georgia	Kazakhstan	Moldova
Vocational Education Training (no credit requirements defined)	Certification courses (min. 10 credits)	Improvement/specialization programs (3-30 credits)
Vocational Education Training (no credit requirements defined)	Advanced training programs (2-9 credits)	Professional re-training programs (10-30 credits) Partial qualification programs – micro-qualifications (5-30 credits)
Short Certificate Courses	Master Classes/ Workshops	Certificate Courses

As Table 4 reveals, all countries require accreditation or registration of professional training/re-training programs. The certificate of completion of these programs is issued by government bodies, which have established procedures for this purpose. An essential requirement for such programs is alignment with the National Classification of Occupations, referred to differently in various countries. Short certificate courses, master classes, and workshops are typically less regulated and fall under the category of informal professional education. Employers and regulatory bodies recognize these forms of education as evidence of specialization or qualification in specific, narrow fields or skills.

Table 4 Accreditation requirements for VET programs

	Georgia	Kazakhstan	Moldova
Fee	Approx. 400 USD	Approx. 250 USD	From 3000 USD
Maximum period from application to registration	90 days	Up to 6 months	Up to 6 months
Validity of license	3 years	3 years	5 years (report every 6 months)
Final approval by	Council of Professional Development	Republican Educational Methodical Council	Management Board of the National Agency for Quality Assurance in Education and Research
Classification of Occupations	National Qualifications framework	National Classification of Occupations	National Register of Professional Qualifications – RNCP CORM 006-2021
Register of Programs	https://vet.ge/ge/programs/r-219 and https://vet.emis.ge/#/training-programs	http://kazmc.kz/index.php/ru/deyatel-nost/katalog-programm	www.ipt.md

In all three countries, national occupation classifications are harmonized with the **International Standard Classification of Occupations 2008** (ISCO-08)[21], and occupations are classified by level of specialization, reflecting the specifics of the country's economy. Governments use national classifications to develop and evaluate employment policies, educational programs, and vocational training systems. It helps policymakers identify skill gaps, forecast labor demand, and design interventions to improve workforce outcomes. The national classifications are often used to design vocational training and technical education programs that correspond to the needs of specific occupations. This alignment helps ensure that graduates possess the relevant skills required by employers in various industries. Therefore, the learning outcomes considered under VET can be related to levels 2nd /3rd /4th /5th of the National Qualifications Frameworks. National classification based on ISCO-08 facilitates the recognition of qualifications and skills across countries, supporting the international mobility of students and workers. Educational systems use it to ensure that their programs meet international standards, which is essential for students who may seek employment abroad.

ISCO-08 and, therefore, **national classifications do not have specific codes exclusively for "data science in public health" or "public health informatics."** However, these roles can be associated with broader occupational categories within ISCO-08 that reflect the general nature of the work. Below are some relevant codes that may encompass these fields and potentially could be used for in-service training program development:

For Data Science in Public Health: 2112 – Statisticians - this category includes professionals who apply statistical theories and techniques to gather, analyze, and interpret quantitative data. Data scientists in public health could fall under this category, especially if their work involves statistical analysis of health-related data. **2519 - Software and Applications Developers and Analysts Not Elsewhere Classified-** data scientists focusing more on developing algorithms, models, and software tools for analyzing public health data might be classified here. This category includes various data science roles, such as machine learning specialists and data engineers. **2421 - Management and Organization Analysts** for data scientists involved in public health policy analysis or the management of health data systems, this code might apply. It includes professionals who analyze organizational structures, methods, and procedures, potentially including public health systems.

For Public Health Informatics: 2521 - Database Designers and Administrators Public health informaticians who design, develop, and manage databases specifically for public health data could be categorized here. This role involves the maintenance and administration of databases and information systems. **2511 - Systems Analysts** – this category includes professionals who analyze and design IT systems, which could involve public health informatics systems designed to manage and analyze health data. **2269 - Health Professionals Not Elsewhere Classified** public health informatics specialists with a strong focus on health data and systems might fall under this broader category of health professionals. This is a more general classification that could encompass a range of public health informatics activities. **2422 - Policy Administration Professionals -** public health informatics professionals involved

[21] ILO 2018. https://www.ilo.org/resource/conference-paper/international-standard-classification-occupations-2008-isco-08 (Accessed August 27, 2024)

in the administration and policy-making aspects of health informatics systems might be classified under this code, especially if their work influences public health policies and strategies.

Developed countries with educational programs in data science and public health informatics often rely on existing occupational classification systems like ISCO-08, which lack specific codes for these emerging fields. Instead, professionals in these areas are classified under broader categories such as statistics, health informatics, and management by adding the code. Educational programs in these countries adapt curricula to address this gap, equipping graduates with the skills needed for the evolving workforce. For instance, the UK uses the Standard Occupational Classification (SOC) system, similar to ISCO-08 but tailored to the UK context[22], where roles in public health informatics are classified under broader categories like "Statisticians" or "Health Informatics Specialists[23]." Similarly, in Canada, data science and informatics roles in public health are categorized under "Health Informatics Specialists"[23] or "Biostatisticians."[24] Universities in the United States offer specialized public health informatics and data science programs. At the same time, the U.S. Bureau of Labor Statistics classifies these professionals under general categories like "Health Informatics Specialists"[23] or "Statisticians." [25] Although these roles are not explicitly labeled as "data scientists in public health," they are increasingly recognized within these broader classifications.

Thus, countries could either use the broad code for classifying these professions or add a new occupation to the national classification, as was done by noted developed countries. Adding a new code involves initiation, review by relevant ministries, and final approval by the Ministry of Labor. For example, the Industry Council for Professional Qualifications in Healthcare (approved in 2023), part of the Ministry of Health in Kazakhstan, can initiate changes in the National Classifier of Occupations and develop a Benchmark Statement and Professional Competencies for these professions.

Continuous Professional Development Requirements

Kazakhstan and Moldova have made more significant strides than Georgia in implementing continuous professional development (CPD) for healthcare professionals. In both countries, CPD is mandatory for healthcare workers. Starting in 2023, Kazakhstan expanded this requirement to include Public Health specialists/managers as well.

In Kazakhstan, healthcare professionals must be evaluated every three years based on CPD scores established by the government. Human resources departments and the heads of healthcare organizations are responsible for ensuring that CPD credits are awarded promptly. The Unified Catalogue of Continuing Education Programs in medical and pharmaceutical specialties offers around 300 programs. These programs undergo peer review by scientific and specialized experts and are approved by the Educational and Methodological Association in the relevant training fields. Most of these programs are government-funded and often are designed by the government requirement.

[22] https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc/soc2020/soc2020volume1structureanddescriptionsofunitgroups

[23] The code for Health Informatics Specialists is not available in the ISCO-08 but was added to the national classification.

[24] https://www.canada.ca/en/employment-social-development/services/noc.html

[25] https://www.bls.gov/soc/

In Moldova, CPD is mandatory only for top management in the health sector, with healthcare workers evaluated every five years based on CPD hours (a minimum of 200 hours, where 1 credit equals 1 hour). The catalog of continuing education programs in medical and pharmaceutical specialties includes more than 300 programs. These programs are peer-reviewed by field experts and approved by the Ministry of Health, with the majority funded by the government. School of Public Health Management, which is based at the 'Nicolae Testemitanu' State University of Medicine and Pharmacy of the Republic of Moldova, is the unique provider of continuous medical education services in the field of Public Health Management since 2020.

In contrast, Georgia currently lacks CPD requirements and regulations. Although the government is working towards introducing CPD requirements, no clear plans and timelines have been established yet.

In all three countries, entities eligible to provide formal CPD education include higher or postgraduate education institutions, national and scientific centers, research institutes, medical colleges with accredited clinical bases, university hospitals, and other accredited organizations. Kazakhstan has additional specific requirements: educational and/or scientific organizations must be accredited by recognized accreditation bodies, and their programs must be listed in the national register of academic programs. Moreover, the occupation must be included in the national classification of occupations, with benchmark statements and professional competencies clearly defined.

Recognition of micro-credentials

The EU Council Recommendation 2023/0100 (NLE) of 25 May 2022 calls on EU Member States to enhance workforce skills by promoting the development of micro-credentials. These credentials are vital for providing flexible, inclusive, and accessible learning opportunities, aligning with the European Commission's goals of eliminating barriers to education. The recommendation emphasizes the importance of education systems supporting diverse learning formats and innovative upskilling and reskilling strategies, particularly in non-formal education and vocational training.

The EU defines a micro-credential as a record of learning outcomes acquired through a small learning volume. These credentials equip learners with specific knowledge, skills, and competencies that address societal, personal, cultural, or labor market needs. They can be standalone or combined into larger qualifications (Source: Council of the EU, 2022)[26].

In May 2022, the European Commission formally recognized the potential of micro-credentials by adopting Recommendation 2023/0100 (NLE), which introduced a European approach to support lifelong learning and boost employability. This framework outlines the development, implementation, and recognition of micro-credentials across Europe, aiming to integrate them into education and training systems to increase flexibility and accessibility for learners.

The recognition of micro-credentials involves formal approval by a competent authority, allowing individuals to use these credentials for admission to education or training programs, credit transfer, or exemption from specific program requirements.

[26] Council of Europe. https://www.etf.europa.eu/sites/default/files/2023-05/Micro-Credential%20Guidelines%20Final%20Delivery.pdf

Since 2020, Georgia and Moldova, along with 47 other countries, have participated in the Bologna Process Implementation project, "MICROBOL – Credentials Linked to the Bologna Key Commitments" (https://microbol.microcredentials.eu/). Georgia has drafted recommendations and outlined future steps for implementing a system to recognize micro-credentials, though formal regulations for this process have yet to be issued.

Thus, when micro-credentialing evolves in these countries, the attractiveness of in-service training is expected to increase further compared to degree programs, and that could become an important demand driver.

Funding for Educational Programs

In all countries, pre-service accredited programs receive financial support from the government, though the specifics vary according to each country's policies.

In Kazakhstan, the Ministry of Education provides financial support through both social and merit-based fellowships for master's programs. Additionally, the Ministry determines the number of tuition-free places (State Order) for priority fields funded out of the state budget. The allocation of these places is specified in an order that details the number of vacancies at specific higher education institutions (HEIs). These institutions must be registered in the National Register and hold a good rating in the relevant field to qualify for these tuition-free places. Currently, IT programs are a priority over healthcare fields, and interdisciplinary programs have minimal chances of being included in the State Order.

In Georgia, the Ministry of Education provides social and merit-based fellowships for higher education programs. However, the budget allocation across different fields is uneven and depends on the Ministry's priorities. Over the past five years, healthcare master's students have received approximately three times less funding than natural sciences or engineering students. Unfortunately, not all training or re-training programs in Georgia are supported by the government. Programs that are in high demand or a priority according to national strategies after accreditation are registered with the National Skills Agency[27] and then will be fully or partially financed from the agency's budget.

In Moldova, public universities receive funding from the state budget. The number of government-funded places, known as "budget places", varies depending on the university's category and is announced annually. Local students enrolled in non-funded places pay a minimal tuition fee of up to 300 euros per year. Private universities, on the other hand, are self-funded, meaning they rely on tuition fees and other sources of income to operate. It should be noted that the Public Health Program in Moldova is offered only by one HEI. The state budget strongly supports Vocational Professional Education Programs registered by government bodies in different ways. However, the financial support depends on the field. Most health service providers have allocated a budget for CPD, but sometimes, the Government orders and finances Medical University programs directly.

In Kazakhstan, all entities operating in the healthcare sector are mandated to allocate at least 2% of their budget for continuous staff development. These funds are used to announce tenders for specific training programs through the state procurement system. However, there's a common practice where the Ministry of Health directly orders particular training programs and allocates additional funds for them. Despite this, mandatory CPD training are

[27] https://vet.emis.ge/?fbclid=IwY2xjawFEiWlleHRuA2FlbQIxMAABHWZPvZ66eTFo5OvGE8XL-ofOsfGH8SlC4h0-9akU8TTYjbDE122WeN4qYA_aem_-HVuLb7NkyClTp1895yNIQ#/training-programs

fully covered by employers to ensure staff pass their required certifications and maintain their professional competence. Failure to complete these mandatory training can result in the staff not passing their certifications.

Thus, while the system of funding CPD exists in all countries and could help support in-service educational programs, advocacy would be required to increase the importance of the proposed professions in the eyes of policy and decision-makers.

Capacity to Deliver Educational Programs

The teaching capacity in Georgia, Kazakhstan, and Moldova reflects common strengths and unique challenges across the three countries. All three nations have ongoing relevant research projects within their academic sectors, and each has begun to explore intersectoral collaboration between IT and healthcare, although at varying stages of development. Georgia and Kazakhstan are in the early phases of this collaboration, while Moldova's efforts remain weaker.

Each country has sufficient PhDs in Public Health, making it well-equipped to launch new programs in this field. Additionally, in all three countries, a PhD degree is not mandatory for teaching in IT-related fields such as data science or informatics, which could facilitate the development and delivery of such programs.

However, there are notable differences in their educational infrastructures. Georgia and Kazakhstan have multiple institutions that contribute to public health education. In contrast, Moldova has only one medical university offering medical education (including for public health). This may constrain its capacity to develop and deliver educational programs in data science for public health and public health informatics. Despite these differences, all three countries share a common potential for growth in data science for public health and public health informatics education, supported by their existing academic resources and evolving collaborations between sectors. However, without international partnerships and external support, advancing faculty capacity and developing teaching programs would be challenging.

Demand Factors

According to Key Informant Interviews (KIIs) across countries, respondents consistently reported a **distinction between the demand for data scientists** and **that for public health informaticians**. Most participants emphasized the necessity of employing data scientists as part of the regular workforce. While responses varied slightly by country—likely due to differing levels of awareness among respondents, as discussed earlier—there was unanimous agreement on the critical shortage of data scientists in the public health sector. However, respondents were unable to quantify the exact need for such professionals. **They recommended conducting market research to estimate better the required number of trained specialists for the sector over the coming years**.

In contrast, the demand for informaticians was acknowledged, but their role is often perceived as temporary, typically filled only to address specific needs. Another "misconception" about informaticians emerged when respondents indicated that public health knowledge is not essential for informaticians to perform their duties. However, only a few respondents held this view, indicating that the robustness of this finding is relatively low.

Currently, the employment market in the health sector is relatively small, likely due to a combination of several interrelated factors. One significant factor is the limited

understanding of the professions mentioned earlier and the value that data could afford. This results in low demand for data analysis and evidence production among policymakers and organizational leaders in the public and private sectors. This low demand is exacerbated by the weaknesses in digital health information systems, as previously discussed, which further hampers the ability to effectively leverage the insights from data. Furthermore, the small market size is also influenced by the small population sizes of countries like Georgia and Moldova, where the overall size of a health sector is naturally limited. This situation creates a challenging environment for the growth of data-driven health professions, as the combination of limited demand, underdeveloped health information systems, and small national populations constrains expansion opportunities.

To address these challenges, targeted efforts are needed to raise awareness about the importance of data science and public health informatics, improve digital health infrastructure, and foster a better understanding of these professions among key stakeholders. Such efforts could stimulate demand and expand the employment market for public health informaticians and data scientists.

Next, while respondents find it challenging to discuss the extent of employment opportunities for these specialists, they do **separate the job market into two broader segments:** (a) the first requiring relatively more trained individuals but with more generic or basic skills employed on a facility and sub-national level and (b) smaller group but with advanced data science and public health informatics skills employed on a policymaking or national level. Consequently, the educational sector (supply side) is expected to deliver variable programs at variable scales to respond to employer demands.

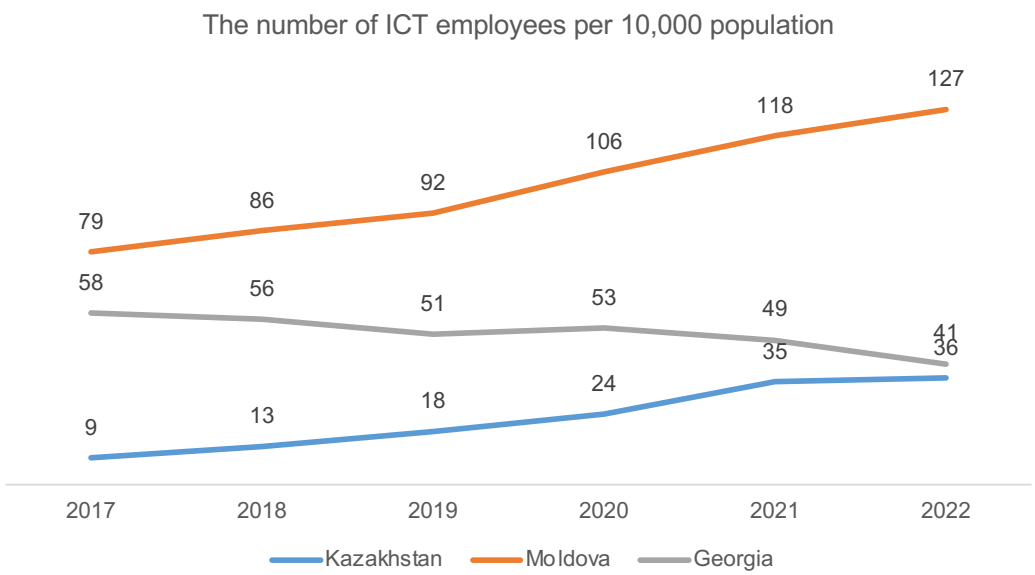
Furthermore, **employers demand flexible educational programs,** in contrast with what educational institutions want. Most employers in all three countries believe that skilled labor force production in these professions would require flexible and short certificate courses to retrain existing staff without detaching from employment for a long time. And employers believe a shorter training course would better meet their needs.

Labor market dynamics emerged as a potential risk to future sustainability, at least for some time. Firstly, in all countries, the digital transition of the economy is gaining pace, and the skilled labor supply is growing (see Figure). While Moldova has the highest supply, it is two times less than in the EU – 281.6 per 10,000 population[28], indicating a significant shortfall in the supply of skilled labor, which is even more critical in Kazakhstan and Georgia[29]. Consequently, the shortages of these specialists in various sectors of the economy are prominent, and it will take years to fill this skill gap. Therefore, it would take some time for the health sector to compete with other industries and attract talent.

[28] Eurostat, 2024 More people employed in ICT in the EU in 2023. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240524-2 (Last accessed August 3, 2024)

[29] The declining trend in Georgia is because many involved in ICT work online for foreign companies, and the National Statistical Office fails to capture and report these numbers.
European Training Foundation. (2021). NEW FORMS OF EMPLOYMENT IN THE EASTERN PARTNERSHIP COUNTRIES: PLATFORM WORK – GEORGIA. https://www.etf.europa.eu/sites/default/files/2021-06/platform_work_georgia_0.pdf

Figure 2 Employment dynamics in ICT sector



Source: National Statistical Offices

Moreover, individuals with data science and informatics skills tailored for public health possess highly transferable expertise that can be applied across various sectors. The earning potential between the health sector and other industries differs significantly, influencing career choices. As illustrated in Figure 3, which compares average monthly earnings in the ICT sector by ownership/employer type (on the left) and the health sector (on the right), there are notable disparities.

In Georgia and Moldova, the **private sector generally offers higher income potential**, whereas, in Kazakhstan, public sector employment remains competitive in both the ICT and health sectors. However, public institutions across all countries face limitations due to existing criteria-based salary policies—which restrict their ability to offer salaries above predetermined rates. In contrast, the private sector enjoys greater flexibility, allowing it to offer more competitive remuneration, exert stronger market power, and more effectively attract top talent.

The data in Figure 3 reveals that the **health sector in all three countries lags behind the ICT sector** in terms of salary offerings. This disparity, combined with the portability of skills possessed by public health informaticians and data scientists, significantly contributes to the migration of skilled professionals from the health sector to more lucrative opportunities in other fields.

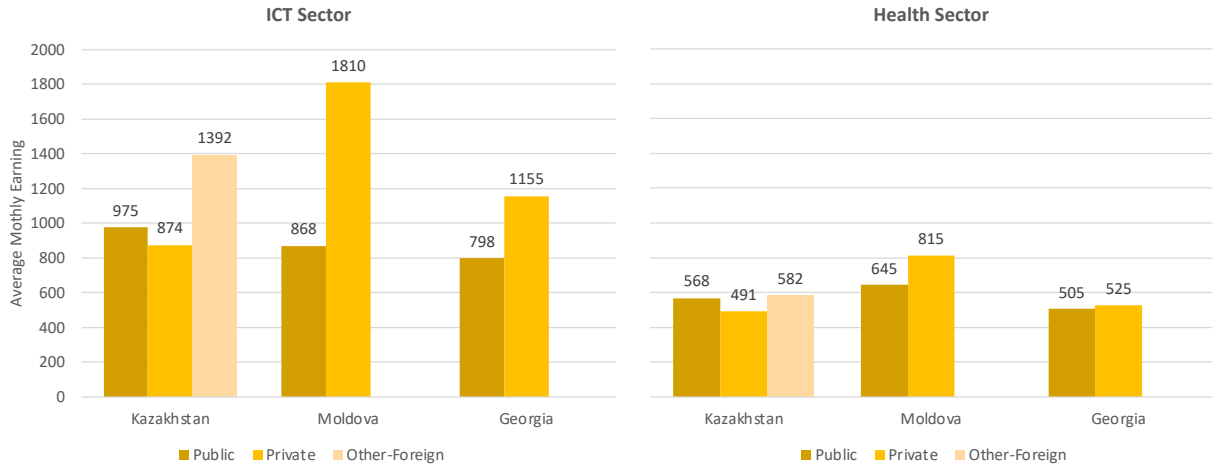
Consequently, most respondents view salary differentials as a significant barrier to advancing data science and public health informatics. The inability of the health sector to compete with other industries in terms of compensation undermines efforts to retain and attract the skilled workforce necessary to drive innovation and improve public health outcomes.

> *"Salary is not competitive. If we give them additional skills, if they learn to do modeling and use artificial intelligence, they will probably leave the job. Because they will find a higher salary [elsewhere]." Respondent from Kazakhstan*

"The big question is who will pay them or who will be able to pay them [trained staff]. Currently, we are fighting for every single IT guy, especially when talking about public institutions, because we are limited in how we pay. So, we have to find different projects to keep them [employed] because the private sector is giving them more money. So, the general idea is how to finance and pay them." Respondent From Moldova

"It is also difficult to interest them with the salary as other industries offer more competitive remuneration." Respondent From Georgia

Figure 3 Average Monthly Earnings in 2022 (current $US)



Source: National Statistical Offices

Lastly, the **salary disparity between domestic and international labor markets significantly impacts workforce retention**. In Kazakhstan, foreign companies consistently offer higher remuneration than domestic employers, as depicted in Figure . This trend is not unique to Kazakhstan; in Georgia, the rise of remote work opportunities with foreign companies has attracted many professionals in the ICT sector, a rapidly growing trend according to KIIs. Working remotely for international employers allows individuals to earn substantially more than they would in local markets.

The discussed salary differentials across economic sectors, between public and private establishments, and across countries highlight a significant challenge for these nations: retaining newly trained specialists with highly portable skills within the healthcare sector. The health sector's limited ability to offer competitive salaries, particularly when compared to more lucrative opportunities in other sectors or abroad, becomes a significant barrier to workforce retention.

Moreover, **the small size of the health sector employment market**, especially in Georgia and Moldova, offers limited career advancement opportunities for young specialists. This lack of career potential adds another layer of complexity to the wage-related issues. Young professionals, critical to the growth and innovation of the healthcare sector, may be more inclined to seek opportunities in larger, more dynamic markets where their skills are in higher demand and better compensated.

Together, these factors underscore the urgent need for strategies that can enhance the attractiveness of careers in public health informatics and data science for public health, whether through improved compensation packages, better career development opportunities, or policies that align public sector salaries more closely with those of the private and international markets. Without such measures, countries risk losing valuable talent to other sectors or foreign markets, thereby hindering the development and sustainability of their healthcare systems.

> *'The market [in healthcare] is not big, it is risky. If I were a business analyst, I could work everywhere; if I prepare for health care, I could only work for 20 companies, and 19 of them would sign me a contract that if I move to another company, I would have to pay the penalties for the rest of my life. I am already very constrained in the health [sector]. There may be demand [for my skills] in America and Europe, but there won't be much here. No matter what, you give a decent salary, there is no competition; it is difficult to move across health companies [in this market]." Respondent from Georgia*

> *"I would like to say that it's not the best option to obtain a master's degree and then work only in this field [healthcare]. This is not the best option. Because our country is small and there are few specialists in this field." Respondent from Moldova*

Given the demand-side challenges outlined above, **most respondents emphasized the need for clear and decisive government policies to stimulate demand** in the market for data scientists and public health informaticians. Specifically, they suggested that government policies establish a mandate requiring these specialists to be included in healthcare teams and define continuing professional development (CPD) requirements for these roles.

These recommendations stem from the lingering influence of Soviet healthcare systems, where government regulation played a dominant role, especially in the health sector. In these countries, the government exerts significant authority over health policy and setting workforce requirements. Therefore, **introducing regulatory mandates could effectively drive demand for these critical roles** by making their presence in healthcare settings a legal or policy requirement.

Moreover, by **specifying CPD requirements, governments could ensure that data scientists and public health informaticians not only enter the workforce but also maintain and enhance their skills** over time, keeping pace with advancements in technology and public health needs. This approach would not only help to fill current gaps but also build a sustainable pipeline of skilled professionals equipped to handle the evolving demands of public health.

In summary, to overcome the current barriers to demand, strategic government interventions are necessary. By leveraging their regulatory power, governments can play a pivotal role in fostering a robust market for data science and public health informatics, ultimately leading to improved health outcomes and more efficient healthcare systems.

> *"There should be a demand created for this [by the government]; if there is no mandate, [from the government] no one will bother hiring or training staff. That is one topic, and the other topic is awareness in general. Analyzing these numbers, how they are done, what they are used for, and their benefits is a hot topic. Now, there are so*

many things thrown at these medical institutions that something that is not demanded [by the government] naturally is not considered by employers." Respondent from Georgia

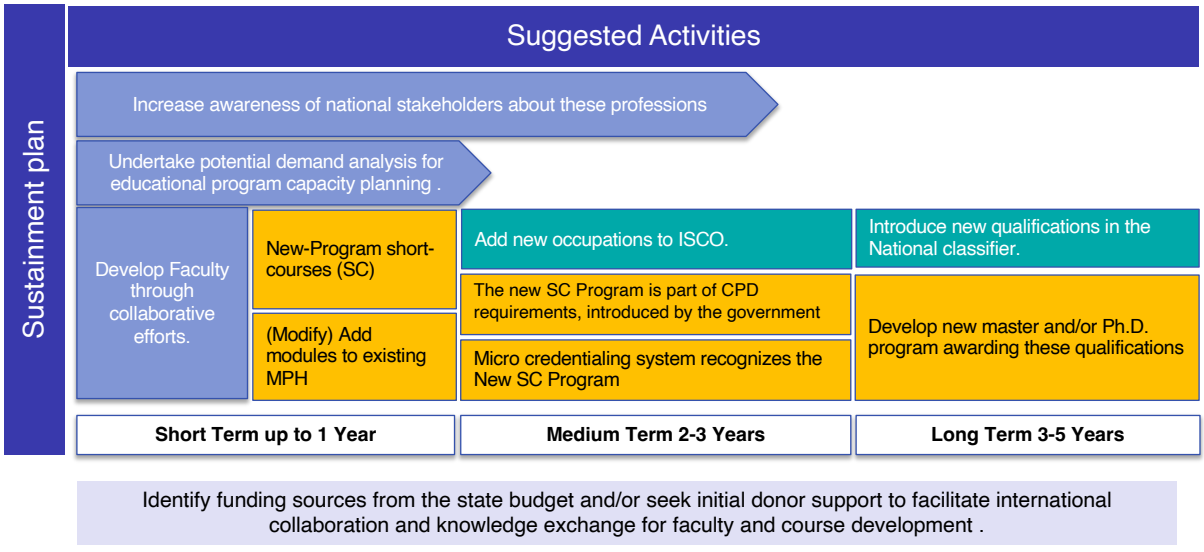
"To raise the image of these professions, there should be some other requirements [imposed by government]." Respondent from Moldova

Vision for Sustainment Pathways

The results from the desk review, key informant interviews (KIIs), and the Delphi survey informed the development of sustainment pathways for establishing and maintaining educational programs in data science, public health, and health informatics. These proposed activities, illustrated schematically in Figure 2 and elaborated upon in this chapter, have been categorized into three timeframes: short-term, medium-term, and long-term.

Given the current low awareness among national stakeholders regarding these professions and the potential value that data can offer to policymakers and facility managers, it is crucial to implement awareness-raising initiatives. These efforts aim to expand the number of individuals who recognize the importance of these professions and understand the value of data in decision-making. The U.S. CDC and WHO-EURO are already supporting regional events, such as Informatics for Leaders (I4L) and the Inter-Governmental Learning Exchange to Advance Data-Driven Decision-Making (I-LEAD), which contribute to raising awareness. However, these regional efforts must be supplemented by country-specific events, either independently or in partnership with other development organizations. Increased awareness is anticipated to drive demand for professionals in these fields, which, in turn, is expected to stimulate the development of relevant educational programs and support growth on the supply side of the labor market.

Figure 2 Sustainment Pathway



The absence of terminology in local languages to denote these professions is anticipated to pose a significant challenge during awareness-raising activities. WHO-EURO could assist in developing appropriate terms with precise definitions, which would not only support these activities but also aid in updating national classifications, as discussed later in this document and will have an impact beyond targeted countries.

Stakeholders have also emphasized the need for market research to effectively plan investments on the supply side, specifically in educational institutions. Such research would be instrumental in informing medium—to long-term strategies for building the necessary academic capacity and securing adequate government budget allocations. However, given the low awareness of these professions and the lack of specific terminology and codes in national classifications, conducting this research will be challenging. Nevertheless, creative and methodologically sound approaches can be identified and implemented to address these obstacles.

Before launching any locally delivered educational courses, it is crucial to enhance the capacity of local faculty. This can be achieved through various methods, such as including representatives from academia as trainees in the IDASH program (already being done for 2nd cohort of trainees), training of trainers (ToT) programs or by delivering training collaboratively with external and national faculty. Securing external funding for collaborative efforts with Western or regional partners, such as through the EU's ERASMUS+ program[30], which supports higher education institutions, could also be beneficial. ERASMUS+ aims to improve the quality of higher education, align it with labor market needs, and enhance skill levels through new educational programs. These funding opportunities have already been discussed with participating countries. Georgian and Kazakh HEIs are interested in partnering with European institutions offering educational programs in public health informatics and data science. However, there might be other funders who might be willing to support the establishment of such academic programs in the region.

While securing EU funding may take some time (at least a year or even two), the U.S. CDC, drawing on the IDASH experience and curriculum, could assist countries in developing short, modular courses. These courses would address employer demands for flexible educational programs that allow staff to gain new skills and knowledge without needing extended periods away from their jobs.

If market research indicates sufficient demand, HEIs could consider amending and modifying their master's programs in public health to include courses related to data science and informatics following the national regulations outlined earlier in the findings section. As previously noted, this would be relatively straightforward in all countries before any regulatory changes in national classifications governing new professions and specializations are introduced.

Our study identified several modifiable factors that could drive demand generation and growth in demand for data science for public health and public health informatics. These factors include (a) the implementation of continuing professional development requirements for specialists in these fields. In Kazakhstan, this implementation may be more straightforward, whereas in Georgia, the absence of formal CPD requirements could result in a longer timeline. Moldova falls somewhere in between these two scenarios. The introduction of formal CPD requirements will necessitate the inclusion of new professions and the assignment of appropriate codes (or the use of existing broad categories) within the ISCO-based national classifications. This step is also crucial to secure state budget funding for CPD programs. Additionally, to further stimulate demand for short courses, the development of a micro-credentialing system could allow individuals to accumulate credit hours over time by

[30] https://erasmus-plus.ec.europa.eu/opportunities/opportunities-for-organisations/cooperation-among-organisations-and-institutions/capacity-building-higher-education?facets__field_eac_tags=174

completing several short courses, ultimately leading to the attainment of an official degree diploma. It is estimated that achieving this goal may require investments over 2-3 years, along with external technical support to advance the process.

In the longer term, the focus should move to developing master's and doctoral programs within higher education institutions where a cadre of trained faculty with experience in teaching data science for public health and public health informatics already exists. This will also involve adding new qualifications to the national classification based on the International Standard Classification of Education, clearly defining national requirements for graduates, and ensuring that HEIs develop educational curricula and programs that comply with national legal and regulatory standards. These programs must also be properly accredited by national accreditation bodies, following the procedures outlined in the results section.

While the proposed sustainment pathway addresses many aspects of the labor markets in the countries discussed in this report, one critical market-specific factor must be emphasized: the portability of skills and the income differential between the public and private sectors, as well as between the health and non-health sectors, and across countries in the region. In the context of an unsaturated ITC labor market, as observed in these countries, these factors will likely draw talent away from the health and public sectors, creating significant retention challenges for employers. Although no mechanisms with proven effectiveness in addressing these retention challenges were identified, we want to highlight the importance of short courses and their corresponding production capacity. Short courses are better suited to meet immediate labor market demands than longer-term educational programs requiring greater financial and time investments. Consequently, the production capacity for short-term courses should be significantly higher than for degree programs. However, this fundamental assumption within the sustainment pathway must be rigorously evaluated during market research and eventually during the implementation of sustainment pathways.