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Challenges and opportunities of micro-credentials as a new form of certification in health science education—a discussion paper

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Abstract

Micro-credentials are an element of the European Skills Agenda 2020. This five-year plan aims to develop improved applied and broader work skills in response to system demands from employers, industry and communities. Within the labour market, employees increasingly want to obtain new skills-based qualifications in a relatively short period of time. Micro-credentials, as a form of lifelong learning, in the health care sector provide significant opportunities for upskilling the workforce in response to rapid changes in health care and service delivery. Moreover, micro-credentials have also been introduced in the context of undergraduate and postgraduate education within the process of accelerated digitalisation during the pandemic. However, despite its relevance, there is limited discussion about the implications and challenges of micro-credentials in the healthcare sciences. According to the findings that emerged from a review of policy documents and scientific papers, a reflective exercise has been conducted to debate the possibilities and challenges of emerging education based on micro-credentials within health care education and employment. Health care delivery is multidisciplinary and statutorily regulated to protect citizens. In such a complex sector, developing a micro-credential friendly ecosystem will require cooperation between various stakeholders if its potential is to be effectively realised.

Keywords Micro-credentials, Healthcare sciences, Education, Narrative review, Reflective practice

Introduction

Health care professionals (HCPs) are obliged to constantly improve their professional competencies to provide high-quality care. There are various forms of continuing professional development (CPD) applied in medical and health sciences education across Europe [1, 2]. The experience of the COVID-19 pandemic and fast digitalisation of higher and CPD education have accelerated the development and establishment of micro-credentials (MCs) to recognise and reward learning achievements as a strategy for expanding knowledge, skills and competencies in a flexible way that is targeted to personal and professional needs. Conceptually, MCs have been defined as

> *"A micro-credential is the record of the learning outcomes that a learner has acquired following small volume of learning. These learning outcomes have been assessed against transparent and clearly defined standards. Courses leading to micro-credentials are designed to provide the learner with specific*

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knowledge, skills and competences that respond to societal, personal, cultural or labour market needs. Micro-credentials are owned by the learner, can be shared and are portable. They may be standalone or combined into larger credentials. They are underpinned by quality assurance following agreed standards in the relevant sector or area of activity" [3].

However, despite its well-established definition and plurennial strategy, its developed structure and progressive affirmation, and the debate regarding its implications in higher education [4, 5], to date, there is limited discussion of MCs' significance and approaches in the field of health care sciences. Therefore, this paper aims to explore the possibilities and challenges of the newly emerging idea of micro-credentialing in the context of health care sciences.

The development of MCs

The idea of MCs first appeared as a part of the European Skills Agenda (ESA) in 2020 within a five-year plan that aims to develop increasingly better applied skills among workers within the European Union (EU) labour market [6]. One of the 12 flagship ESA initiatives was directed at supporting the quality and transparency of MCs [7]. In accordance with the European Pillar of the Social Rights Action Plan, MCs are considered innovative instruments that play a crucial role in supporting workers both in their job and changing professional pathways by promoting the creation of flexible learning routes [8].

In the Communication from the European Commission (EC) on achieving the European Education Area by 2025 (30 September 2020), the initial idea of MCs was deepened [9]. This stated that there should be a European Approach to MCs. Communication highlights the key role of higher education in supporting lifelong learning and reaching a more diverse group of learners [9]. This approach was further emphasised by the European High Education Area (EHEA) Ministers, who met in November 2020 [10].

Two years later, on the 16th June 2022, the Council of the European Union (EU) (the representative body of the governments of the Member States of the EU) adopted the Recommendation of a European approach to MCs for lifelong learning and employability. This identified three aims: (a) to empower people "to acquire the knowledge, skills and competencies they need to thrive in a changing labour market and society"; (b) to focus on the "preparedness of providers of MCs to enhance the flexibility of the learning offer"; and (c) to promote "inclusiveness and equal opportunities, contributing to the achievement of resilience, social fairness and prosperity for all" [11].

The Recommendation proposed a list of measures that might support the process of developing an appropriate policy infrastructure for micro-credentialing across EU Member States with the goal of strengthening the position of CPD through lifelong learning. Similar actions are being undertaken by other countries aiming at building micro-credentialing friendly ecosystems [12]. A "Micro-credential Implementation Project" was launched in 2022 by the Organisation for Economic Co-operation and Development (OECD) [12]. Figure 1 presents the key policy documents and projects that show the progress of MC-friendly ecosystem development.

The introduction of this new form of certification highlights the need to rethink traditional ways of learning and opens new opportunities for access to higher education. This includes MCs as complements to bachelor's, master's, and doctoral education as a strategy to overcome the gap between "the learning outcomes of initial formal qualifications and emerging skills needs in the labour market" [13].

MCs, it is argued, are a response to system demand from employers, industry, and communities [13] and are reflective of speed in labour market changes. At the

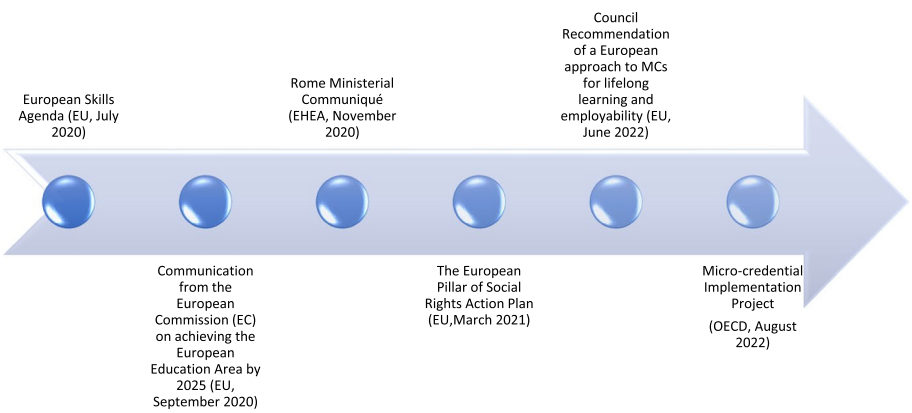

Fig. 1 Progress in developing MC-friendly ecosystems: key policy documents and projects

individual level, micro-credentialing requires changes in the mindset of professionals (including educators) to promote continuous learning through the provision of increasingly adaptable and modular educational options [7]. Rapid technological advances combined with the development of new employment patterns require workforces to be up-to-date and equipped with essential skills and competencies for making effective use of technological and nontechnological expertise [7].

Typologies of MCs and main characteristics

The term MCs is not universally agreed upon. It "encompasses various forms of credential, including 'nanodegrees', 'micro-masters', 'credentials', 'certificates', 'badges', 'licences' and 'endorsements'" [13, 14]. To date, there are many discrepancies regarding how to define the shape of MCs. For example, they can refer to smaller educational modules than traditional academic degrees or even small units of learning, high personalisation and benefits to the constantly evolving labour market [13, 14], which distinguishes them from higher education degrees [15]. Often, they are an element that can become part of a larger course [15–18], although they are usually a short educational experience [19] aimed at achieving a wider range of skills, competencies, or knowledge [7].

Oliver from Deakin University (Australia) highlighted that MCs are additional, alternate or complementary [18] to traditional courses. Other commentators have underlined that they may not only be standalone but also be combined into larger credentials or qualifications as a part of an individual's professional portfolio [15]. It is also stressed that MCs can be any credential that includes more than one course but is less extensive than a full degree [20]. MCs can also be allocated European Credit Transfer System (ECTS) score [13, 15].

Various typologies of MCs exist. There have been proposals to categorise them into three groups, differentiated on the basis of the following criteria: duration, award type, methods of quality assurance (QA) and overall aims [21, 22]:

(1) Skill credentials take approximately 4–12 learning hours as non-formal learning. They are not accredited explicitly by external quality assurance bodies. Their main goal is to acquire specific skills [21, 22].
(2) Modules whose duration is longer than the skill credentials. They take between 25 and 150 learning hours. They represent formal learning and include various assessment options. They are accredited by external quality assurance bodies to acquire a set of learning outcomes [21, 22].
(3) Short formal learning programmes that include options for assessment, which vary from 150 to 1500 learning hours. Their quality is always explicitly evaluated by an external quality assurance body. The goals of short learning programmes are linked to specific career professional goals, which differentiates them from the previous two goals in that they can be mapped to qualification frameworks, either as partial qualifications or as special categories of micro-qualifications [21, 22].

The synergy of these types of MCs is an accessible response to personal, societal, and cultural needs to equip the learner with the knowledge, skills, and competencies expected by the labour market [15]. Reflecting a notion of immediacy, MCs are often presented through a digital platform that promotes skills and competencies in an easily understandable format [7]. The Griffith University (Australia) emphasised that MCs should be easily exchanged between educational institutions, employers, and individuals [13, 23].

MCs imply portability, which is the "ability to share and translate credentials from one context to another and to represent them in different combinations for different audiences" [14, 24]. Courses ending with this certification should be available to everyone, irrespective of the time zone and geographical and cultural context, thus minimising limitations resulting from unequal access to education facilities and enabling the acquisition of new skills and competencies. Portability means that the owner of MCs is the holder/learner, who has the right to store their MCs and share them easily through, for example, secure digital wallets [3]. To facilitate portability within the EU, secure digital wallets in which a holder can store their digitised certification, such as Europass, are available [3].

Formal recognition of MCs is important in terms of mobility and engagement with other formal models of learning and progression. They should be acknowledged as a prior form of recognised learning, and universities should, for example, facilitate their recognition for admission purposes and/or for all types of qualifications (awarded and nonawarded) [13]. Moreover, universities can participate in developing MCs in collaboration with other Higher Educational Institutions (HEIs), employers, learners, nongovernmental organisations (NGOs) and public authorities [15].

It is recommended that MCs be explicitly included within existing national policies devoted to educational quality assurance to ensure internal and external quality procedures of accreditation by the system producing them by applying established quality criteria in terms of course design, review, and evaluation [3, 22].

Importantly, MCs offered by HEIs should comply with the National Qualification Framework (NQF), and the appropriate level(s) of NQF for MCs should be agreed upon. The EU proposes a formal outline of certification that should include elements such as the name of the holder, achieved learning outcomes, methods of assessment, awarding body, the qualifications framework and the amount of credit assigned [7]. Other constitutive elements also include the form of participation in the learning activity and access requirements [25]. There is an agreement that a "common format is necessary for providers to document the MCs and their value" [25].

Table 1 shows the elements that constitute MCs proposed by key European stakeholders lobbying and acting for open education development and recognition.

Therefore, in comparison with traditional degree programmes, MCs are characterised by a smaller volume, both in study duration and workload, concentration on targets, in terms of skills or topics of study, flexibility of delivery and portability to ensure benefits [27]. Moreover, MCs should be formalised by being subjected to accreditation and certification. They can be used for education and employment purposes as well as personal development and growth [21].

Recognition of MCs for education/training refers to the formal approval of such credentials by a competent authority or educational institute to be admitted to an education programme, transfer credit within it or exempt the learner from part or all of the programme [21]. Recognition of MCs in hiring requires acceptance of formal credit by an employer that then provides an applicant with the possibility of employment or career progression [21].

Methods

Aim and research question

The aim was to explore the MC ecosystem, an area that is currently underexplored in relation to its potential and challenges in the health care sector. Thus, the research question was as follows: "What are the challenges and opportunities of micro-credentials as a new form of health science education?".

Study design

A multimethod approach based on a preliminary narrative review [28] followed by a reflective practice method, such as "a systematic process for group based on sharing stories and analysing cross-cutting themes to inform future action" [29], was used to analyse retrieved documents, grey literature and scientific literature referenced to MCs and debate their implications in the health care sector.

First, the review was conducted. Sukhera has identified types of narrative reviews as state-of-the art, critical and integrative reviews [28]. In accordance with Sukhera's recommendations, a state-of-the art narrative review

Table 1 Elements constituting MCs proposed by key European stakeholders [7, 25, 26]

	European Union * Mandatory elements	MICROBOL	OEPass
Identity of the learner	✓	✓	✓
Title of the micro-credential	✓	✓	✖
Information about provider	✓	✓	✓
Reputation of the issuer	✖	✖	✓
Awarding body	✓	✓	✖
Date of issuing	✓	✓	✖
Workload needed to achieve the learning outcomes	✓	✓	✓
Level of the learning experience leading to the micro-credential	✓	✖	✓
Overarching Framework of Qualifications	✓	✓	✖
Learning outcomes	✓	✓	✓
Form of participation in the learning activity	✓	✓	✖
Prerequisites needed to enrol in the learning activity	✓	✓	✖
Type of assessment	✓	✓	✓
Supervision and identity verification during assessment	✓	✓	✖
Quality assurance	✓	✓	✓

MICROBOL (Micro-credentials linked to the Bologna Key Commitments) was a 2-year project (2020--2022) co-funded by the EU's Erasmus+ Key Action 3 funding scheme - Support of Policy reform, specifically "Support to the implementation of EHEA reforms". OEPass: (Open Education Passport) aims to create a standard format for describing open education and virtual mobility experiences in terms of ECTS. (The Bologna Process was established in 1999 and is an educational framework that facilitates the recognition of outcomes between comparable degrees across the European Higher Education Area. Its purpose is to promote trust for successful learning mobility and cross-border academic cooperation).

[28] was chosen as a narrative approach capable of producing a summary of the main characteristics of MCs as established in policy documents. There is no standard structure or relevant guidelines that support the performance of narrative reviews. However, the presentation of the findings in a chronological format or as a conceptual or thematic framework according to the main issues has been suggested [30]. Two researchers with a sociology and health sciences background and two researchers with a nursing background undertook "desk-based research" by searching for:

(a) relevant policy documents through EU web pages; then, a free search was performed to capture grey literature discussing MCs, not only in the European context, without any limitations in time until August 2024; and.
(b) scientific literature in the health care sector accessing PubMed and the Cumulative Index to Nursing and Allied Health Literature (CINAHL), without any limitations in time until September 2024.

The key word used across the search process was "micro-credential(s)", to ensure a wide search without any limitations. The review was undertaken in the context of an EU4Health co-funded project, Dynamic Digital Skills for Agility and Resilience in Medical and Allied Professions (DDS-MAP) (https://ddsmap.easpd.eu/). This project aims to develop and test new training provisions for healthcare workers (including regulated professionals such as doctors and nurses, professionals allied to medicine and unregulated health care workers such as administrators and support staff), focused on the acquisition and mastery of new digital technologies in the delivery of care services.

A total of 17 policy documents and guidelines and 17 scientific papers from PubMed and CINAHL were retrieved (see Supplementary Table 1). The output of this desk research identified a set of policy indicators, experiences, and editorials, which contributed to framing a preliminary concept of strengths and weaknesses in the implementation of micro-credentials in the broader European context. A summary was produced by the same researchers and circulated among the team to help understand the current MC ecosystem, enabling an in-depth understanding of the status of MCs and how this status was achieved and allowing discussion regarding the potential future (and challenges) of MCs in the health care sector. Therefore, the research team, in multiple meetings, discussed the implications of the health care sector both inductively by considering the policy document implications and insights and then deductively by considering available experiences, as documented in the scientific literature, in supporting the strengths and limitations of MCs in the health care sciences. The discussion was conducted online, in person and via written narratives involving all team members (see authors) who had a mainly health science education background, working in higher education and having recognised expertise in the field of health science education. Thus, the findings have been organised into (a) a summary of the policy documents regarding (1) education and (2) the labour market and (b) a discussion regarding their implications for health care according to the literature in the field.

Results

Micro-credentialing in education

MCs can be earned before, during and after higher education degree programmes and as a new way to certify competencies acquired earlier in life [25, 31]. MCs may be used at each stage and level of education, and for any lifelong learning activities prior to or after such programme levels. However, to combine Bologna outcomes with micro-credentialing the following issues need to be considered: (1) quality assurance (QA), (2) recognition, and (3) ECTS and qualification frameworks [25].

Quality assurance

QA is essential to guarantee that those looking for MCs have access to high-quality training and qualifications for employment purposes [21]. Therefore, the QA process should be tailored to specific purposes, appropriately documented and easily accessible [3]. In accordance with MCs linked to the Bologna Key Commitments (MICROBOL), the primary responsibility for the quality of provision of MCs lies with the HEI [25]. They should be supported by QA agencies in developing a QA protocol and ensuring the potential beneficiaries of the effectiveness of MCs. The New Zealand National Qualifications Authority has emphasised that MCs should be set at least at the same training standards as other programs and reviewed annually to confirm that they continue to meet their purposes [13]. The EU highlights that external QA is based mostly on the assessment of providers and the effectiveness of their internal QA procedures [11, 21]. Providers might choose or be required to verify quality by means such as (a) accreditation or licensing procedures involving regulatory authorities, which allow MCs to be offered within a jurisdiction; (b) professional and employer certifications, which rely on the approval of providers and/or courses by the business sector and large employers; and (c) external QA certification schemes provided by standardisation bodies or platform certification schemes, which refer to platforms offering online courses that conduct their own QA before the

Table 2 Dimensions of MC quality (Adapted from Everhart et al. [32])

Transparency Transparency builds trust in MCs as it helps stakeholders, such as employers, to understand what MCs are and potential learners to understand how MCs support their personal development.	•gives clear definition of competences •defines clear education path •provides easy comparison with other credentials •defines clear quality assurance process •defines clear requirements for renewal •defines clear characteristic of credential (e.g. language frameworks)
Modularity Modularity offers flexibility in constructing the individual profile of the learner based on his/her interests, preferences, and choices.	•highlights independent value of credential •gives possibility of combining with other micro-credentials •gives possibility of building upon other credentials (stackability) •includes measurable milestones
Portability Portability gives freedom to use the MCs in a variety of environments.	•enables to move within credentialing ecosystem because is valid at various levels (local, national international) in various contexts •enables to move vertically and horizontally within and across the credentialing ecosystem
Relevance Relevance provides a link between the needs of the stakeholders such as employers with other authorities, such as professional/regulatory bodies, in various contexts and applicability of credentials.	•prepares for further education/training or is a part of continuous lifelong learning •prepares for career, employment, civil and social engagement, contribution of communities of practice •has value to specific stakeholders (labour markets, educational systems, civic organizations, and/or social groups, locally, regionally, nationally, or internationally •has symbolic value based on recognition and interpersonal interpretations •has documented value associated with concrete evidence •can be regularly updated to ensure that the knowledge and skills are current •can be verified by one or more authorities
Validity Validity helps to understand the broad value of MCs and connection to the opportunities that they give.	•can be recognized and accredited •can be credible (face validity) •represents the right things in the right balance (content validity) •predicts an individual's ability to do something in the future (predictive validity) •shows parallel evidence supporting the claims made in the credential (concurrent validity)
Equity Equity refers to overcoming disadvantages, which might occur when accessing MCs. It helps the learner to connect to various opportunities provided by these credentials.	•promotes emotional, social and economic mobility •supports access for students with varying abilities, preparation, and/or prior credentials or unfinished credentials •represents stackability to other credentials •supports careers development in education and other contexts •helps in understanding the own knowledge, skills and abilities to the learner

course is offered to a wider audience [21]. Internal QA should be based on standards such as the overall quality of the MCs, the quality of the course and the learner's and peers' feedback on the learning experience [3]. At the overall level, several more generally recognised QA dimensions exist. These are transparency, modularity, portability, relevance, validity and equity [32, 33] (see Table 2).

Recognition

MCs may be recognised for academic or employment purposes on the basis of standard recognition procedures, e.g., cross jurisdiction recognition of foreign qualifications and learning periods abroad. Standards and guidelines exist to formally recognise credentials in education, such as the Standards and Guidelines for QA in the European Higher Education Area (2015) and the Guidelines for credential evaluators and admission officers developed from within the ENIC-NARIC network - EAR Manual (2016) [26].

MCs can be recognised by HEIs through procedures aligned with the Lisbon Recognition Convention [25]. The learner provides proof of the learning outcomes they have achieved, referenced to transparent requirements and after an appropriate assessment. The assessment should be performed by nationally recognised higher education institutions or other recognised assessment providers as part of its national QA framework [25].

Camilleri and Rampelt [26], in an OEPass paper, proposed structuring credentials in accordance with their level of formalisation. This classification included formal qualifications on the basis of the formal learning experience received after completing an assessment (e.g., professional certificates and degrees); non-formal certificates, which are the result of a non-formal educational course that confirms successful accomplishments (e.g., MOOCs); recognition of skills confirming the achievement of specific skills (e.g., recognition of non-formal learning); and records of experience that confirm the achievement of specific experiences (e.g., certificates of participation). MCs could expand the area of both formal and non-formal education.

Various stakeholders should be included in the recognition process [34], as they can all interact with the same credential. OEPass proposes dividing them into three groups: (a) *learners*, meaning those who obtain credentials; (b) *issuers*, referring to institutions that offer and award credentials; and (c) *consumers*, including HEIs, employers and recruiters. These may also assign values to credentials [26].

ECTS and qualification framework

The ECTS helps to describe MCs in a clear way, and the possible credit range is between 1 and 59 [25], although credits can vary from 5 to 30 ECTS points [19, 32]. The National Qualification Authority in New Zealand states that the upper limit should reach 40 ECTS points [33]. In practice, however, it is expected that most MCs will have between 1 and 15 credits [25]. In the available grey literature, there is no clarity as to whether credit attribution refers to a single MC or a group of MCs.

The ECTS system comprises two main elements: the learning outcomes, which are verifiable descriptions of the competencies the learner will be able to demonstrate at the end of a learning experience; and the volume of learning, understood as the amount of time in general a learner needs to achieve such competencies [25]. These two elements should be considered when assessing the allocation of the ECTS to every course. The discussion on the inclusion of MCs within the European Qualification Framework (EQF) is still ongoing. One question is whether there is a need to cover MCs within the EQF given that accreditation and recognition are not available for many courses [22]. The inclusion of MCs within the broader qualification framework requires appropriate quality assurance procedures; however, currently, no governmental or regulatory quality standards exist. In this context, Ireland and New Zealand are leaders in including MCs in their national qualifications frameworks [22].

Micro-credentialing in employment

Traditional employment foundations are built on the assumption of linear careers via a life model of "learn, do, retire" [35]. To be considered employable and current, workers must search for new ways to improve and develop skills [36], which are needed quickly [37, 38]. As a result, there is an urgent demand for effective agencies that can convey the skills that individuals need to acquire over the course of their lives [39, 40]. In accordance with the World Economic Forum's Future of Jobs Report [41], between 2024 and 2027, approximately 61% of workers will require retraining [41]. Skills-based hiring and MCs can be effective educational responses to address skills talent shortages quickly at scale [41].

Currently, employers hire according to a skills-based strategy [21, 42]. In this context, hiring is a set of practices that are based on the identification of skills that are needed to work efficiently in a given position and then "match potential employees to the opportunity" [21, 39]. Appropriate matching should reflect the skills and competencies obtained or the willingness of an individual to acquire new skills and competencies in a timely manner.

MCs are supportive of skill-based hiring, as they can focus on critical skills desired by employers rather than broader-based traditional-based qualifications [42]. Moreover, MCs not only confirm the skills and competencies acquired but also show positive attitudes towards learning and personal development needs [43]. There is no one strategy for recognition of MCs in hiring, as this depends upon the employer and their needs.

Camilleri et al. [44] noted that the demand for verification by large-scale employers and SMEs varies across regulated professions. While large employers usually outsource the verification procedure, SMEs perform verification in-house or not at all. For regulated professions, verification is necessary in all application processes. The authenticity of the credential is verified as a condition of application/employment in some cases [38]. For other non-regulated professions, both in the case of large employers and SMEs, the content of credentials is critical at the application stage.

MCs, as a form of certification, are more flexible in adjusting to the rapidly changing technical and economic context [37] and are a less expensive way to shape and adjust the professional pathway through promoting the acquisition of new skills and competencies.

We are witnessing a transition from the recent Fourth Industrial Revolution. This is a society and economy based on high digital connectivity, human–machine interaction and the use of new technologies such as health informatics technologies and robotisation during the Fifth Industrial Revolution. This is a society and economy that draws on the 4th but emphasises harmonious human–machine engagement on the basis of collaborative interaction between the worker and the machine. Artificial intelligence (AI) and machine learning devices for diagnosis and providing suggestions for clinical management are examples of this. The Fifth Industrial Revolution focused on an economy and society that promotes the wellbeing of all stakeholders through communal, institutional and personal development.

These two revolutions demand a workforce that can quickly acquire and update their technical/digital skills. Such workplace and societal changes are transforming the workforce's expectations and fostering demand for quick access to new skills sets and training approaches [45]. Employers now need to retain employees by providing cost-effective training and development opportunities that the employee feels benefit them as well as the employer. In health care in particular, staff retention is a particular challenge [46]. MC accessibility (often requiring little to no time away from the workplace because of their online delivery modality), specific focus and small volume delivery are attractive to employers and employees alike in this context. MCs based on skills acquisition can offer equal and rapid opportunities for developing professional paths to new careers for job seekers and at the same time broadens and diversifies the talent pipelines available for employers [41]. Notably, in Ireland, a leader in developing MCs has seen them increasingly used in health care, one of the societal and economic sectors that has seen the greatest impact of the 4th and 5th Industrial Revolutions.

Discussion: MCs in health care sciences

The introduction of MCs is important from both economic and social perspectives [7]. There is demand from employers and employees for new qualifications that can be obtained in a relatively short period of time. At present, MCs are a form of education and qualification that complements traditional forms of education and learning and provides support for HEIs in facilitating the learner to be more competitive in the labour market. However, the rapidity of societal and technical change suggests that their presence as a form of education and training is likely to expand significantly in the future, particularly in health care [47].

The recognition of MCs in the labour market and in the education sector is increasing. As they focus on the development of specific skills or the strengthening of knowledge in particular areas, they help individuals acquire recognition of targeted experience and expertise, both of which are now emphasised in health care practice [48]. MCs also demonstrate the commitment of the learner to professional development and can lead to professional career development and advancement and support staff retention, which is currently a major issue in health care across the EU [46].

The added value of MCs is that they may be obtained in a relatively short time and equip the learner with immediate skills that are aligned with up-to-date trends within an industry. The speed of change currently taking place within health care [49] means that the immediacy of employment relevance combined with flexibility (delivery, such as online workshops or personalised courses) and stackability (combining a number of MCs into more comprehensive qualifications) can allow health care workers to reskill or upskill without resigning from their employment commitments. From a clinical employer's point of view, this is extremely attractive.

Supporting employers with incentives to engage with MCs and integrating them into training and/or development programs reflects the shift in employment from a degree-based approach to a skill-based approach in which health care is not only immune but also, in many cases, has been a leader [50]. The advantage of such a

shift for both employers and employees is that they are more cost-effective than traditional degrees are and meet immediate needs and changes.

In the ecosystem of MCs and often emphasised in health care settings is lifelong learning, particularly within the context of rapid technological change [51]. MCs encourage this. The adaptation to new technologies combined with the formal recognition of skill acquisition associated with such adaptation is increasingly an essential element in the qualification ecosystem that informs health care workers' career development [51]. This requires, in part, recognition that the complexities of the health care labour market both currently and in the future will involve a myriad of co-dependencies that will be multidisciplinary, multiprofessional and multiagency [52]. In this context, enrollment in MC-based programs can promote opportunities to build across discipline networks of specialist contacts through an applied learning experience.

Opportunities and challenges for health science education

Scientific papers focusing on MCs and health science education have reported that both pandemic and technology integration have accelerated the introduction of these new forms of education in health care sciences [53–55]. The accelerated integration of MCs has also emerged from the perspective of socio-technological movement associated with health-profession education [56]. Progressively, the role of MCs has gained importance and has been defined as a new ecosystem for learning and skills acquisition in the health science education context. Documented examples of MCs in undergraduate and postgraduate courses, as well as in continuing education pathways, have been provided in the literature (see Supplementary Table 1), where MCs have been reported to contribute to the advancement and refinement of skills and competencies according to specific learning needs [55, 57]. However, the debate is still open, with some in favour of certain circumstances [54, 56, 57] and others [58, 59] (see Supplementary Table 1), with limited empirical evidence available [54, 55, 60], suggesting that in this field, not only more research is needed but also more discussion among educators, students and employers is needed. Micro-certifications should be considered not as a panacea but as a strategy to improve the quality of care delivered to patients [59].

However, MCs have been highlighted as important when structured educational pathways are not locally available. For example, highly specialised clinical nurses who require very specific courses (those that are not available through more generic programmes of education) can be updated through MC programmes that specifically meet their needs without having to leave their clinical practice, which is something that nurses find attractive and benefits employers [61, 62]. Moreover, they can also be considered valuable in promoting transdisciplinary competencies among HCPs through the collaboration of HEIs with the health care system to develop comprehensive pathways shared learning (e.g., in promoting digital skills, teamwork abilities) [63].

MCs may also promote a stronger partnership between HEIs and the National Health Systems. This partnership is already well established for the purpose of ensuring students' clinical rotations in undergraduate education and when universities disseminate research outputs in their so-called "third mission" to create knowledge outside of academic environments to benefit sociocultural and economic development [64]. In addition, the applied nature of MCs requires dialogue and collaborative working between the provider of education and the clinical service (the National Health System) to design and deliver short educational programs, effectively evaluating and certificating them for life-learning purposes. The collaborative intersection of these two worlds to deliver MCs may then initiate a "fourth university mission" aimed at exploring local needs and targeting them; in turn, such effective interaction with the local health service may inform changes in broader undergraduate and postgraduate health sciences education, thus ensuring that HEI degrees delivered are continuously shaped and updated.

However, in the context of lifelong learning, there are several challenges in integrating a fully realised MC system into health services. One of them combines MCs with existing CPD protocols. In the case of medical professions, CPD systems tend to be broader in volume and more professionally regulated [65], whereas there is still a lack of agreement in the literature and within policy for the standardisation of MCs in terms of definition, the nature of delivery and accreditation. All medical professions are regulated, and skills and competencies are certified by regulating bodies. For such bodies to accept MCs, a universally agreed-upon definition of MCs and processes of assessment, recognition, and QA need to be stated and agreed upon at the institutional, national and EU levels [13].

Currently, even though MCs allow health care professionals to acquire skills and knowledge, they are not fully accepted in most countries in Europe in terms of their value and goals, even when the learning outcomes of MCs are described and referenced to the descriptors of national and/or regional qualifications frameworks promoted by national regulatory bodies. For this to happen, professional stakeholders such as regulatory bodies, professional bodies and scientific associations need to be brought together with the intent to promote

a collaborative process to establish universally agreed-upon and standardised criteria for MCs to ensure consistency and harmonisation of their structure and to promote their acceptance and recognition.

There will also need to be an integration and harmonisation of the work of a range of MC providers and the variety of digital platforms that offer such courses to ensure consistent quality across course provisions. As part of the promotion of MCs to clinical services, HEIs themselves may need to promote and recognise MCs within their own staff development programmes to avoid the impression that MCs are second class programmes.

Policy makers and other stakeholders within health care need to engage with the MCs' agenda [34], which is, after all, EU educational policy in health care [66], if clinical staff are to engage with the opportunities to upskill through this type of credentialing [3]. Such engagement will also serve to stimulate regulatory solutions that need to be in place to create an MC-friendly ecosystem at both the national and European levels. Overall, given that most of the empirical evidence has been produced in the pharmacological and nursing fields [67–69], more transdisciplinary research is needed to establish the value of MCs in specific sectors of education, from those initial to those embracing life, with the goal of providing a balanced perspective regarding the appropriateness of MCs in developing or updating clinical skills. Furthermore, given that systems regulating health professionals' practices and education are established by countries with the contributions of professional bodies, more studies ensuring the validity of the skills acquired with this system are encouraged. Above all, given that the aim of education is to promote reflective practitioners, who are capable of deepening the acquired knowledge to perform the best practice in the interest of patients, more data are needed to understand the underlying learning processes promoted by MCs and which strategies may prevent superficial learning.

Opportunities and challenges for employment in the health sector

MCs are considered valuable for organisations that can use them to enhance their employees' skills or address a skill gap in their workforce to promote a culture of learning and engagement to support retention; they can support new entrants, career advancements and experienced workers without formal degrees [70]. However, as reported by Southard [58], the utility of MCs to employers should be determined, which may be challenging given that standards and policies around them continue to evolve. Similarly, MCs substantially deinstitutionalise the education process to allow more flexibility in creating alternative pathways to train the workforce [37], which poses a challenge.

Although MCs present many possibilities in health science education, many issues remain to be addressed. One of them is the recognition of such credentials by employers and across different systems composing the landscape of national health services. There is a need to establish a clear and transparent criterion: employers should specify appropriate MCs that are relevant to their organisation, defining the skills and competencies needed. There is an urgent need for collaboration with educational institutions offering MCs to customise programs and meet the needs of the healthcare sector.

Some employers seem to assess negatively the added value of MCs and the reasons reported reference the quality of credentials as a consequence of a lack of clarity regarding the variety of offers delivered and branded as alternative credentials [11]. The recognition of MCs in healthcare settings suggests some changes in employment patterns. This would mean implementing strategies such as the introduction of learning culture in the company, the recognition of the MCs with respect to the changed expectations of the labour market (responsiveness to the employee's needs) and the implementation of quality assurance measures that are updated constantly.

By developing a learning culture, we mean encouraging HCPs to obtain MCs and providing them with space to share those experiences with their colleagues and peers. To promote this approach, a reward system should be implemented for CPD, and a reimbursement protocol should be introduced (for example, such a system exists in Irish health services in terms of course fees and pays rewards once a qualification is achieved, although in a very limited format).

Recognition of MCs and responsiveness to the labour market means implementing strategies for including information about MC recognition in contracts of employment and job advertising and increasing the awareness of their value among human resources and recruitment teams. Considering the changing context of the labour market and future challenges in terms of the speed of technological and societal expectations, a discussion within the (health) sector is needed. The MCs may align with sector standards that could be facilitated by sectoral guidelines for the recognition of certain credentials. This could be the way to engage the providers of MCs in dialogue with the industry branch or (health) sector by understanding the content, methodologies, and accuracy of the courses.

Finally, effective recognition of MCs by employers is possible only when quality assurance is provided. The development of appropriate MC assessment protocols and verification of the authenticity of applied learning

experiences are needed. In this context, recognition strategies should be constantly evaluated in terms of effectiveness and adjustment to the emerging challenges in the healthcare sector.

Limitations

This study has several limitations. First, the scientific literature was searched in two databases, as they reflect the largest indexed journals in the context of health care. However, with increasing interest in the field, more databases can be considered. Second, the discussion was developed by team members (see authors) with specific backgrounds and in the context of a large EU project (DDS-MAP); however, their educational and professional backgrounds, which are mainly academic and nursing oriented, may have shaped the discussion.

Conclusion

The European Commission strongly recommends the adoption of MCs as a learning strategy that should be recognised at both the educational and labor system levels. MCs provide a relevant work qualification and are faster to obtain than more traditional approaches to learning. Responsiveness and speed are important in a dynamic, changing environment, especially in relation to clinical environments. MCs give the opportunity to learn independently in terms of time and place. MC-based courses might have onsite and online formats of delivery that enable the learner to link their learning experience with work and personal duties.

However, within the context of health care, MCs face challenges that should be addressed. The publication of information associated with the quality of MCs and transparency becomes essential to build trust for their recognition among regulatory bodies, employers and indeed health care workers themselves. There is a strong need for multisectoral consultations and cooperation with multilevel stakeholders to build a universal definition based on agreed-upon standard elements for describing MCs, developing them in a friendly ecosystem including an institutional recognition structure and introducing appropriate legislation regarding the integration of MCs with National Quality Frameworks. Moreover, to provide evidence of their effectiveness on the range of competences expected by health care professionals (clinical skills included) and to further discuss their implementation, there is a need to invest in scientific evidence. These issues are specifically important for regulated health professions if MCs are to be successfully integrated with the broader undergraduate and postgraduate ecosystem of education that underpins the EU health care sector.

Abbreviations

AI	Artificial Intelligence
CPD	Continuing Professional Development
DDS-MAP	Dynamic Digital Skills for Agility and Resilience in Medical and Allied Professions
EC	European Commission
EU	European Union
ECTS	European Credit Transfer System
EHEA	European High Education Area
ESA	European Skills Agenda
EQF	European Qualification Framework
HEI	Health Education Institutions
HCP	Health Care Professional
MCs	Micro–credentials
MICROBOL	Micro–credentials linked to the Bologna Key Commitments
NGO	Non–Governmental Organisation
NQF	National Qualification Framework
OECD	Organisation for Economic Co–operation and Development
OEPass	Open Education Passport
SMEs	Small Medium Enterprises
QA	Quality Assurance

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

All the authors made substantial contributions to the conception and design of the article. KZ and BD searched relevant policy documents by consulting EU web pages and then performed a free search to capture grey literature discussing MCs, not only in European context. SCh and AG searched scientific literature in the health care sector accessing PubMed and the Cumulative Index to Nursing and Allied Health Literature (CINAHL). KZ led the drafting of the manuscript. BD, MD, AG, SCh, AP and JW provided valuable feedback and conceptual input throughout the development of the final structure of the article. All authors have reviewed the draft critically and suggested revisions, given final approval of the version to be published and agreed to be accountable for all aspects of the work. JW edited the final version of the manuscript and provided the linguistic verification of the text. All authors have read and approved the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

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Competing interests

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