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Essential Milestones in Japanese Medical Education and Data Utilization with Practical Cases from a Regional Medical University

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Abstract

Outcome-based education has recently begun receiving considerable attention to assure the quality of higher education in Japan. Subsequently, institutional research, dealing with data management within an educational institution, has become an essential component of quality assurance. In medical education, institutional research that corresponds to the field is required to satisfy international standards. In Japan, the assurance of the quality of medical education is based on the Model Core Curriculum for Medical Education—the guidelines for establishing medical school curriculums to provide students with the knowledge and skills required by future physicians. Therefore, this paper aims to provide a descriptive overview of Japanese medical education by focusing on milestones indicated by the core curriculum and educational data. First, this paper will provide background knowledge about the current educational policies of Japan and international standards for medical education. Second, it will discuss features of the core curriculum and provide a comprehensive overview of milestones in Japanese medical education and how educational data can be utilized and analyzed. Furthermore, this paper will introduce a case describing the data practices of Asahikawa Medical University to illustrate current efforts toward the effective use of educational data.

Keywords: Outcome-based education, Japanese medical school, educational data, model core curriculum, milestones

1 Introduction

1.1 Recent Higher Education Policies of Japan

The Ministry of Education, Culture, Sports, Science, and Technology (MEXT) of Japan has promoted higher education policies that focus on visualization and assessment of student learning outcomes to achieve outcome-based education. In 2018, the Central Council for Education of Japan published the "Grand Design for Higher Education toward 2040," where the vision for the

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year 2040 in Japanese higher education was elaborated to ensure competent human resources for the future Japanese society. Particularly, it emphasized the importance of advancing quality assurance in higher education by shifting from teacher-oriented to learner-oriented education [1]. This urged Japanese universities to restructure their curriculums and strengthen their quality assurance system for enhanced learning outcomes.

To further move toward the direction envisioned in the Grand Design, the Central Council for Education's Subcommittee on Universities published the "Guidelines for Management of Teaching and Learning" in 2020, which provided a framework for the management of teaching and learning by collecting educational data [2]. Especially at the degree level, it is crucial to clarify the learning outcomes of particular educational programs, and design curriculums to realize these outcomes. This will enable students to achieve educational objectives specific to a degree program, and contribute to society with skills and abilities gained through the program. Thus, it is imperative for Japanese universities to collect educational data and improve student learning based on evidence.

1.2 International Accreditation in Japanese Medical Education

Accreditation by international standards has been recently recognized as an essential element of quality assurance in Japanese medical education [3]. A movement toward pursuing international accreditation was partly facilitated by the external influence of the Education Commission for Foreign Medical Graduates of the United States (US). In 2010, the Commission announced that effective in 2023 (later changed to 2024 due to the COVID-19 pandemic), international medical graduates would be unable to apply for residency or fellowship programs unless they received their medical degrees from universities accredited according to globally accepted criteria, such as those set by the World Federation for Medical Education (WFME) [4]. In response to this, the Japan Accreditation Council for Medical Education (JACME) was established in 2015 and received approval as an official accreditation agency by the WFME in 2017. Since its establishment, the JACME has been in charge of evaluating whether Japanese medical schools meet international criteria for medical education.

Furthermore, the JACME created, "The Basic Medical Education: Japanese Specifications," evaluation standards that correspond to the WFME standards. The latest version of the Japanese standards was released in 2020 with nine evaluation areas [5]:

1) Mission and learning outcomes
2) Education program
3) Student assessment
4) Students
5) Academic staff
6) Educational resources
7) Program evaluation
8) Governance
9) Continuous improvement

These nine evaluation areas are further divided and there are 36 subareas in total with two types of standards: the basic standards that all medical schools must meet, and the quality improvement standards that they are required to partially meet or demonstrate their efforts toward satisfying them. Based on performance regarding the two standards for each subarea, the evaluation result of "Fulfilled," "Partially fulfilled," "Not fulfilled," or "Not applicable" is assigned. Although the Japanese standards underwent several revisions, including minor ones, the nine evaluation areas have not been significantly modified since their introduction.

The study that analyzed the accreditation results of 34 medical schools identified 3) Student assessment and 7) Program evaluation as potential weak areas [6]. The results, publicly available on the JACME website, imply that Japanese medical schools need to improve their assessment methods of student performance, including medical knowledge, skills, and attitudes. Thus, what is essential from this global perspective is that student learning outcomes are identified, measured, and assured by international standards, safeguarding medical services in the long term. To this end, outcome-based medical education must advance where student learning outcomes are clearly articulated, and education is provided to ensure clearly articulated learning outcomes by managing educational data.

1.3 Demands for Data Management and Use

Owing to the demands for institutional accreditation by third-party organizations as well as program-specific accreditation such as the JACME, institutional research (IR) in Japanese higher education has begun receiving considerable attention in recent times. Dealing with different aspects of data at an educational institution, IR is considered an indispensable component that can contribute to the effective management of university activities, not only for accountability but also for internal quality assurance. Specifically, IR has been identified as the foundation to support the management of teaching and learning to achieve educational outcomes [2]. In the field of medical education, an IR database system was introduced at a Japanese medical school along with the introduction of educational data for IR [7]. Subsequently, plugins of a learning management system, to facilitate the use of educational data for IR and learning analytics, were implemented [8].

The present study contributes to the existing literature on IR in medical education by focusing on common educational milestones and data usage. As previously discussed, it is essential to collect and manage educational data to advance outcome-based medical education. Drawing upon previous discussions on the importance of data management in Japanese medical education [9], this paper aims to further describe the core curriculum and discuss the essential milestones shared by various Japanese medical schools. It will discuss data collection and utilization to support student achievements of those milestones. Case studies of data usage at a Japanese medical school are presented to illustrate actual data practices. Therefore, this paper intends to provide a comprehensive overview of milestones and educational data in Japanese medical education.

2 Overview of the Model Core Curriculum for Medical Education in Japan

Japanese medical schools offer a six-year program for those who intend to become physicians. Figure 1 depicts an overview of Japanese medical education, from admissions and medical school study to post-graduation.

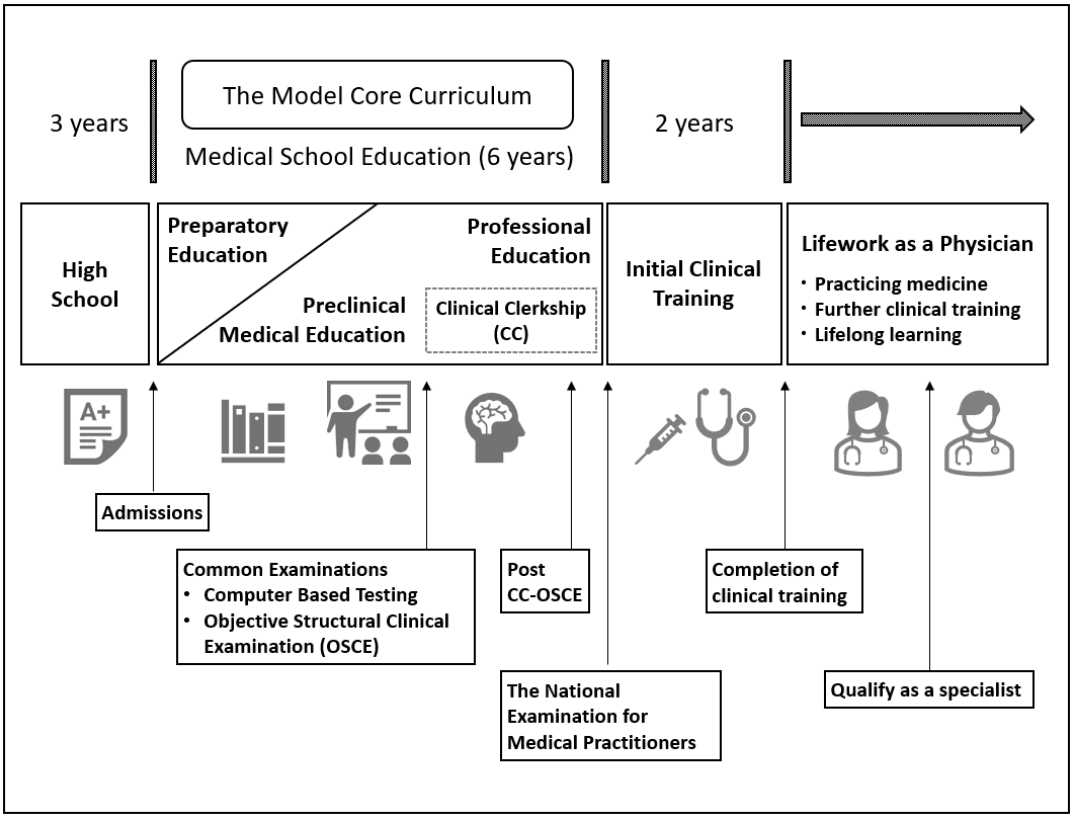

Figure 1: Overview of Japanese Medical Education

Traditionally, there was an emphasis on imparting medical knowledge to students, instead of on teaching attitudes and skills necessary for physicians. Reforms in Japanese medical education were aimed at shifting from knowledge-focused education to teaching patient-oriented medical skills, such as fostering enhanced humanity and developing communication skills. Japanese medical schools adhere to the Model Core Curriculum for Medical Education (MCC-ME) published by the MEXT. The MCC-ME is defined as "an abstraction of the 'core,' within the respective 'curriculum' formula by each university, which should be taught by all universities in Japan; it is systematically organized as a 'model' of what that core contains [10]." It provides guidelines for organizing curriculums to teach essential knowledge and skills necessary for physicians. Based on outcome-based education, it lays out the minimum requirements of knowledge, skills, and attitudes for all graduating medical students with specific goals and objectives. To ensure that all graduating medical students satisfy the basic requirements for physician competence, two-thirds of the curriculum of each medical school need to comply with the MCC-ME. The rest is based on the mission and characteristics of each school.

Since its introduction in 2001, the MCC-ME has been revised to accommodate societal changes and needs for physicians, with the 4th edition released in 2016. This latest revision was intended to nurture physicians who can respond to diverse needs due to the changes in public hygiene and medical systems, and societal changes such as the super-aging society and internationalization. One of the critical features of the revision was the emphasis on community medicine and community-based integrated system. The MCC-ME is divided into seven themes, ranging from foundations to clinical training as follows:

A. Basic qualities and abilities required for a physician

B. Society and medicine/medical practice

C. General issues in medicine

D. Normal structure and function, pathophysiology, diagnosis, and treatment of each organ system of the human body

E. Systemic physiological change, pathophysiology, diagnosis, and treatment

F. Basis of medical practice

G. Clinical clerkship

Each theme includes different components, divided further into specific sub-components. For instance, "F. Basis of medical practice" has three components: F-1: Approaches from signs and symptoms/pathophysiology; F-2: Basic clinical knowledge; and F-3: Basic medical practice skills. F-1 is further divided into 37 types of medical conditions, each with specific educational objectives. Incorporating courses for clinical experiences at an early stage of medical education is strongly recommended. To this end, the MCC-ME aims to enable early exposure to hospital settings and clinical clerkship (CC). CC is clinical training for medical students focused on specific roles and responsibilities in a medical team, and differs from clinical observations previously incorporated into Japanese medical education. In CC, medical students must demonstrate their knowledge, skills, and attitudes to participate in a medical team.

To examine the preparedness of the 4th year students for CC, the MCC-ME highly recommends two types of standardized examinations: computer-based testing (CBT) and the objective structured clinical examination (OSCE). The CBT is a computer-based examination assessing medical knowledge gained through the MCC-ME. It consists of 320 multiple-choice type items. Answers to 240 questions are considered for evaluation, whereas the other 80 answers serve for item analysis and future use. In contrast, the OSCE is a performance-based examination where fundamental clinical skills and attitudes are evaluated by two examiners. These examinations are a prerequisite for CC in the 5th and 6th years, during which students receive their clinical training as student doctors.

Upon successful completion of CC, students are typically required to take two examinations at the end of the 6th year: the post-clinical clerkship OSCE, an examination to confirm skills and attitudes in medical practice, and the National Medical Practitioners Qualifying Examination (NMPQE), an official medical license examination for physicians to confirm medical knowledge

accumulated throughout their entire education. MCC-ME highlights continuous education during the medical career, which is integrated into theme A (basic qualities and abilities required for a physician). Attitudes and motivations toward continuous education should, thus, be nurtured throughout medical education.

3 Milestones of Japanese Medical Education and Educational Data with Practical Cases

In view of recent educational reforms and demands for satisfying global medical standards in Japan, it is vital to identify milestones in medical education and assure student learning outcomes that correspond to those milestones. Thus, educational data collection and management are key in examining whether medical students have achieved them. This way, it will become possible to support medical students to improve their learning outcomes based on evidence. Japanese medical education is divided into three stages: admissions, medical school study, and post-graduation. Educational data necessary for effective management of teaching and learning are discussed regarding essential milestones in each stage of medical education, after which an actual case is presented. Educational data discussed in this paper may not be fully applicable to all medical schools, because of a certain degree of flexibility in the model core curriculum. However, this paper aims to provide insights into data management in medical school by focusing on the essential aspects driven by the MCC-ME.

The cases of utilizing educational data shown in the tables to illustrate data practices at Japanese universities are taken from the institutional research office (IRO) at Asahikawa Medical University (AMU), a national medical university in Japan focused on training competent physicians for local areas in need of medical care. AMU was founded in 1973 with a Doctor of Medicine degree program to improve regional medical services and welfare, and to reduce urban and rural medical-care disparities. In addition to the medical program, AMU currently offers a Bachelor of Nursing degree and two graduate degrees in Medical Science and Nursing Science. Its essential missions include nurturing medical care professionals and researchers who strive to acquire a high level of knowledge and technique, and advance medical research rooted in community medicine. Notably, as the northernmost medical university in Japan, AMU aims to contribute to medical care in local areas, including the northern and eastern regions of Hokkaido. To fulfill this mission, the medical school of AMU employs admission strategies for recruiting local students to contribute to community medicine. The IRO aims to collect and transform institutional data into meaningful information, provide insightful analyses, and support the strategic planning and decision-making of the university.

3.1 Medical School Admissions

Japanese medical schools employ different admission systems, leading to entrance examinations. Data on the results can be organized around admission types and their examination contents. Some studies conducted at national medical schools suggested that medical students admitted under certain admission types tended to earn higher grade point average (GPA) than those under other admission types [11]. Further, gender, specifically female gender, was identified as a potential factor positively influencing academic performance [12]. In addition, it is reported that entrance examination scores may be related to performance on particular subjects during medical

education [13]. Thus, an analysis of admissions data may lead to valuable findings that can predict the future academic performance of medical students.

In Table 1, admissions data and their potential analyses are summarized. Furthermore, it is also important to collect data on birthplaces or high school locations because the rural background may impact the choice of future work locations [14]. For decades, the Japanese medical care system encountered a relative shortage of physicians in rural areas. To solve this issue, a special admission system was incorporated into Japanese medical schools in 2008 to increase enrollment capacity for future rural physicians. Applicants with a geographic background from the region of the medical school and an intention to work there are eligible to apply under this frame. The regional frame admission system must function as a crucial gatekeeper to control the quality of medical students admitted under the frame, which potentially influences the quality of future medical care in rural areas.

Table 1: Data and Purposes with a Practical Case at Admission

Data	Purposes
Admissions and Entrance Examination Data 1. Admission types 2. Entrance examination results 3. Birthplace 4. High school information	• Explore links between entrance examination scores and academic performance during medical school • Examine whether students under certain admission types perform academically better than those under other types • Determine whether high school locations/birthplaces are related to their future workplaces
Practical Case Our office analyzes admissions data, especially the entrance examination results of admitted students by different admission types. Since our medical school assigns as much as almost half of its total enrollment capacity to the regional frame, we focus on the academic performance of our medical students based on four admission types: two types of general admissions and the regional frame that include admission office examination and recommendation examination. Based on the admission types, we compare the mean score in the entrance examinations and cumulative grade point average during medical school. Additional analysis is conducted to explore predictors at each admission type.	

3.2 Course of Study at Japanese Medical Schools

Although the MCC-ME may be adopted into medical school curriculums in different ways based on school missions and resources, it provides essential shared components for all medical school curriculums in Japan. To facilitate an understanding of studying at Japanese medical school, a typical course of study is illustrated below according to the MCC-ME. Table 2 summarizes education data during medical school and their purposes.

In line with the milestones, a course of study in Japanese medical schools is divided into (1) preparatory education period, (2) preclinical medical education period, and (3) clinical clerkship period. In the MCC-ME, liberal art education is usually provided in the early stage of medical school. First year students typically take many liberal art education courses fundamental to basic human sciences with some introductory specialized medical subjects. The 1st year of study at medical school may be the most important time for medical education to detect early signs of academic difficulty or dropout risk. Class attendance can be associated with GPA in the 1st year of study. Furthermore, GPA in the 1st year tends to be highly correlated with that in subsequent years [15]. Thus, it is crucial to ensure that medical students have positive learning experiences in their 1st year.

From the 2nd year onward, students start to take more specialized subjects in medicine. As the MCC-ME indicates, students are educated about various medical topics, covering normal structure and function, pathophysiology, diagnosis, and treatment of each organ system before the 5th year. In addition, students learn about the basics of medical practice to prepare for their clinical clerkship in their 5th and 6th years. As medical students acquire specialized knowledge of medicine, it is important to find potential weak areas of student learning. One method to identify such weak areas is to map out links between courses on specific medical topics and their learning outcomes. This way, it is possible to analyze deficits related to particular medical topics. Efforts must be made to overcome such deficits before students take the two examinations in their 4th year.

Table 2: Data and Purposes with a Practical Case at Medical School Study

I. PREPARATORY EDUCATION PERIOD AND PRECLINICAL MEDICAL EDUCATION PERIOD	
Data	Purposes
All Year: 1. Class attendance 2. Student course grades 3. Course evaluations 4. End-of-year questionnaires	• Identify and support students with academic difficulties and dropout risk • Clarify areas of weaknesses in medical knowledge and skills • Measure the level of mastery and align courses with the seven areas of medical skills and knowledge in the MCC-ME • Give students a voice and find areas for development to improve student satisfaction • Improve educational content by course evaluation • Collect information on student reflections, behaviors, and adjustments
II. PROFESSIONAL EDUCATION PERIOD (CLINICAL CLERKSHIP)	
Data	Purposes
4th Year* 1. Computer-based testing (CBT) 2. Objective structured clinical examination (OSCE)	• Identify strengths and weaknesses in medical knowledge, skills, and attitudes • Discover how course grades are related to the CBT results • Examine the preparedness of students in clinical settings through the OSCE

	• Analyze the relationship between the required examination results and the seven areas of medical knowledge and skills in the MCC-ME
5th to 6th Years* 1. Clinical clerkship 2. Post-clinical clerkship OSCE	• Evaluate performance on clinical clerkship • Explore how performance on clinical clerkship correlates with results of the CBT and OSCE • Examine whether students have acquired sufficient clinical skills and qualities specified in the MCC-ME • Assess the preparedness of students to enter clinical practice and use these data for program improvements
III. PRE-INITIAL CLINICAL TRAINING PERIOD	
Data	Purposes
NMPQE 1. Results (pass or fail) 2. Self-scoring results 3. Pass rates of all medical schools	• Examine factors associated with a pass or fail on the NMPQE • Analyze links between self-scoring results on the NMPQE and results of the CBT and OSCE • Compare pass rates among other medical schools and different cohorts
Before Graduation Survey 1. Educational experiences 2. Locations of clinical training	• Receive feedback on educational experiences, including an educational program, courses, faculty, facilities, and resources • Examine whether graduating students achieved educational objectives • Identify the trends of initial clinical training locations
Practical Case One of the important milestones in medical education is the National Medical Practitioners Qualifying Examination (NMPQE), because it is a mandatory national examination to register as a physician in Japan. Although the NMPQE does not directly measure clinical skills, courses offered at medical school must be relevant for the NMPQE. Thus, our office analyzes correlational coefficients between the self-scoring results on the NMPQE and learning outcome measures, such as the CBT, cumulative GPA, and comprehensive examinations in the 5th and 6th years. Additionally, the pass rate of the NMPQE was compared among different cohorts and against other medical schools in Japan, especially those similar to our medical school in characteristics. Considering our university's mission in enhancing regional medical care, it is important to ensure that graduates receive training in Hokkaido, especially at the affiliated hospital. This will help solve the issue of maldistribution of physicians in rural areas. As such, our office analyzes locations of initial clinical training of the graduates with a focus on the regional frame students. We are interested in how the introduction of the regional frame influences the locations of training and future medical practice.	

*Due to the flexibility of the MCC-ME, some universities may not follow the descriptions in Table 2. For instance, a few medical universities conduct CBT and OSCE for 3rd year students to start clinical clerkships from April of the 4th year.

As discussed previously, there are two essential milestones in the 4th year of Japanese medical education: the CBT to test medical knowledge and the OSCE to examine clinical skills and attitudes. These examination results need to be analyzed to identify any lack of knowledge on medical topics and any insufficient skills and attitudes. It may be useful to find associations between the CBT results and course grades because good grades in certain medical subjects may lead to high performance on the corresponding part of the CBT. After successfully completing the two examinations, students progress into clinical clerkship in the 5th and 6th years usually in their affiliated medical university hospital. It is worth analyzing correlations between performance in clinical clerkship and results of the CBT and the OSCE [16].

In the latter half of the 6th year, students will take the post-clinical clerkship OSCE as well as the NMPQE. As the NMPQE result details are not reported, it becomes necessary to ask students to self-score their examination results. It is important to examine any links between self-scoring results on the NMPQE and other academic results, such as the CBT and course grades. Identified associations can be utilized to improve educational content for future students. In addition, comparing the national license examination results with those of other medical schools may be helpful to expand efforts to increase the national license examination pass rate.

Immediately before graduation, a survey can be conducted to ask graduating students about their overall educational experiences; this survey can explore various aspects of educational experiences related to education programs, courses, faculty, facilities, and resources. The students' feedback could provide insights into how the current educational system can be improved, to maximize student experiences.

3.3 Post-Graduation

Two-year initial clinical training is required to become a physician in Japan. It is important to analyze data in the Evaluation System of Postgraduate Clinical Training, an online evaluation system of postgraduate clinical training. The introduction of its second version, the E-Portfolio of Clinical Training (EPOC2), was recently announced [17]. In addition to its function as an E-Portfolio, where a history of medical practices, including goal-setting, reflections, workshop attendance, and academic activities are accumulated, EPOC2 stores useful data related to supervising clinical trainees, such as the evaluation results of trainees' various abilities as physicians and their clinical experiences. Specifically, the trainees are evaluated in terms of their professionalism, qualities and abilities as physicians, and basic medical services on a scale of one to four [18]. Furthermore, it stores the evaluation results from medical professions other than their supervisors, and patients and their families. Surveying students about their general training experiences is also important for improving future clinical training.

To advance seamless clinical training in Japanese medical education, Clinical Clerkship E-Portfolio of Clinical Training (CC-EPOC) is scheduled to be introduced in 2021. CC-EPOC is an online e-Portfolio system used during clinical clerkship, where medical students learn fundamental medical skills. Traditionally, there was no link between clinical clerkship and postgraduate clinical training. Introducing both CC-EPOC and EPOC2 enables seamless clinical education, where the clinical skills of medical graduates can be improved further based on their experiences with CC [19].

Furthermore, an alumni survey can be implemented to explore various aspects of students' opinions about the education they received and their current situations, yielding insights that lead to optimization of current education. Additionally, comparing survey results by different cohorts or curriculums to explore any major differences among those groups is recommended. Results of an alumni survey can shed light on the universities' unique characteristics and strengths, and be utilized to establish and promote their values. A new physician specialization system in 19 basic fields of medicine was introduced in 2018. Collecting information on medical specialty is of interest to identify characteristics of career pathways, which can reveal unique attributes of the medical school. In Table 3, educational data after graduation and their objectives are summarized.

Table 3: Data and Purposes with a Practical Case at Post-Graduation

Data	Purposes
Initial Clinical Training 1. EPOC2 2. Clinical experiences	• Examine clinical experiences at an affiliated medical university hospital • Ensure seamless clinical education by examining transitions between clinical clerkship and initial clinical training
Lifework as a Physician (Alumni Survey) 1. Alumni experiences 2. Current status 3. Specialty obtained	• Measure alumni academic, clinical, and student experiences and satisfaction with areas of their education, and collect information on the current status and career pathways
Practical Case As part of quality assurance in medical education, it is important to demonstrate that medical schools provide graduating students with the skills and abilities required for physicians. Exploring alumni feedback on the education they received is necessary to improve the quality of education. Accordingly, our office analyzes the results of an alumni survey to explore their educational experiences. The questionnaire covers various aspects of alumni's educational experiences, including demographic information, reasons for choosing a medical school, their medical school study, and extracurricular activities. We identify and focus on educational experiences that are conducive to their current jobs and those that need improvement.	

3.4 Limitations

First, due to the flexibility of the model core curriculum, educational data discussed in this paper may not be fully applicable to all medical schools. Some educational data may not be relevant to some medical schools, whereas those not discussed may be important. Actual data in our practical cases could not be shared in this paper for administrative reasons. Second, as the COVID-19 pandemic has considerably impacted the provision of education worldwide, it is essential to identify effective ways to support the management of teaching and learning during and after the pandemic, for the advancement of medical education. Lastly, it is important to determine the rela-

tionships between courses and learning outcomes in the model core curriculum and/or the diploma policy (i.e., the learning outcomes of a degree program) [20]. Although creating the curriculum mapping alone may not lead to the achievements of degree-level competencies [21], it is crucial to move toward competency-based medical education to further enhance outcome-based education. Even with limitations, however, this paper provides essential insights on typical data practices of Japanese medical schools by focusing on shared model core curriculum.

3.5 Future Studies

Admissions data can provide important implications for students' performance during medical school. As entrance examinations vary, sharing analysis of admissions data can yield insights on improving medical school admissions. Furthermore, essential milestones identified in the core curriculum, such as the CBT, the OSCE, clinical clerkship, and the NMPQE, need to be carefully analyzed, because they lead to acquisition of medical knowledge, skills, and attitudes of a competent physician. This is especially important, as the CBT and OSCE become mandatory in Japanese medical education. For the advancement of medical education, it is also crucial in the future to develop methods to effectively analyze the contents of CC-EPOC and EPOC2 to ensure that clinical experiences are maximized throughout pre- and post-graduation clinical training. Lastly, it is imperative to ensure that students intending to work in rural areas contribute to rural medicine.

4 Conclusion

This paper discussed recent educational policies of Japan, international standards of medical education, the model core curriculum, and educational data to support students' progress and measure their achievements. This leads to the necessity of outcome-based education, where education can be improved by analyzing data on student learning outcomes. Each set of data has its valuable objectives, which can serve to form the basis of advancing outcome-based education. This paper identified milestones of Japanese medical education and their associated data to enable the assessment of whether medical students accomplish their milestones, with evidence. Additionally, practical cases were discussed to illustrate how data practices can contribute to the advancement of outcome-based education.

This paper aimed to provide a descriptive overview of educational data that correspond to shared milestones of Japanese medical education. By discussing the core curriculum adopted by almost all Japanese medical schools, this paper described a typical course of study at a Japanese medical school to enable general educators in medicine to gain insights on improving data management in Japanese medical education. It is our hope that educators will relate to and recognize the importance of utilizing educational data to ensure best student learning outcomes at their institutions.

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