

Development and validation of competency framework for teaching management of refractive errors: A participatory Delphi approach

Vidyut Rajhans, Ramesh S Ve, Ciraj Ali Mohammad¹, Sumita Rege²

Purpose: Competency-based education and assessment are globally trending, also embraced by recently announced National education policy 2020, India. Medical programs are rapidly transforming to produce competent health professionals, to satisfy public health requirements. This paper describes Delphi study with a participatory approach, to develop a competency matrix required for training of eye care professionals. **Methods:** Scoping review of literature formulated the baseline architecture of competency framework identifying two core competencies for management of refractive error, namely, “visual function assessment” and “optical technology management.” The Delphi technique was employed for the development of a competency matrix with detailed knowledge, skills, and attitude (KSA) definitions for all competency elements. A heterogeneous group including optometry practitioners, academicians, researchers, association representatives, and industry representatives accomplished the objective in four rounds. **Results:** Delphi study resulted in defining two competency clusters (CC): “CC1: Refraction” with 10 units and 43 elements and “CC2: Dispensing optics” with 8 units and 54 elements. KSA components of each of competency elements were identified and mapped with applied optics curriculum in the optometry program. **Conclusion:** Participation of all stakeholders of the educational system is essential and beneficial for nurturing of the competent workforce in healthcare. It helps build a curriculum not only having theoretical knowledge and skills but also the attitude and behavioral component of measurable competencies that satisfies the needs of the local healthcare system. This study has evolved a comprehensive competency matrix highlighting essential competencies required for the effective management of refractive error.

Key words: Competency-based education, curriculum development, Delphi method, dispensing optics, optometry, participatory approach, pedagogy, refractive error

The year 2020 witnessed enormous disruptions with the economic slowdown, loss of jobs, demands of up-skilling and reskilling for common citizens of most countries as a result of the COVID-19 pandemic.^[1,2] Work from home and remote education are seen evolving as “new normal.” An increasing number of people are experiencing digital eye strain, caused by continuous exposure of eyes to electronic screens, adding to the already existing massive burden of uncorrected refractive error.^[3] This calls for a large number of competent eye care professionals, with advanced knowledge and skills and competency toward efficient management of this public health issue.^[4] Novel approaches such as myopia control will show impact only when eye care practitioners are competent to use it as regular interventions^[5,6] and engage in continuous upgradation of their competencies of patient care. However, there is a significant lack number of trained professionals required to tackle this issue.^[7] Improving accessibility, acceptability, and affordability of primary eye care for

Department of Optometry, Manipal College of Health Professions,
¹Centre for Continuing Education and Interprofessional Development,
²Department of Occupational Therapy, Manipal College of Health Professions, Manipal Academy of Higher Education, Manipal, Udipi, Karnataka, India

Correspondence to: Dr. Ramesh S. Ve, Department of Optometry, Manipal College of Health Professions, Manipal Academy of Higher Education, Manipal, Udipi - 576 104, Karnataka, India. E-mail: ramesh.sve@manipal.edu

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addressing the issue of uncorrected refractive error through an institutionally trained competent workforce is the need of this hour.^[8] Further, the sudden shutdown of medical educational institutions with the rise of COVID-19 pandemic and its impact on clinical training in post pandemic world is likely to degrade the competency of the workforce being trained.^[9] Therefore, the training of primary eye care professionals must be restructured to address the challenges of the present situation.

Relevance and purpose of this paper

This study was completed in 2019. It finds more relevance and applicability in the present movement of transformation of the educational system.^[10] Competency-based education and assessment are globally trending, also embraced by recently announced National education policy 2020, India.^[7] Educational programs, especially in medicine and health professions, are getting modernized, adapting competency-based education, aimed to produce competent professionals, to satisfy public health requirements of the country.^[11] Presently, in India, the formulation of a regulatory council for healthcare professionals

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is in progress. However, there is a lack of a descriptive competency matrix, essential for the competency-based training and benchmark performance of primary eye care professionals. The objective of this study was to develop the holistic competency matrix with detailed knowledge, skill, and attitude (KSA) descriptions of each unit of core competencies of the eye care profession which will further guide the development of a competency-based curriculum.

Methods

Ethics statement

This study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the Institutional Ethics Committee (No: IEC 327/2017).

Study design

A baseline competency framework was established by a scoping review of the literature. This was followed by a qualitative study using the Delphi process. This study was informed by the standards for Conducting and Reporting Delphi Studies guidelines,^[12] and the outcomes are reported using standards for reporting qualitative research.^[13]

Selection and formulation of competency clusters (CCs)

According to the World Council of Optometry and the World Health Organization, “vision function services” and “optical technology services” are the two fundamental categories of optometry practice.^[14,15] Precisely, these competencies are required to effectively address and manage the problem of refractive error. Hence, a subject-based curriculum related to “refraction” and “dispensing optics” was chosen for transformation. A scoping review of the literature of entry-level competencies required in various countries across the globe was done to derive a baseline competency matrix framework.

The rationale for the choice of Delphi

The Delphi technique is one of the popular methods for the development of competency frameworks and a curriculum in medical and allied health professions.^[16] The Delphi technique provides tools to effectively get professional inputs from study participants and help address challenges such as seniority or experience of experts, physical distances of experts, the difference of opinions (mostly due to variation in practices or setup-optometry clinical and in optical setup), conflicts, biases, etc., Therefore, we decided to use the Delphi consensus method for this study. We made structured changes to the Delphi technique in the first and second round of this study to achieve efficiency and precision.

Experts panel in the Delphi consensus study

With purposive sampling, 19 optometry professionals of national repute, key opinion leaders in different job roles, such as clinicians, educators, researchers, and industry representatives were invited to participate in this study. Participants in this study comprised of three graduates with a Bachelor in optometry, 15 postgraduates and 1 PhD qualified professional with experience ranging from 2 to 30 years.

The Delphi panel of experts comprised of external stakeholders of national repute, key opinion leaders of the profession, experienced clinical practitioners, and industry partners were invited to develop and validate the competency matrix. Internal stakeholders like students, subject

teachers, academicians, and researchers were approached for their involvement in developing a competency matrix and subsequently translating it into a competency-based curriculum. The study also included international academic expertise (optometry and medical education) intending to benchmark our curriculum with global educational trends and practice standards.

Participants were invited to voluntarily participate in the study and were given the liberty to exit at any point if they felt the inability to continue. E-consent was obtained from all participants; they were sensitized to the objective and methodology of the study using an instructional guide and were assured of anonymity. The inputs given by experts underwent anonymous compilation and analysis was done at the end of each round to avoid the risk of bias. Two reminders with personal messages or phone calls were given in each round when the response from a participant was not received within the stipulated time. A participant was considered withdrawn if he/she did not respond even after two reminders.

Predetermined definitions of consensus for Delphi rounds

- First round: The Likert scale scoring 1–4 described as not required (1), desirable (2), essential (3), and most essential (4) was used. The experts were asked to mark each competency element using this scale. All the competency elements which had scored 3 or 4 by at least 75% of participants would be included in the competency matrix
- Final round: At least 95% agreement for the definition of each competency element was required between all participants of the final round of the Delphi process, which considered it as a valid KSA description in the final competency document
- Stability of agreement: A comparison of definitions in rounds 3 and 4 with less than 10% variation in the number of participants reporting differently will be considered as stability of agreement.

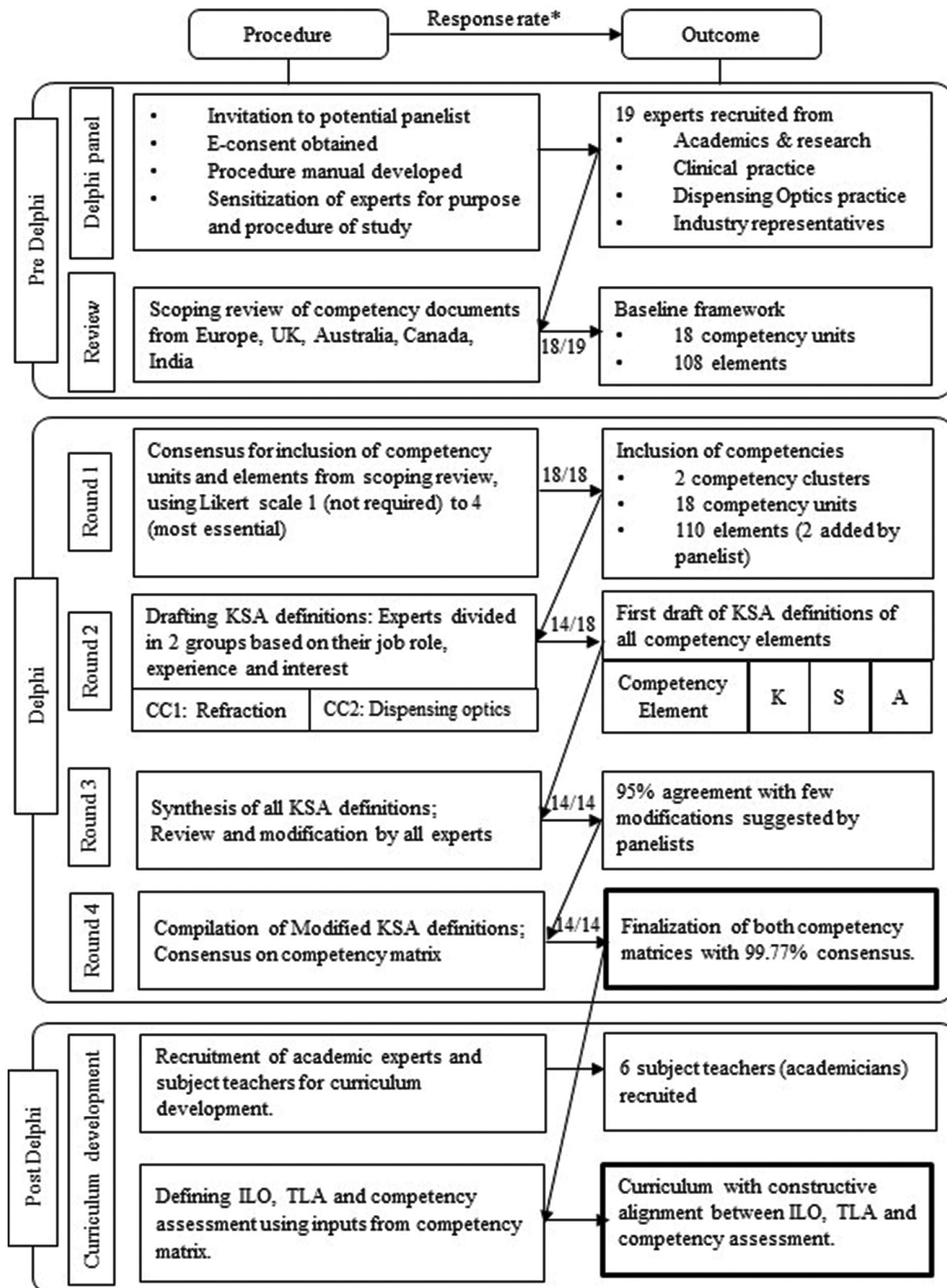
Modified Delphi procedure

Delphi procedure was modified to best fit the design and purpose of this study.^[17] In the first round, open-ended questions were replaced by a structured questionnaire with a Likert scale to finalize the baseline competency framework. In the second round which aimed at developing KSA, the competency units were grouped in two clusters, namely, “CC1: refraction” and “CC2: dispensing optics.” Delphi panel experts were also distributed across these two groups based on their interest and experience. A detailed KSA matrix for each CC was developed simultaneously.

All definitions of each competency element were reviewed by all experts in the third round and modifications were suggested. Modified definitions were reviewed and validated by Delphi experts again in the fourth round. Consensus and stability of agreement were computed with descriptive statistics using MS Excel (2013) by PI of the study. Fig. 1 shows the detailed procedure and outcome of each round of this Delphi study.

Results

The scoping review identified 10 documents related to the definition and/or description of competencies in the domains of “refraction” and “dispensing optics.” A qualitative synthesis



*Response rate= No. of responses received/No. of panelist

Figure 1: Delphi method

of competencies mentioned in these documents resulted in 18 competency units, described in 108 competency elements.

Eighteen out of 19 invited experts volunteered to be part of the Delphi panel. One expert declined the participation on the grounds of unavailability due to international travel plans. The Delphi procedure for defining and validation of competency matrix was completed in the sequence of four rounds.

Round 1 in the Delphi process recorded 100% response, determining the inclusion of competency elements in the competency matrix. With the addition of two elements by the experts, a total of 18 competency units, described in 97 elements, were included in the baseline competency framework. The units were divided into two CCs, namely, "refraction" and "dispensing optics" for further KSA descriptions. Tables 1 and 2

show the baseline competency framework with a description of competency units and applicable competency elements in each unit.

In the second round, 14 out of 18 (78%) experts, seven in each group, responded with narrative construction of the KSA matrix. A qualitative synthesis of KSA definitions was done and sent to all the experts to seek agreement in further rounds. CC1 recorded average agreement of 97.42% (range: 82.93–100%), while CC2 recorded 98.02% (range: 92.59–100%) in the third round of Delphi process. The fourth round achieved average of 99.75% (range: 93–100%) and 99.84% (range: 97–100%) agreement in CC1 and CC2, respectively. All the competency units showed stability of agreement between the third and fourth round. The outcome of the fourth round was an

Table 1: Competency framework for CC1: Refraction

Unit no	Short title and description of competency unit	Short description of competency elements
1	Case history: Ability to efficiently record a structured and accurate history from ophthalmic patients	Communicate effectively with the patient Build rapport and empathy with patients Record a structured, efficient, and accurate history Assimilation of information received from the patient External/general observation of a patient's condition
2	Vision assessment: Ability to record presenting visual acuity for distance	Record unioocular/binocular distance visual acuity with available test setup
3	Objective refraction: Ability to find out refractive status of eye using objective tests of refraction	Retinoscopy Keratometry
4	Subjective refraction: Ability to find out refractive status of eye using subjective tests of refraction	Lens compare (trial frame) method Duochrome technique Fogging technique JCC technique Binocular refraction Binocular balancing Cycloplegic refraction
5	Near vision assessment: Ability to record near visual acuity and determine near vision correction for different age groups	Assessment of near visual acuity Determination of add power Visual assessment at specific working distance Determination of refractive correction at specific working distance
6	Refraction in special cases: Ability to determine refractive status of eye in uncommon cases	Pediatric patients Amblyopia Anisometropia Aniseikonia Strabismus Aphakia Visual field defects Neuroophthalmic patients Low-vision patients
7	Prescribing Prisms: Ability assess binocular alignment and prescribe prisms when necessary	Assessment of ocular alignment Determination of prism power Determination of final prescription of prisms
8	Primary eye examination: Ability to perform general primary eye examination in patients with refractive error	Assessment of pupil reaction Assessment of accommodation Assessment of convergence Assessment of BSV
9	Management of refractive error: Ability to prescribe appropriate correction for refractive error	Determination of final prescription Prescribing the final refraction Patient counselling/education for refractive correction
10	Choice of optical aids: Ability to determine and counsel for appropriate optical aid for correction of refractive error	Ocular refraction vs spectacle refraction Spectacle magnification, relative spectacle magnification Ocular accommodation vs spectacle accommodation Choice of aid based on etiology of refractive error Advising patient for use of appropriate optical aid

Table 2: Competency framework for CC2: Dispensing optics

Unit no	Short title and description of competency unit	Short description of competency elements
11	The interpretation of prescriptions: Ability to interpret and ensure validity of refractive error prescription	Communicate effectively with the customer Analysis of prescription Finding need and use of spectacles Identification of vocational/avocational use of spectacles External/general observation of patient
12	Previous spectacle: Ability to identify various parameters of previous spectacles and prescription	Frame specifications Lens specifications Lensometry Transposition Vertex distance calculations and effectivity Base curve of spectacle lenses
13	Choice of frames: Ability to recommend appropriate choice of frame for given ophthalmic prescription for a patient	Construction of frames Classification of frames Frame measurements Considerations for appropriate frame selection Counselling for appropriate frame selection Value addition in selection of ophthalmic frames Face measurements and markings Special types of frames (ptosis spectacle, monocles, safety glasses, etc.)
14	Choice of Lenses: Ability to make appropriate choice of ophthalmic lenses for given ophthalmic prescription for a patient	Types of lens designs (SV, BF, progressive) Materials of lenses Forms of lenses Best form of ophthalmic lens Center-edge thickness Manufacturing of ophthalmic lenses Various types of surface coatings Quality of finished ophthalmic lens Tolerance limits to errors in lens power Special types of lenses (aspheric, toughened, polarized, tinted, etc.) Value addition in ophthalmic lenses Selection of appropriate lens Counselling for selection of lenses Placing order for ophthalmic lens
15	Fitting and glazing process: Ability to understand fitting process and ensure its quality	Prefitting quality assessment Lens centration and axis marking Glazing process Postfitting quality assessment Standard alignment Final verification and standard alignment of spectacle
16	Dispensing the spectacle: Ability to dispense the spectacle with appropriate counseling	Quality assessment of spectacle before delivery Verification at the time of delivery of spectacles Counselling of customer at the time of delivery of spectacles Customer's FAQs and their ideal answers
17	Troubleshooting of nonadapting cases: Ability to identify causes of nonadaptation and manage the troubleshooting process	Most frequent complaints/nonadaptation issues Assessment of spectacle and its fitting Finding of probable causes of nonadaptation Possible solutions to solve the complaints Counselling of nonadapting cases Spectacle repairs/readjustments
18	Business aspects in dispensing optics: Ability to comprehend business aspects of dispensing optics and optometry profession	Inventory management Legal and ethical aspects in dispensing optics National/international safety norms Advancements in dispensing technology/products

all-inclusive competency matrix containing two CCs, namely, "CC1: Refraction" and "CC2: Dispensing optics," subdivided into 18 competency units and 97 competency elements.

Curriculum development

The outcome derived from the Delphi consensus study, a competency matrix with a detailed description of KSA

required for each competency unit, forms the basis of curriculum development. Horizontal and vertical integration of competency units was done by a group of subject teachers which translated the KSA components into learning objectives. The curriculum was then customized to suit the local academic environment by aligning teaching-learning activities and assessments with the learning objectives.

Discussion

Benefits of the participatory approach and holistic matrix

The trend of transforming a traditional curriculum into the competency-based curriculum is catching up in most healthcare education programs and eye care is no exception.^[18-21] The competency matrix obtained in this study is highly consistent with the present competency frameworks of many international optometry institutions/councils.^[14,18,22] Findings of our scoping review suggest that competencies are often described in terms of performance expected from a graduate optometrist. In the current study, a holistic approach was adopted to define the KSA components of each competency element, which facilitated the easy transition of the competencies into learning objectives. Further, it also simplified the process of integration of various competency elements which helped in achieving constructive alignment between learning objectives, teaching-learning methods, and assessment. The process brought clarity to the curriculum by decluttering the curriculum with the removal of redundant theoretical topics and deduplication of contents in multiple subjects.

Development of task force for addressing public health issue

The main concern in addressing the problem of uncorrected refractive error is the lack of competent human resources.^[23] World report on vision (2019) estimates that about 2.2 billion people having visual impairment with the most prevalent cause of unaddressed refractive error 123.7 million and additionally 826 million presbyopes.^[24] The incidence and prevalence of myopia are alarmingly on the rise, affecting 27% (1893 Million) of the world population in 2010, estimated to reach 52% (4949 million) by 2050.^[25] With improved life expectancy, the aged population is estimated to increase from 9% (2019) to 16% (2050) globally^[26] thus increasing the need for refractive care among the elderly population. The number of presbyopes with unaddressed near vision impairment is considerably high, resulting in a significant loss in productivity, globally contributing to the economic burden of \$25.367 billion (0.037% of GDP, in 2015).^[27] Additionally, uncorrected refractive error is identified as a substantial barrier in the education of children.^[28] Loss of productivity due to an uncorrected refractive error at a young age has a significant impact on socioeconomic developments.^[29,30] Considering the emerging work cultures post COVID-19 pandemic across the globe, and with increasing dependency on electronic gadgets and screens, visual demands and eye care needs are enormously increasing.^[31]

Globally, there is an uneven distribution of eye professionals engaged in primary eye care services and there is a lesser number of new graduates with good competency to address the increasing magnitude of refractive error.^[25,32,33] Further, the training imparted to most health professional curriculum does not match industrial and professional standards. The increasing need for eye care professionals and lack of adequate training standards is paving way for malpractices and substandard care, especially in developing countries.^[24] There is a need to customize existing training programs in the development of the task-specific skilled workforce, catering to the country's healthcare needs.^[21,24] The experience of developing an ophthalmic technician cadre for reduction of cataract backlog adopted by the National program for control of blindness and Vision 2020 programs proved largely successful.^[34] With these programs running for over 20 years, the training of primary

eye care professionals has been more focused on screening eye ailments and pre-post-surgical care for cataract patients.^[35] Now, the training programs for the upcoming decade need to be focused on addressing the issue of uncorrected refractive error.^[21] To the best of our knowledge, this is the first study of its kind that seeks to develop the holistic competency matrix with a description of KSA mapped for core competencies required for primary eye care professionals. The matrix not only elaborates on the required knowledge and skill but also gives description for the attitude element, often referred to as a hidden curriculum in medical and health professional curriculum.^[36] The outcome of this study, the competency matrix, may be used as the basis of developing a customized curriculum for developing task-specific competencies in the early years of existing professional education programs. Evidence mainly from maternal health and HIV prevention programs suggest that task sharing to mid-level cadres is a promising strategy and good health outcomes are possible.^[37,38] Competent students in the early years of their optometry or other primary eye care educational programs can be recruited for mass screening of refractive error in community and school camps, with minimal supervision by qualified professionals. This is a win-win solution for both, the academic institutions and the community. On one end, it is a cost-effective and time-efficient solution to reach the unreached community. On the other end, students will learn using experiential learning methods, effectively adopting the directions of National Educational Policy, 2020.^[7] Adapting the competency framework, students will not only know the theoretical aspect but will also be able to apply that knowledge to solve the problems of the community. Additionally, the competency framework developed in this study is useful as an assessment guide for certification of competency of these trainees in management of refractive error.

Limitations

The process of transforming the subject-based curriculum into the futuristic competency-based curriculum was based on already established norms of today's eye care practice. Therefore, the results of this study may appear more conservative. It is difficult to predict the future of management strategies of refractive error. Curriculum development is not one time but a dynamic and continuous process. This study highlights the importance of a holistic approach to curriculum development. The competencies considered here represent the views of participating experts of this study. Since all but one panelist were familiar with the Indian curriculum, it is possible that consensus is biased toward the established Indian curriculum, but can be best suited for educational programs of primary and secondary eye care much similar to India. However, the variety in professional role and experience of experts has brought a sense of completeness in the competency matrix and therefore it may be used as a baseline framework for developing a competency-based curriculum in eye care professional training programs at various levels.

Conclusion

The focus of eye care services in the upcoming decade will be the management of visual impairment due to unaddressed refractive error. A brigade of eye care professionals trained with task-specific competencies is a dire requirement. The competency matrix developed in this study provides a ready framework for curriculum development along with

an emphasis on assessment aspects. This competency matrix would help in determining KSA and behavioral component of the curriculum, aligning it with National Educational Policy, 2020, and will potentially satisfy the local needs of the healthcare system of developing country like India.

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Conflicts of interest

There are no conflicts of interest.

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