Indicators for Assessing the Quality of Refractive Error Care

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SIGNIFICANCE: Quality refractive error care is essential for reducing vision impairment. Quality indicators and standardized approaches for assessing the quality of refractive error care need to be established.

PURPOSE: This study aimed to develop a set of indicators for assessing the quality of refractive error care and test their applicability in a real-world setting using unannounced standardized patients (USPs).

METHODS: Patient outcomes and three quality of refractive error care (Q.REC) indicators (1, optimally prescribed spectacles; 2, adequately prescribed spectacles; 3, vector dioptric distance) were developed using existing literature, refraction training standards, and consulting educators. Twenty-one USPs with various refractive errors were trained to visit optical stores across Vietnam to have a refraction, observe techniques, and order spectacles. Spectacles were assessed against each Q.REC indicator and tested for associations with vision and comfort.

RESULTS: Overall, 44.1% (184/417) of spectacles provided good vision and comfort. Of the spectacles that met Q.REC indicators 1 and 2, 62.5 and 54.9%, respectively, provided both good vision and comfort. Optimally prescribed spectacles (indicator 1) were significantly more likely to provide good vision and comfort independently compared with spectacles that did not meet any indicator (good vision: 94.6 vs. 85.0%, $P = .01$; comfortable: 66.1 vs. 36.3%, $P < .01$). Adequately prescribed spectacles (indicator 2) were more likely to provide good comfort compared with spectacles not meeting any indicator (57.7 vs. 36.3%, $P < .01$); however, vision outcomes were not significantly different (85.9 vs. 85.0%, $P = .90$). Good vision was associated with a lower mean vector dioptric distance ($P < .01$) but not with comfort ($P = .52$).

CONCLUSIONS: The optimally prescribed spectacles indicator is a promising approach for assessing the quality of refractive error care without additional assessments of vision and comfort. Using USPs is a practical approach and could be used as a standardized method for evaluating the quality of refractive error care.

Supplemental Digital Content: Direct URL links are provided within the text.

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In 2015, an estimated 950 million people were blind or vision impaired simply because they were unable to access an eye examination or appropriate refractive correction.[1] Uncorrected refractive error accounts for 48.9% of the global burden of distance vision impairment,[1] and it is anticipated that the prevalence of myopia will increase significantly by 2050 because of increased urbanization and lifestyle changes.[2]

Spectacles are a cost-effective intervention for uncorrected refractive error; however, they are prescribed and dispensed by a wide range of eye care cadres globally, including primary eye care workers, midlevel ophthalmic personnel, optometrists, ophthalmologists, and personnel without any formal training. In addition, the services and functions carried out by each type of eye care cadre is largely dependent on the local legislation, health system structures, available training, the demand for services, and cultural perceptions.[3] The wide range in personnel and significant variations in curricula can result in inconsistent knowledge and skills in the delivery of services, potentially compromising quality of care.

Quality of care can be defined as the degree to which health services increase the likelihood of a desired health outcome,[4] and it is an essential component of universal health coverage and sustainable development goals. The need to establish quality standards and indicators for eye health was identified by the World Health Organization Resolution 66.4 "Universal Eye Health: A Global Action Plan 2014–19" as critical for providing comprehensive and equitable eye care.[5] Refractive error care should be effective, safe, people-centered, timely, equitable, integrated, and efficient.[4,6] Previous cross-sectional studies have provided information on the prevalence of blindness and vision impairment, and the proportions due to uncorrected or inappropriately corrected refractive errors. However, such studies offer limited information on the quality of the local refractive error care, and hence, a new approach is needed.

Quality indicators for cataract surgical outcomes have been established for two decades and use visual acuity as a primary indicator of quality.[7] However, visual acuity alone is not an appropriate indicator for assessing refractive error care outcomes because of the eye's ability to accommodate, which can affect vision comfort when induced unnecessarily. Assessing the quality of refractive error care outcomes therefore requires consideration of both vision and comfort.

In addition to an accurate refraction, effective refractive error care requires the availability of suitable spectacles, including appropriate lens powers and materials, absence of aberrations or unwanted prismatic power, and a comfortable frame. To assess the quality of spectacles, the skill of both the person performing the refraction and the optical dispenser (although in some instances, potentially the same individual) need to be considered.

The gold standard for evaluating clinical practice quality is the use of simulated clients or unannounced standardized patients, where "actors" are trained to act covertly as patients in a standardized fashion while observing clinical techniques and services provided.[4,8–10] Unannounced standardized patients have been used extensively in low- and middle-income countries, often in evaluating family planning, pharmaceutical dispensing patterns, and clinical prescribing patterns.[10,11] If executed well, the distinct advantage of using unannounced standardized patients is that observation bias is minimized, as care providers are less likely to modify behaviors if they are unaware of being observed. In the refractive error care context, this approach would allow for the identification of the refraction elements performed, equipment used, spectacle recommendations, and accuracy of any spectacles made. It also provides the opportunity to assess patient outcomes across a range of refractive error profiles, as different skills and techniques are used in different presentations.

The aim of this study was to develop a set of patient outcomes and indicators of quality refractive error care and field test in a real-world setting using unannounced standardized patients. Vietnam is a prime example of a setting where multiple eye care cadres exist in the public and private sectors. Although national medical guidelines lay out the minimum training requirements to prescribe spectacles, the oversight and implementation of these regulations have been questioned, along with the quality of refractive error care.[12] Therefore, the protocol was field tested in Vietnam.

METHODS

Patient outcomes and quality of refractive error care indicators were developed by reviewing existing literature, available refraction training standards criteria, and consulting refraction and dispensing educators. Twenty-one unannounced standardized patients with various refractive errors were trained to visit optical stores across Vietnam, have a refraction conducted, observe refraction techniques, and order spectacles. We investigated the associations between patient outcomes and the quality of refractive error care indicators for each pair of spectacles to identify the most appropriate quality of refractive error care indicator for predicting the best patient outcomes.

Patient Outcomes: Vision and Comfort

Good vision and comfortable vision are the primary desired outcomes for refractive error care. Although visual acuity is a standard measure used by eye care providers to assess visual function and monitor change, measurements can vary depending on the chart type, clinician, and individual. Test-retest reliability of visual acuity among various clinicians is typically within 1 to 1.5 lines on a logMAR visual acuity chart.[13,14] Accordingly, we defined "good vision" as follows: (1) achieving visual acuity not more than 1.5 lines worse than the baseline best-corrected visual acuity in each eye on a logMAR visual acuity chart (<logMAR change of 0.15), and (2) logMAR 0.4 at 40 cm with both eyes for nonpresbyopes (those

who do not require a near addition because of age-related lens changes) or (3) logMAR 0.4 at 40 cm with both eyes for presbyopes with near correction if prescribed.

As accommodation and demands on binocular vision increase with near work, vision comfort was assessed subjectively at near. "Good comfort" was defined as no reports of eye strain or discomfort with spectacles when reading a near visual acuity chart for those prescribed near or bifocal spectacles and, for nonpresbyopes, those prescribed distance spectacles for constant wear.

Suitable spectacles are a necessary component of appropriate refractive error care and should correlate with good vision and comfort outcomes. Therefore, we also examined the associations between good vision and comfort with the three objective quality of refractive error care indicators, which were developed to compare a pair of spectacles with the participant's baseline subjective refraction. Each of the three quality indicators was then assessed to determine which was best correlated with both vision and comfort.

Quality of Refractive Error Care Indicator 1: Optimally Prescribed Spectacles

We reviewed various refraction training standards for marking criteria in an attempt to define the criteria for refraction and prescription spectacles. Criteria were available in various countries including Australia, India, Mozambique, United Kingdom, and United States[15–19] and reported as a set of ranges for spherical power, cylindrical power, and cylindrical axis that were considered "accurate." These ranged from within 0.25 diopter sphere (DS)/diopter cylinder (DC) to 0.75 DS/DC, with cylinder axis tolerance limits ranging from 5 to 10°. However, because we were unable to ascertain the rationale for why the marking criteria were selected from these training standards, they proved unsuitable for our use. We therefore developed spectacle quality criteria based on subjective intolerance to spectacles for lens power and induced prism, as comfort was considered essential to spectacle acceptance. Available literature indicated that most patients intolerant to their spectacles were found to prefer a prescription change of 0.50 D or less to either sphere or cylinder power for spectacle acceptance.[20] An alternative study demonstrated that most participants were able to comfortably tolerate up to 1 and 0.50 prism diopters of induced horizontal and vertical prism, respectively.[21] These values were used as the maximum tolerance compared with the baseline prescription for the respective spectacle components. Because we were unable to identify published evidence on subjective tolerance to cylindrical axis, published standards were used.[22] Achieving all criteria in both lenses compared with the baseline prescription was defined as "optimally prescribed spectacles" (Table 1).

Quality of Refractive Error Care Indicator 2: Adequately Prescribed Spectacles

In some circumstances, spherocylindrical lenses might not be prescribed. For example, in low-resource settings, spherocylindrical lenses might not be available or affordable for the patient. Alternatively, the eye care provider might determine the patient to be intolerant to astigmatic correction. To account for this, less stringent criteria were also developed, within which spherical equivalent power in combination with vertical and horizontal prism was evaluated (Table 2). Achieving these criteria in both lenses compared with the baseline prescription was defined as "adequately prescribed spectacles."

TABLE 1. Criteria for indicator 1: optimally prescribed spectacles

Spectacle component	Tolerance limits compared with baseline prescription
Spherical power	±0.50 D
Cylindrical power	±0.50 D
Cylindrical axis (if baseline ≤−0.50 DC)	±7°
Cylindrical axis (if baseline > −0.50 to ≤−1.50 DC)	±5°
Cylindrical axis (if baseline > −1.50 DC)	±2°
Horizontal prism	<1 prism diopter (in/out direction)
Vertical prism	<0.50 prism diopter (up/down direction)

DC = diopter cylinder.

Quality of Refractive Error Care Indicator 3: Vector Dioptric Distance

The vector dioptric distance formula has been previously considered as a quality indicator because it has the advantage of combining the spherocylindrical refractive components into a single value. The following formula or a similar version has been used to assess refraction differences among clinicians and between clinicians and autorefractors.[23–26]

$$\text{Vector dioptric distance} = \sqrt{2} \times \sqrt{(M_1-M_2)^2 + (J0_1-J0_2)^2 + (J45_1-J45_2)^2}$$

where

- M = sphere power + (cylinder power/2), also known as spherical equivalent refractive power
- J_0 = −(cylinder power/2) × cos (2 × axis)
- J_{45} = −(cylinder power/2) × sin (2 × axis)
- 1 = baseline refraction
- 2 = dispensed spectacles

Refractive Error Quality Assessment Using Unannounced Standardized Patients

Unannounced Standardized Patient Recruitment, Training, and Optical Store Sampling

The study was conducted across three locations in Vietnam, namely, Phu Tho, Da Nang, and Ho Chi Minh City, which were distinct locations and varied in sociodemographic profiles. Vietnam was selected as the study setting because of the significant rates of vision impairment from uncorrected refractive errors in the region.[2]

We recruited unannounced standardized patients with various refractive error types including emmetropia and from the corresponding locations to minimize the risk of identification. Exclusion criteria for unannounced standardized patients comprised any prior formal ophthalmic or refraction training to avoid potential bias in guiding optical staff and any ocular or systemic conditions that could result in variable refractions (keratoconus, dry eye disease, poorly controlled diabetes), any previous refractive surgery, or any binocular vision disorders that could influence subjective comfort responses with spectacle wear.

Each unannounced standardized patient received three subjective refractions from three experienced refractionists from two of Vietnam's leading tertiary eye hospitals, overseen by a registered optometrist, and the results were averaged to provide a baseline prescription. For all eyes, spherical equivalent refractions were within 0.75 D in 97% of the repeated measures between refractionists (Appendix Table A1, available at http://links.lww.com/OPX/A472). The unannounced standardized patients were then trained in observing objective and subjective refraction techniques, as well as other aspects such as testing distance relative to the distance visual acuity chart or target and lighting (Appendix Table A2, available at http://links.lww.com/OPX/A473). The additional aspects were to assess whether physiological accommodation could be induced and affect refraction outcomes. Unannounced standardized patients were, however, not trained to identify whether the clinical refraction techniques were performed correctly, only to identify if the techniques were conducted.

The sampling frame was a list of refractive error services in the three locations, which was provided by the local government. We used an "opt-out" approach, under which all optical stores identified were provided the Participant Information Statement and Withdrawal Forms at least 2 weeks before data collection. A total of 104 private optical stores were randomly selected across the three locations (60 in Ho Chi Minh City, 29 in Da Nang, 15 in Phu Tho). The number of stores selected from each location was representative of the total number of stores in each location. Because considerably more stores in Ho Chi Minh City were selected, two groups of unannounced standardized patients were recruited to attend up to 30 stores each.

Each unannounced standardized patient was instructed to enter each selected store within his/her location, request an eye examination, observe refraction tests that were conducted, and purchase prescription lenses for use with spectacle frames that were provided. If an unannounced standardized patient was identified by the store staff, the visit was abandoned and any data were excluded from analyses. The unannounced standardized patients who were classified as having emmetropia or low ametropia were instructed to purchase spectacles only if recommended by the refractionist. At the end of each visit, the unannounced standardized patient recorded the tests that were performed by the refractionist or store staff, as well as levels of communication (Appendix Table A2, available at http://links.lww.com/OPX/A473). Unannounced standardized patients attended quality check visits with trained refractionists after every 10 store visits to assess whether their observations were being conducted appropriately (Appendix Table A3, available at http://links.lww.com/OPX/A474).

Unannounced standardized patients wore each pair of ordered spectacles at the visits with the research refractionist. The research

TABLE 2. Criteria for indicator 2: adequately prescribed spectacles (spherical equivalent)

Spectacle component	Tolerance limits compared with the baseline prescription
Spherical equivalent power	±0.50 D
Horizontal prism	<1 prism diopter (in/out direction)
Vertical prism	<0.50 prism diopter (up/down direction)

refractionist, masked to baseline refraction results, then assessed corrected distance (monocular and binocular) visual acuity, near visual acuity (binocular), and vision comfort at near. Spectacle lenses were also measured with focimetry for power, axis, horizontal lens centration distance, and the presence of vertical prism.

Approximately 2 months after the completion of data collection, a questionnaire was sent to the optical stores to assess whether unannounced standardized patients had been identified and, if so, to determine the features that led the unannounced standardized patient to be exposed to the optical store staff.

Analysis

Data were recorded using Epi Info mobile application (Centers for Disease Control and Prevention, Atlanta, GA). Statistical analyses were conducted with IBM SPSS Statistics software (version 25; SPSS, Chicago, IL). Descriptive statistics were applied to summarize demographic information, refractive error type, and pupillary distance. Induced prismatic effect was calculated based on the mean pupillary distance at baseline, lens centration distance, and lens power. Good vision, comfort, and quality of refractive error care indicators 1 and 2 were analyzed as categorical variables, whereas analyses with vector dioptric distance as a continuous variable were conducted. Optimally prescribed spectacles were also likely to pass indicator 2; therefore, to compare the two criteria, "adequately prescribed spectacles" included those that only met indicator 2. The relationship between subjective and objective indicators was assessed using the χ^2 and McNemar's tests for independent and dependent categorical data, respectively. Bonferroni correction was applied to multiple comparisons. Spearman ρ and Mann-Whitney U tests were used for nonparametric correlation and comparison of nonparametric continuous data, respectively. $P < .05$ was considered statistically significant.

Ethical Conduct of Research

Ethics approvals were obtained from the Hanoi University of Public Health (no. 017-358/DD-YTCC) Institutional Ethical Review Board and the University of New South Wales Human Research Ethics Committee (HC17415).

RESULTS

A total of 21 unannounced standardized patients were recruited across the three locations. Table 3 presents the basic demographics of each unannounced standardized patient, classifies the type of refractive error in each eye, and records the presence of presbyopia. The baseline refraction and mean spherical equivalent outcomes of each unannounced standardized patient are presented in detail (Appendix Table A3, available at http://links.lww.com/OPX/A474).

A total of 93 optical stores were included, and 480 visits were performed, with 11 stores in Ho Chi Minh City withdrawn and excluded from analyses because of them not being provided the Participant Information Statement and Withdrawal Forms before the first unannounced standardized patient visit. Only three stores responded to the post-unannounced standardized patient data collection questionnaire, all from Phu Tho. No unannounced standardized patients were reported as having been identified. A total of 417 pairs of spectacles were prescribed: 196, single vision distance; 216, single vision near; and 5, bifocals. The unannounced standardized patients with emmetropia or low prescription (n = 4) were prescribed spectacles at 38.7% (36/93) of visits. Of those prescribed spectacles, 8.6% (8/93) were provided with either plano or −0.25 DS lenses.

Overall, 44.1% (184/417) of spectacles achieved good vision and comfort. Of the spectacles that met quality of refractive error care indicators 1 and 2, 62.5 and 54.9%, respectively, provided both good vision and comfort. Table 4 presents the proportion of spectacles that achieved good vision or comfort for quality of refractive error care indicators 1 and 2. Spectacles meeting quality of refractive error care indicator 1 (optimally prescribed spectacles) were significantly associated with good vision and comfort, in combination (Fig. 1) and separately. Unannounced standardized patients who achieved good vision outcomes were significantly more likely to have optimally prescribed spectacles rather than spectacles that met quality of refractive error care indicator 2 (adequately prescribed spectacles [$P = .04$] or spectacles that did not meet either criteria [$P = .01$]). However, there were no significant differences in the vision outcomes of unannounced standardized patients who received adequately prescribed spectacles and those whose prescribed spectacles did not pass either criteria ($P = .90$). Unannounced standardized patients who were prescribed spectacles meeting the optimally prescribed criteria or the adequately prescribed criteria were more likely to report comfortable vision compared with those prescribed spectacles that did not meet either standard ($P = .001$).

Of the spectacles that did not meet indicators 1 or 2, 85.0% (199/234) still achieved good vision. Based on the difference of best vision sphere power compared with baseline, 58.8% (117/199) were prescribed with more minus in at least one lens, 35.2% (70/199; all near spectacles except one) were prescribed with more plus in at least one lens, and 5.0% (10/199) were prescribed a mix where one lens was more plus and the other more minus when compared with the baseline prescription. The remaining two pairs of spectacles had the same power compared with baseline but did not meet either criteria because of vertically misaligned optical centers.

The mean (standard deviation) vector dioptric distance for right eyes was 0.74 (0.63), and that for left eyes was 0.77 D (0.62). Vector dioptric distances were reasonably well correlated between the two eyes of unannounced standardized patients at each visit (Spearman $\rho = 0.70$, $P < .001$); therefore, the vector dioptric distance from one eye, per visit, was randomly selected to assess relationships with vision and comfort. Good vision was associated with a significantly lower mean vector dioptric distance of 0.69 D (0.64 to 0.75 D) as compared with 1.22 D (0.91 to 1.51 D) for those with unacceptable vision ($P < .001$). However, vector dioptric distance was not associated with vision comfort (0.77 [0.69 to 0.85] vs. 0.74 [0.65 to 0.83] D, $P = .52$).

DISCUSSION

Using the developed criteria for optimally prescribed spectacles (quality of refractive error care indicator 1) and unannounced standardized patients, we present herein a method for evaluating the quality of refractive error care. Because we have demonstrated that there is a strong association between the criteria for optimally prescribed spectacles and both vision and comfort, we suggest that the criteria for optimally prescribed spectacles are suitable for

TABLE 3. USPs: basic demographics and refractive error type

| USP | Age (y) | Sex | Refractive error type* | | Presbyopia? |
			Right eye	Left eye	
Da Nang					
1	21	Male	Low myopia	Low myopia	No
2	54	Female	Astigmatism	Emmetropia	Yes
3	55	Male	Low hyperopia	Emmetropia	Yes
4	38	Female	Astigmatism	Astigmatism	No
5	33	Male	Emmetropia	Emmetropia	No
Phu Tho					
6	59	Male	Low hyperopia + astigmatism	Low hyperopia + astigmatism	Yes
7	47	Female	Emmetropia	Emmetropia	Yes
8	57	Female	Moderate hyperopia + astigmatism	Moderate hyperopia	Yes
9	24	Male	Low myopia	Low myopia + astigmatism	No
10	34	Female	Emmetropia	Emmetropia	No
11	43	Female	Emmetropia	Emmetropia	Yes
Ho Chi Minh City: Group A					
12	36	Male	Low myopia + astigmatism	Low myopia + astigmatism	No
13	27	Male	High myopia + astigmatism	High myopia + astigmatism	No
14	50	Male	Low hyperopia	Low hyperopia	Yes
15	26	Female	Low myopia + astigmatism	Low myopia + astigmatism	No
16	34	Female	High myopia + astigmatism	High myopia + astigmatism	No
Ho Chi Minh City: Group B					
17	33	Male	Low myopia	Low myopia + astigmatism	No
18	43	Female	Emmetropia	Emmetropia	Yes
19	49	Female	Emmetropia	Emmetropia	Yes
20	39	Female	Emmetropia	Emmetropia	Yes
21	34	Female	Emmetropia	Emmetropia	No

*Refractive error classification: low myopia spherical equivalent, >−5.00 to −0.50 D; high myopia spherical equivalent, ≤−5.00 D; low hyperopia spherical equivalent, >+0.50 to ≤+ 2.00 D; moderate hyperopia spherical equivalent, >+2.00 to ≤+5.00 D; astigmatism, ≤−0.50 diopter cylinder; presbyopia near addition, ≥+1.00 D. USPs = unannounced standardized patients.

assessing the quality of refractive error outcomes, without additional assessments of vision and comfort. The criteria defined here and applied using unannounced standardized patients provide a practical yet reliable evaluation approach for "real-world" settings because of the absence of observer and response bias. This approach could be implemented across a range of settings to compare refractive error care and establish baseline measures for future quality improvement programs.

The 85% of spectacles that did not meet either indicator 1 or 2 yet still achieved good vision highlights that visual acuity alone cannot be used as the only indicator for the quality of refractive error care. The majority of such spectacles had too much minus distance correction for nonpresbyopic unannounced standardized patients or too much plus near correction for the presbyopes. Overminussed distance spectacles still permitted good vision because our myopic patients had active accommodation. For near spectacles with additional plus, extra magnification could have influenced vision outcomes.

Development of Indicators

Although vector dioptric distance has been previously used as an indicator to compare refractions between personnel and/or machines, prior assessments have evaluated the eye with the better corrected visual acuity only, rather than both eyes.[24,25] Because most spectacle wearers have been shown to prefer lenses with zero

TABLE 4. Spectacles that achieve either or neither Q.REC indicator and the associated subjective outcomes

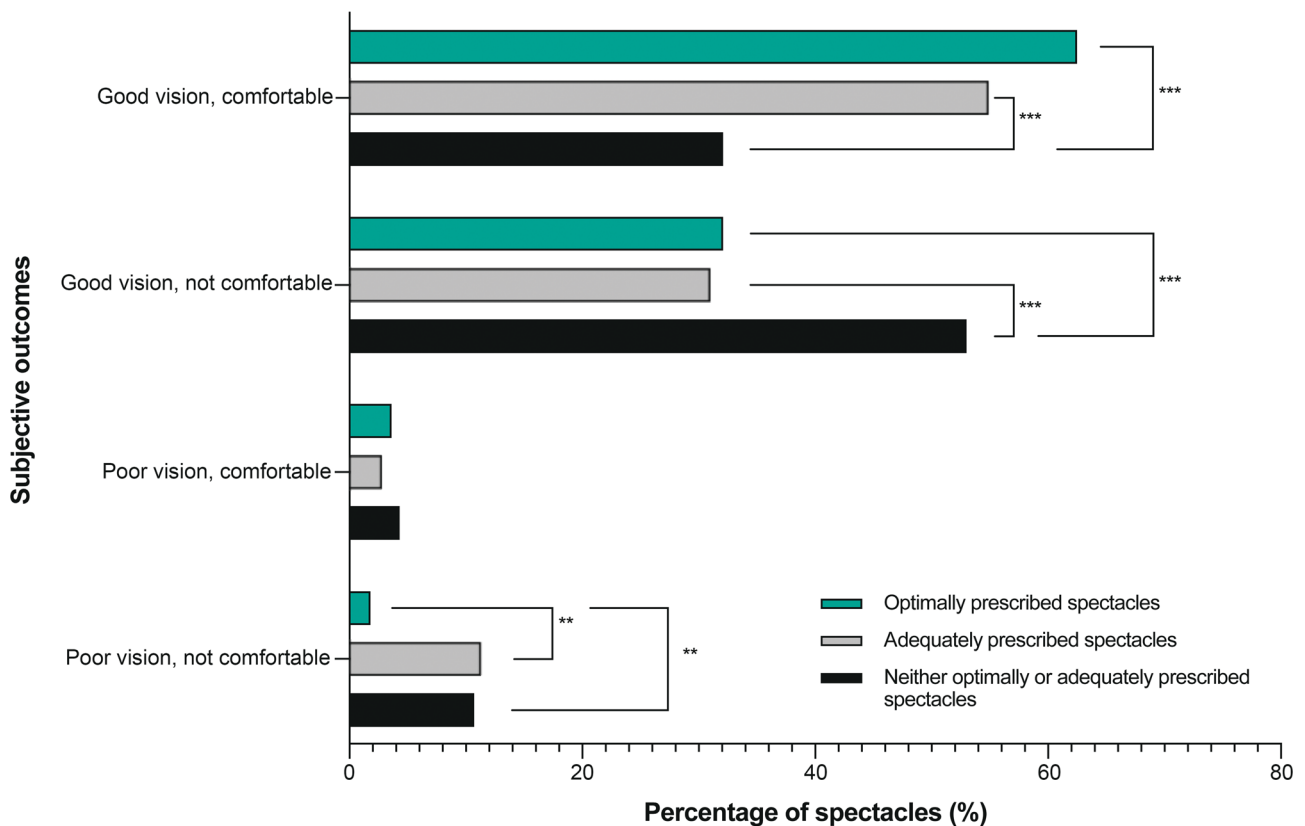|	Indicator 1: optimally prescribed spectacles (n = 112)	Indicator 2: adequately prescribed spectacles (n = 71)	Neither (n = 234)
Good vision	106 (94.6%)	61 (85.9%)	199 (85.0%)
Comfort	74 (66.1%)	41 (57.7%)	85 (36.3%)

Q.REC = quality of refractive error care.

FIGURE 1. Associations between prescribed spectacles and vision and comfort outcome. **Significant at $P < .05$. ***Significant at $P < .001$.

errors compared with positive or negative monocular or binocular errors, even as little as 0.50 D,[27] it is important to assess the lens suitability for both eyes, when assessing spectacle quality. In addition, prior applications of vector dioptric distance have also applied the formulae erroneously, as spherical power rather than cylindrical power was used to calculate J_0 (i.e., $-$[spherical power/2] $\times$ cos [2 $\times$ axis] rather than $-$[cylinder power/2] $\times$ cos[2 $\times$ axis]),[24,25] which subsequently altered previously reported vector dioptric distance measures. Although vector dioptric distance may be an appealing measure owing to the simplicity of a single value representing a quality indicator, we suggest that vector dioptric distance alone is not an appropriate measure because of the lack of clinical relevancy and the absence of insight into where errors in refraction or spectacle dispensing might have occurred. Furthermore, because there is limited literature on associations between the magnitude of vector dioptric distance and patient tolerances, vector dioptric distance would need to be paired with other indicators such as comfort, if used as a quality indicator. In contrast, the criteria for optimally prescribed spectacles could be used without these additional measures, simplifying procedures significantly.

Using Unannounced Standardized Patients

Using unannounced standardized patients to evaluate refractive error care provides an opportunity to assess many of the dimensions of care quality (effectiveness, efficiency, equity, people-centeredness, safety, timeliness, and integration).[4,6] The method presented here allows for the assessment of whether refractive error services are effective, safe, and people-centered. We were able to assess whether the spectacles prescribed were clinically appropriate for various refractive error types, whether there were any instances of unnecessary prescription, and whether the unannounced standardized patient was able to have information about his/her examination outcomes communicated clearly. To understand other care quality dimensions such as how equitable and integrated refractive services are, unannounced standardized patients of distinct age, sex, ethnicity, income, or the presence of other ocular comorbidities could be recruited. Similarly, monitoring additional components of care, such as appointment availability and waiting periods for spectacles and access to history, will allow for the assessment of timeliness and efficiency.

The approach presented here also offers the opportunity to investigate clinical factors in detail that may be associated with refractive error outcomes. For instance, the impact of objective and subjective refraction techniques such as autorefraction, retinoscopy, or assessing astigmatism with a cross cylinder could be explored.[9]

The employment of unannounced standardized patients necessarily imposes some study limitations with ramifications for the quality criteria developed here. First, this approach is suitable for assessing the quality of refractive error care in adults only. Extending this protocol to include children—although theoretically possible with the addition of a baseline cycloplegic refraction—would require additional ethical considerations and appropriate procedures to ensure child safeguarding. Second, the same unannounced standardized patients would ideally visit all the stores to reduce variation and enable better comparison between stores. However, because our three locations were not close, it was impractical to have the same group of unannounced standardized patients visit all

selected stores. In addition, unannounced standardized patients from one area faced a greater risk of identification in one of the other two locations because of differences in regional accents. These logistical constraints may not be as problematic elsewhere. Third, because of financial constraints, unannounced standardized patients were instructed to order only single-vision or bifocal lenses (no progressive addition lenses were purchased). Hence, the quality of prescribing progressive addition lenses was not assessed. Had more bifocal lenses or progressive addition lenses been purchased, adding "fitting height" as a criterion for optimal or adequate spectacles would have been included. Fourth, assessing subjective comfort at near was included as a proxy indicator for the potential confounding effect of accommodation and to identify when a pair of spectacles may not result in sustained comfortable vision. A more comprehensive assessment would require unannounced standardized patients to wear the spectacles during regular daily activities across an extended period before assessing vision comfort, incorporating accommodation-vergence assessments into the quality of refractive error care indicators and/or using validated tools that measure spectacle comfort. Finally, only two unannounced standardized patients were classified with hyperopia. Although the refractive characteristics of our unannounced standardized patients are likely to reflect the adult Vietnam community in general, it could be argued that the process of probing and testing refractive error care should aim for maximum spread rather than a community match.

To an extent, refraction can be considered an art rather than a science. With the subjective component of refraction, mistakes inherently occur when responses are misinterpreted, or a patient is unable to discriminate between finite changes. In addition, sometimes it is not appropriate to adhere to a fixed examination routine when patients might benefit from alternative examination techniques.[28] Accordingly, eye care providers should be able to adapt and tailor their examinations to each patient's needs and complaints. In this respect, using unannounced standardized patients to assess the quality of refractive error care provides a practical approach, which also allows for discrimination between potential sources of error. Using unannounced standardized patients would also allow for the assessment of whether there are specific refractive profiles (e.g., high hyperopia and astigmatism) that are associated with reduced quality. In addition, issues with spectacle dispensing rather than spectacle prescription can also be easily identified. Understanding where any quality issues exist provides information on what training may be required and how services might improve delivery.

The use of unannounced standardized patients and refractive error care quality indicators presented here is a practical and promising approach for assessing refractive error care. The methodology could be used in other settings to confirm the appropriateness of quality of refractive error care indicators and evaluate the quality of refractive error care in a systematic and comparable manner.

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