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Research Article

An Internationally Validated Direct Observation of Clinical Skills Rubric for Subjective Refraction

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Abstract

Background: Globally, refractive error is the most common cause of correctable vision impairment. Refractometry is a skill that is difficult for beginners to learn and challenging for the evaluators to assess. A well-constructed rubric can provide guidance as a teaching tool to the novice refractionist and as an assessment tool to the instructor.

Purpose: A new rubric was created to provide clinical educators with an internationally valid and standardized method to teach and assess competency in subjective refractometry.

Methods: A panel of seven international content experts participated in a qualitative research study to create a distance vision subjective manifest refractometry rubric by identifying the key steps of the procedure, determining performance levels of competency, and creating behavioral descriptors for each procedural step and level of competency. The rubric was reviewed by a total of 34 international subject-matter experts from 18 countries and from various roles, to ensure content validity.

Results: A 15-step rubric for subjective refraction was created. Levels of competency were defined as novice, beginner, advanced beginner and competent. Precise descriptions of performance were determined for each step at each performance level. Content validity was achieved by incorporating reviewer's comments.

Conclusions: This internationally valid and standardized rubric is an assessment tool that can be applied globally to teach and assess distance vision manifest subjective refraction.

Keywords: Subjective Refraction; Refraction; Rubric; Refractive Error; Refractionist

Abbreviations

CYL: Cylinder (Cylinder Power in Diopters); DC: Diopters of Cylinder (Power); DS: Diopters of Sphere (Power); IDOCS: International Direct Observation of Clinical Skills; ICO: International Council of Ophthalmology; IRB: Institutional Review Board; JCC: Jackson Cross Cylinder; OF: Ophthalmology Foundation; OSCARS: Ophthalmology Surgical Competency Assessment Rubrics; PD: Pupillary Distance; SPH: Sphere (Sphere Power in Diopters); VA: Visual Acuity; VD: Vertex Distance

Introduction

Global estimates indicate that uncorrected refractive error and cataracts are the most common causes of correctable visual impairment and blindness worldwide. According to the World Health Organization, unaddressed refractive error (e.g., myopia or hypermetropia) causing vision impairment or blindness, affects 123.7 million people globally [1]. To address this, eyecare professionals are needed to assess patients with vision related problems, must be competent at subjective refraction, and, when appropriate, prescribe spectacles in many locations around the world. Thus, the Ophthalmology Foundation (ophthalmologyfoundation.org) has created a new rubric to provide clinical educators with a content-valid, internationally-standardized rubric to teach and assess competency in subjective refraction.

Materials and Methods

The authors were chosen based on a key informant sampling and expert sampling to represent different regions of the world. Initially, key steps of subjective refraction were identified, levels of competency determined, and behavioral descriptors were created for each procedural step and level of competency. Collectively, the group summarized that the major issues to consider are 1) the type of equipment being used to house the corrective lenses (phoropter vs trial frame with loose lenses), 2) whether minus or plus cylinder power notation is being used, and 3) ensuring that the generalized rubric for subjective refraction is intended for distance vision with the correction for myopia or hypermetropia, rather than for near vision with an appropriate reading correction if indicated (e.g., in presbyopia).

The authors collaborated to create multiple drafts that were reviewed and refined. A second panel of 27 content experts then reviewed the refined authors' draft, made comments, and the comments were incorporated as deemed appropriate by the authors. A total of 34 refraction experts reviewed the rubric, including 17 ophthalmologists, seven optometrists, eight technicians, and three orthoptists representing 18 countries in North America, Latin America, the Caribbean, Europe, Asia, and Australia. The ultimate goal was for the rubric to provide sufficient detail to truly assess the eye care professional's competency, while being flexible enough to allow for regional or practice preferences.

The initial framework of the critical steps for subjective refraction was based on several resources on subjective refractions authored by established ophthalmic professional organizations, including the American Academy of Ophthalmology's Basic and Clinical Science Course, Section 3. Clinical Optics [2], the Cybersight Subjective Refraction Handbook for Clinicians [3], and other sources [4,5].

The rubric's general design was based on the International Council of Ophthalmology's Ophthalmology Surgical Competency Assessment Rubrics (ICO-OSCARs). The ICO-OSCARs break down a given ophthalmic procedure into 20 steps that are scored on a modified Dreyfus scale with four levels of competency: Novice, Beginner, Advanced Beginner, and Competent [6].

Results and Discussion

The result of this research is the International Direct Observation of Clinical Skills (IDOCS): Subjective Refraction rubric (Figure 1). It is comprised of 15 critical steps that are scored on a modified Dreyfus scale with four levels of competency: Novice (2 points), Beginner (3 points), Advanced Beginner (4 points), and Competent (5 points). Behavioral descriptors were provided to define the behavior necessary to achieve each competency level for each of the critical steps. The wording was carefully chosen to be specific about expected actions and to minimize ambiguity. The rubric takes into account subjective refraction performed by phoropter technique as well as by trial frames with loose lenses. Recommendations for training and preparation of trainers as well as instructions for teaching and assessing the trainee are included on the first page of the rubric.

The panel of reviewers recommended changes to the rubric content, order, and wording. Numerous comments were submitted

about the starting point for the refraction. Suggestions included, "(The refractionist) needs to identify where they are starting from. Is it from-scratch (zero), or do they have access to an auto-refraction, retinoscopy, lensometry, or other clues?" and "Retinoscopy is faster, I always do ret(inscopy) first". Wording in the rubric was adjusted to address a variety of starting points. Many of the reviewers had no suggested edits. We received many positive comments such as, "This looks fantastic!", "My feeling is that your rubric does help the beginning refractionist understand the steps and what is expected of them", "Overall I think it looks great!", "I worked really hard to find a point to challenge, but your work is really solid", "This is a great training tool!", and "It will be very handy to use for new trainees as well as for self-evaluation". Ultimately, all reviewers' comments were considered and the authors incorporated the suggestions that were appropriate and useful, thus establishing a level of content validity and face validity [5].

Uncorrected refractive error remains the leading cause of reversible visual impairment despite the relatively low cost and amount of training required for remedy, as compared to the cost and level of training required to become an ophthalmologist and perform surgery. Facilitating the appropriate training of skilled refractionists is one method by which the availability of this much-needed service can be increased. The Ophthalmology Foundation's IDOCS: Subjective Refraction rubric can be used as an invaluable tool to both support the training of refractionists and assess their competence. It has been internationally validated and can be used in a variety of settings around the world. The rubric was designed to be specific enough to be used for robust training and competency assessment in subjective refraction, yet flexible enough to allow for local and situational variations in the approach to subjective refraction such as differences in starting point, equipment availability, practice preferences, and the purpose of the refraction.

We recommend both trainers and trainees be given the rubric in advance to review. Trainers having a good understanding of the behavioral requirements for each competency level will reduce the subjectivity of the assessment. During a refraction encounter with a patient, the trainer can simply observe the trainee in action and circle the behavior they observe at each step. The trainee, in turn, should be familiar with the performance required to achieve the "Competent" level for each critical step. The IDOC: Subjective Refraction rubric should be used frequently both during training to provide formative feedback as well as at the completion of training to provide a summative assessment of competency.

There are several limitations to the IDOCS: Subjective Refraction rubric. We did not include objective refraction, or refraction of pediatric patients younger than 15 years old, cycloplegic refractions, refraction for near or intermediate distance such as for presbyopic correction. This would have resulted in much too lengthy a rubric. Future work will include rubrics for these situations and an inter-rater reliability study of the IDOCS: Subjective Refraction rubric to be sure that different raters score the same performance similarly.

Conclusion

We have developed a n internationally validated rubric to both teach and assess skill at subjective refraction. We hope it will help in the training of eye care professionals and ultimately decrease global avoidable visual impairment.

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This study did not meet the definition Human Subject Research, and as such, the University of Cincinnati IRB waived approval and determined the research to meet "Exempt" status on January 26, 2021 This study adheres to the Declaration of Helsinki and all federal or state laws in all countries.

Conflicts of Interest

None of the authors have any financial interest or conflicts of interest related to this article.

International Direct Observation of Clinical Skills (IDOCS): Subjective Refraction

The IDOCS: Subjective Refraction rubric was developed by a panel of international subject matter experts with the intent of providing clinical educators ("evaluators" and "trainers") with an internationally-standardized rubric to teach trainees and assess their competency in subjective refraction. The process of subjective refraction has been divided into 15 critical steps with detailed behavioral descriptions corresponding to four levels of performance: Novice, Beginner, Advanced Beginner, and Competent.

Subjective refraction relies on a significant amount of patient interaction, and as such the refractionist-in-training (trainee) needs to explain the process, ask appropriate questions, listen to the patient's responses, decide on next steps, and act accordingly. Effectively communicating with the patient throughout the process is vital to an efficient and accurate subjective refraction. The evaluator is encouraged to consider the appropriateness of the trainee's interaction with the patient throughout the refraction process.

Teaching and assessment instructions

- Trainers may use the rubric as a training tool and trainees may use the rubric as a learning guide on performing the steps of subjective refraction. This is a guide and does not intend to be fully inclusive of every detail or technique.
- An evaluator may observe and evaluate the performance of a trainee's subjective refraction using the rubric or the trainee may self-assess using the rubric to assess their recently performed refraction (The line-item descriptors in red bold font are considered mandatory for competency.).
- Evaluators should review and discuss the rubric before the first evaluation session. If there are multiple evaluators in a program, it is recommended that all the evaluators conduct one or more of the initial evaluations together to facilitate an internal consensus on how to rank each step. Please keep in mind the importance of the trainee's verbal interactions with the patient at every step, in addition to the physical steps of refracting.
- The evaluator (or trainee if self-evaluating) may rank the level of performance of each step by selecting (circling) the corresponding behavioral descriptor for the observed performance at each step.
- A cumulative overall score can be calculated by adding the line item scores: Novice: <60 points; Beginner: 60-75 points; Advanced Beginner : 76-91 points with item scores ≥ 4 in all mandatory categories; Competent: 92-100 points with all item scores ≥ 4, and item scores in all mandatory categories = 5.
- Additional comments by the trainer/evaluator are strongly encouraged to provide the trainee with a detailed understanding of which steps were done well and which steps need improvement. This will help maximize the educational value of the rubric.
- Timely and detailed discussion of the results of the assessment between the trainer/evaluator and the trainee is also an invaluable part of effective education.
- Discussion, development, and implementation of a subsequent detailed plan for additional training, practice, or modified performance within a set timeframe is strongly encouraged to accelerate skill development in this area. Ensuing repeat evaluations may need to be scheduled.
- The evaluation may occur more than once as the novice trainee practices and gains more experience with subjective refraction. The goal would be to work towards higher performance levels with additional experience until all steps are performed at the Competent level.

International Direct Observation of Clinical Skills (IDOCS): Subjective Refraction

Evaluator:	**Refractor Type:** [ ] Phoroptor→ [ ] Trial Frame **Age of Patient:** (Intended for patients ≥15 years)	**Trainee:** **Date:**	

	Critical Steps	Novice Each Step Score = 2	Beginner Each Step Score= 3	Advanced Beginner Each Step Score= 4	Competent Each Step Score = 5
1	**Interact with the Patient** Communicating well with the patient throughout the process is important to maximizing the success and efficiency of subjective refraction.	Does not provide guidance to the patient unless prompted.	Only one of these is performed: [ ] Gives patient clear instructions [ ] Asks patient appropriate questions [ ] Allows appropriate time for patient to view lenses and respond [ ] Listens to patient's answers [ ] Decides next step, acts accordingly.	Two to four of these are performed: [ ] Gives patient clear instructions [ ] Asks patient appropriate questions [ ] Allows appropriate time for patient to view lenses and respond [ ] Listens to patient's answers [ ] Decides next step, acts accordingly	**All five of these are performed:** **[ ] Gives patient clear instruction** **[ ] Asks patient appropriate questions** **[ ] Allows appropriate time for patient to view lenses and respond** **[ ] Listens to patient's answers** **[ ] Decides next step, acts accordingly.**
2	**Set Up Equipment** Selects the correct chart/non-accommodating target. Adjusts lighting as needed. Ensures clean equipment is at the correct distance from the patient, Vertex Distance (VD) and Pupillary Distance (PD) are adjusted, Phoroptor→ convergence levers are out, and Phoroptor→/trial frames are level. Chooses correct starting point, either zeroed out or enter starting point SPH, CYL, AXIS.	Does not set up chart or adjust room/chart lighting.	One of these is performed: [ ] Selects appropriate chart [ ] Sets up chart correctly [ ] Adjusts room/chart lighting correctly	Two of these are performed: [ ] Selects appropriate chart [ ] Sets up chart correctly [ ] Adjusts room/chart lighting correctly	**All three of these are performed:** **[ ] Selects appropriate chart** **[ ] Sets up chart correctly** **[ ] Adjusts room/chart lighting correctly**
		Does not position the Phoroptor→ (or trial frame).	One of these is performed: [ ] Follows all appropriate infection control procedures [ ] Enters starting point if available OR [ ] starts from zero SPH, CYL, and AXIS [ ] Correctly sets PD, VD, and level [ ] Correctly positions Phoropter®/trial frame	Two or three of these are performed: [ ] Follows all appropriate infection control procedures [ ] Enters starting point if available OR starts from zero SPH, CYL, and AXIS [ ] Correctly sets PD, VD, and level [ ] Correctly positions Phoroptor→ /trial frame	All four of these are performed: **[ ] Follows all appropriate infection control procedures** [ ] Enters starting point if available OR starts from zero SPH, CYL, and AXIS [ ] Correctly sets PD, VD, and level [ ] Correctly positions Phoroptor→ /trial frame
		Does not position patient.	One of these is performed: [ ] Aligns patient with chart [ ] Positions patient at correct distance from chart [ ] Ensures nothing is obstructing the patient's view	Two to four are performed: [ ] Aligns patient with chart [ ] Positions patient at correct distance from chart [ ] Ensures nothing is obstructing the patient's view	All five of these are performed: [ ] Aligns patient with chart [ ] Positions patient at correct distance from chart [ ] Ensures nothing is obstructing the patient's view
			[ ] Ensures patient is positioned comfortably [ ] Occludes fellow eye	[ ] Ensures patient is positioned comfortably [ ] Occludes fellow eye	[ ] Ensures patient is positioned comfortably [ ] Occludes fellow eye
3	**Determine Sphere Power** GOAL: To determine the most plus/least minus sphere power that gives the best vision [1,2].	Does not check sphere power at all.	Does not check sphere power first.	Checks sphere power first, but does not correctly determine the most plus/least minus sphere power that gives the best vision.	**Correctly determines the most plus/least minus sphere power that gives the best vision. (Max Plus, Least Minus, Max Visual Acuity)**
4	**Determine Presence of Astigmatic Correction** GOAL: To determine the approximate location of any cylinder axis either by [1,2] [ ] Jackson Cross Cylinder (JCC), by checking at: 180°, 135°, 90°, 45°1 OR [ ] An alternative method.	Does not identify if cylinder power is present from the starting point SPH, CYL, and AXIS.	Identifies that cylinder power is present but unsure of next steps.	Identifies cylinder power is present but performs unnecessary steps.	Correctly identifies that cylinder power is present from the starting point and moves to the next step.
		Does not know how to determine if astigmatic correction is present using JCC or appropriate alternative method.	Attempts to detect cylinder with JCC or appropriate alternative method, but does not perform the detection method correctly.	Attempts to detect cylinder with JCC or appropriate alternative method correctly but fails to check at 180°, 135°, 90°, and 45°when necessary.	**Detects if cylinder power is present and the approximate location of the cylinder axis by using JCC or appropriate alternative method to check at 180°, 135°, 90°, and 45° when necessary.**
5	**Refine Cylinder Axis** GOAL: To refine the cylinder axis by using the CYL axis mode of the JCC [1,2]	Does not refine the cylinder axis.	Attempts to refine the cylinder axis but does so incorrectly, for example, uses the CYL power mode of the JCC.	Roughly refines the cylinder axis using the JCC but does not bracket correctly.	**Accurately refines the cylinder axis using the axis mode of the JCC and brackets correctly.**
6	**Refine Cylinder Power** GOAL: To measure cylinder power using the CYL power mode of the JCC.[12]	Does not refine the cylinder power.	Attempts to refine the cylinder power but does so inaccurately or ineffectively.	Refines the cylinder power correctly, but does not adjust the sphere power accordingly.	**Accurately refines the cylinder power using the JCC, adjusts sphere accordingly by adding -0.25 DS change for every +0.50 DC change (or +0.25 DS for every -0.50 DC change)**
7	**Refine Sphere Power** GOAL: To determine the most plus/least minus	Does not refine the sphere power.	Attempts to refine the sphere power but does so inaccurately or ineffectively.	Attempts to refine the sphere power but does not determine	**Accurately refines the sphere power to determine the most plus or least minus sphere**

	sphere power that gives best vision.[1,2]			the most plus or least minus sphere power accurately.	**power that gives the best vision.[1]**
8	**Avoid Excess Sphere Power** [ ] Monocular Duochrome (Red-Green) [ ] Monocular +1.00 Blur Test [ ] Alternative technique	Does not perform Duochrome, +1.00 Blur Test, or appropriate alternative technique.	Attempts Monocular Duochrome, +1.00 Blur Test, or appropriate alternative technique but does not perform the technique accurately.	Performs either Monocular Duochrome, +1.00 Blur Test, or appropriate alternative technique but does not adjust sphere power correctly in each eye.	**Performs either Monocular Duochrome, +1.00 Blur Test, or appropriate alternative technique correctly and accurately adjusts sphere power in each eye.**
9	**Refract Fellow Eye** Repeat Steps 1-7 on fellow eye. Evaluator may comment here or in steps above.	• Initial SPH • (Determine Astigmatic Correction) • Refine CYL Axis • Refine CYL Power • Refine SPH/ Avoids Excess SPH Power	No points here, but can add points to sections above for second eye.		
10	**Perform Binocular Balance[2]** [ ] Prism Dissociation [ ] Alternate Occlusion [ ] Humphriss Immediate Contrast Technique	Does not perform any technique for binocular balance.	If indicated, attempts to perform binocular balance but does not perform accurately.	If indicated, performs, but does not fully adjust sphere powers correctly in both eyes.	If indicated, performs steps of a binocular balance technique correctly and accurately adjusts the sphere power in both eyes.
11	**Determine Final Distance Visual Acuity (VA)** Monocularly and binocularly.	Does not determine final distance VA.	Attempts to determine distance VA but does not do so accurately.	Accurately determines distance VA monocularly or binocularly but not both.	**Accurately determines distance VA, both monocularly with each eye and binocularly.**
12	**Determine Overall Accuracy** Evaluator rechecks refraction for accuracy of the final result.	Trainee is unable to determine sphere power, or sphere power is > ± 1.00 DS off from Trainer's results.	Trainee's sphere power is > ±0.75 DS off from Trainer's results in at least one eye.	Trainee's sphere power is within ± 0.50 DS of Trainer's results in at least one eye.	**Trainee's sphere power is within ± 0.25 DS of Trainer's results in both eyes.**
		Trainee is unable to determine cylinder power or cylinder power is >±1.00 DC off from Trainer's results.	Trainee's cylinder power is ≥ ± 0.75 DC off from Trainer's results in at least one eye.	Trainee's cylinder power is within ± 0.50 DC of Trainer's results in at least one eye.	**Trainee's cylinder power is within ± 0.25 DC of Trainer's results in both eyes.**
		Trainee is unable to determine cylinder axis or cylinder axis is >25° from Trainer's results.	Trainee's cylinder axis is >20° off from the Trainer's results for cylinder powers between 0.50 to 0.75 DC or >15° off for cylinder powers ≥ 1.00 DC in at least one eye.	Trainee's cylinder axis is 15°-20° off from the Trainer's results for cylinder powers between 0.50 to 0.75 DC or 10°-15° off for cylinder powers ≥ 1.00 DC in at least one eye.	**Trainee's cylinder axis is < ±15° of Trainer's result for cylinder powers between 0.50 to 0.75 DC or < ±10° for cylinder powers ≥ 1.00 DC in both eyes.**
13	**Document Results**	Did not document refraction results at all or documents very poorly including mixing up the laterality.	Attempts to document refraction results but does so inaccurately.	Documents sphere, cylinder, axis accurately, including using correct nomenclature (signs, units, and proper decimal points included) in one eye but not both.	**Accurately documents the sphere, cylinder, and axis using correct nomenclature (signs, units, and decimal points) for both eyes in the patient's chart.**
		Unsure how to document unusual findings.	Documents unnecessary or incorrect information.	Documents unusual findings but not accurately or thoroughly.	Accurately documents relevant unusual findings, if applicable. If not applicable, can give examples of when and what to document.
14	**Clean/Store Equipment**	Does not clean or store equipment.	Stores but does not properly clean equipment.	Cleans but does not properly store equipment.	Cleans and stores equipment properly per practice standards.
15	**Determine Overall Speed and Fluidity**	Hesitant, frequent starts and stops, and/or unable to complete refraction.	Occasionally starts and stops, inefficient and unnecessary steps are common.	Makes occasional inefficient and/or unnecessary steps.	Refraction process and movements are smooth, and avoids inefficient and unnecessary steps.
	Score for Each Level:	**(# x 2) = _____**	**(# x 3) = _____**	**(# x 4) =_____**	**(# x 5) = _____**
	Determine Overall Score Sum the total score of all columns Novice, Beginner, Advanced Beginner, and Competent = _____	**Novice Overall Score < 60 points**	**Beginner Overall Score = 60-75 points**	**Advanced Beginner Overall Score = 76-91 points**, with item scores ≥ 4 in all **mandatory** categories.	**Competent Overall score = 92-100**, with all item scores ≥ 4, and with item scores =5 in all **mandatory** categories.
Additional Comments from Evaluator Recommendations for Next Steps					

Figure 1

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