

A Systematic Review of the Quality and Utility of Observer-Based Instruments for Assessing Medical Professionalism

Yu Heng Kwan, BSc (Pharm) (Hons)
 Kelly Png, BSc (Pharm) (Hons)
 Jie Kie Phang, BSc (Life Science) (Hons)
 Ying Ying Leung, MBChB, MD
 Hendra Goh, BSc (Life Science) Candidate

Yi Seah, BDS Candidate
 Julian Thumboo, MBBS, MRCP, FRCP
 A/P Swee Cheng Ng, MBBS, MRCP
 Warren Fong, MBBS, MRCP
 Desiree Lie, MD, MSED

ABSTRACT

Background Professionalism, which encompasses behavioral, ethical, and related domains, is a core competency of medical practice. While observer-based instruments to assess medical professionalism are available, information on their psychometric properties and utility is limited.

Objective We systematically reviewed the psychometric properties and utility of existing observer-based instruments for assessing professionalism in medical trainees.

Methods After selecting eligible studies, we employed the Consensus-based Standards for the selection of health Measurement INstruments (COSMIN) criteria to score study methodological quality. We identified eligible instruments and performed quality assessment of psychometric properties for each selected instrument. We scored the utility of each instrument based on the ability to distinguish performance levels over time, availability of objective scoring criteria, validity evidence in medical students and residents, and instrument length.

Results Ten instruments from 16 studies met criteria for consideration, with studies having acceptable methodological quality. Psychometric properties were variably assessed. Among 10 instruments, the Education Outcomes Service (EOS) group questionnaire and Professionalism Mini-Evaluation Exercise (P-MEX) possessed the best psychometric properties, with the P-MEX scoring higher on utility than the EOS group questionnaire.

Conclusions We identified 2 instruments with best psychometric properties, with 1 also showing acceptable utility for assessing professionalism in trainees. The P-MEX may be an option for program directors to adopt as an observer-based instrument for formative assessment of medical professionalism. Further studies of the 2 instruments to aggregate additional validity evidence is recommended, particularly in the domain of content validity before they are used in specific cultural settings and in summative assessments.

Introduction

Medical professionalism is defined as “the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and community being served.”¹ Professionalism is critical to trust between physicians and patients as well as the medical community and the public.² Assessing professionalism is essential to medical education because professionalism in practice is central to a physician’s social contract with society.^{3,4} Despite growing recognition of its importance, the lack of a consensus definition of professionalism limits its effective operationalization.⁵

While approaches such as critical incident reporting have been used to recognize when professional breaches occur, the need for trainee assessment and program evaluation necessitates quantitative and objective positive measures of professionalism to track the demonstration of competence and assess curricular effectiveness.⁶ Valid and reliable instruments that can discriminate levels of professionalism and identify lapses to facilitate remediation and further training are needed.

Many instruments have been developed to assess medical professionalism as a comprehensive standalone construct or as a facet of clinical competence.⁷ There is a tendency for programs to use multiple instruments, and selecting the most suitable instrument for a given program can be challenging for educators.^{5,8} Workplace- and observer-based assessments allow for the systematic assessment of professionalism by different assessors in various clinical contexts,⁸ which may complement other assessment

DOI: <http://dx.doi.org/10.4300/JGME-D-18-00086.1>

Editor’s Note: The online version of this article contains tables of PRISMA 2009 checklist, study search strategy, domains measured by each instrument, and methodological quality assessment.

modes such as self- and peer assessments. Observer-based instruments are in keeping with the current trend of adopting entrustable professional activities.⁹

Previous systematic reviews of professionalism measures have focused on different assessment methods, including direct observation, self-administered rating forms, patient surveys, and paper-based ratings.^{10–12} The most recent review concluded that studies were of limited methodological quality and recommended only 3 of 74 existing instruments as psychometrically sound; of note, 2 of these were from studies involving nurses.¹⁰ There were no current systematic reviews that focus on observer-based instruments to assess medical professionalism¹³ and on the utility of the instruments. The primary aim of this study was to identify observer-based instruments for use by program directors and to examine their psychometric properties and utility for practical application.

Methods

We performed a systematic review in accordance with the Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) checklist (provided as online supplemental material).

Search Strategies

We searched the PubMed, Scopus, ERIC, and PsycINFO databases from their inception to July 2018. The search strategy was adapted and revised from a previous systematic review¹⁴ in consultation with a medical librarian, and the full search strategy is provided as online supplemental material. Our focus was on observer-based instruments that measured professionalism.

Study Selection

Inclusion criteria were English-language, full-text original studies on the validation of observer-based instruments, or questionnaires assessing or measuring medical professionalism of residents and medical students. Instruments had to be applied to the evaluation of professionalism in an actual clinical setting or context (see FIGURE). We excluded articles not in English, studies of professionalism in other health disciplines, and review articles. Duplicate studies were removed using EndNote X8 (Clarivate Analytics, Philadelphia, PA), and cross-checked by the researchers. Studies that met inclusion criteria were independently screened by 2 researchers (J.K.P. and H.G.) based on titles and abstracts. Full-text studies selected were independently read and assessed for eligibility, and the reference lists were hand-searched

for additional eligible studies. Disagreements in the selection process were resolved by discussion with a third researcher (Y.H.K.).

The study did not involve human subjects and did not require Institutional Review Board approval.

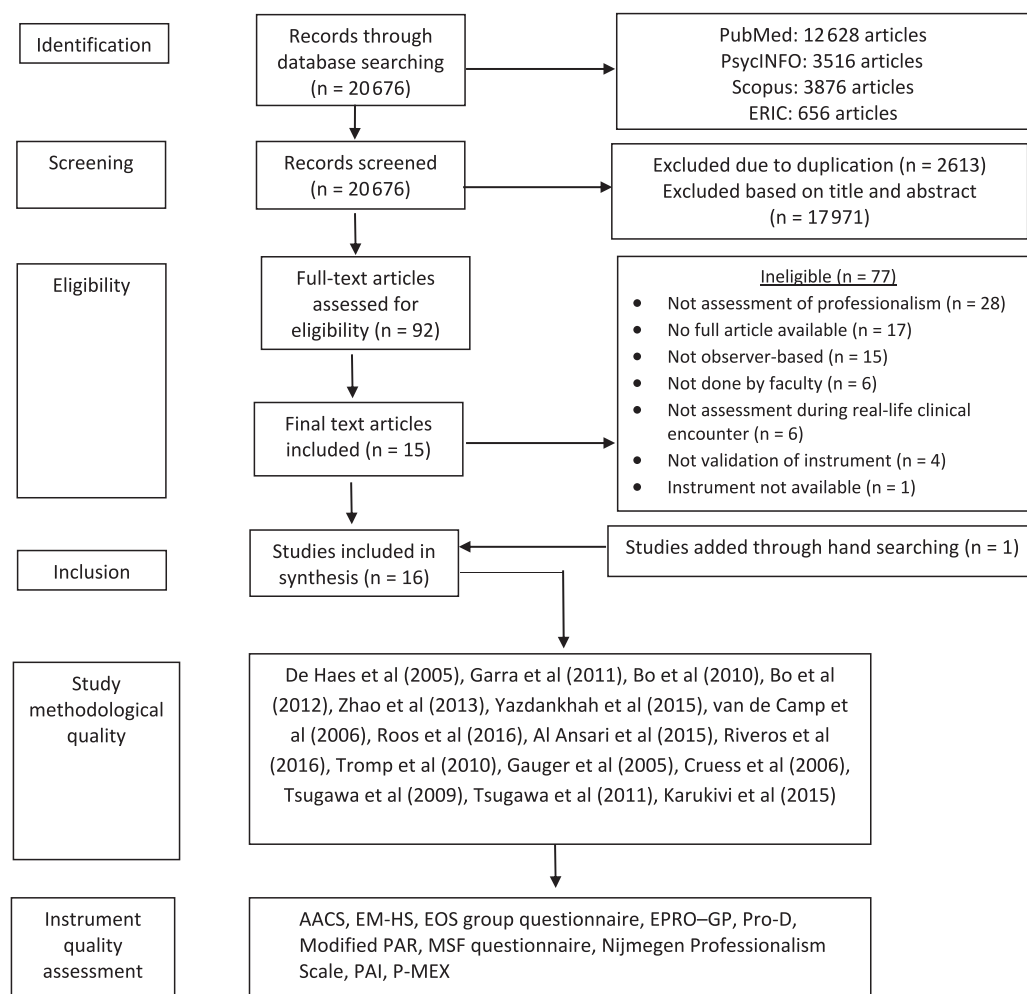
Data Extraction

For studies deemed eligible, data were extracted independently by 2 researchers (H.G. and Y.S.) using a standardized data extraction form. The following data were extracted: general characteristics of each instrument (name of instrument, author, language, number of domains, number of items, and response categories) and characteristics of study samples (sample size, age, settings, and country).

Study Methodological Quality and Instrument Psychometric Property

We performed 3 levels of quality assessment. First, 2 researchers (K.P. and H.G.) independently assessed each study using the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) checklist (FIGURE). Disagreements were resolved by a third reviewer (Y.H.K.). We selected the COSMIN checklist because it is a consensus-based tool for study appraisal involving instruments.^{15,16} The checklist addresses 9 criteria: content validity, structural validity, internal consistency, cross-cultural validity measurement invariance, reliability, measurement error, criterion validity, hypotheses testing for construct validity, and responsiveness. The checklist is presented in boxes, with each box comprising items to assess the study methodological quality for each criterion. Items are rated on a 4-point scale, which includes the ratings *inadequate*, *doubtful*, *adequate*, or *very good*.¹⁷ As there is no accepted “gold standard” for assessing professionalism, we did not assess criterion validity of the studies. Second, we assessed the psychometric quality of each instrument using an adapted version of the Prinsen et al criteria¹⁸ to synthesize evidence that supported the measurement properties of instruments (see FIGURE). Third, we assessed the utility of each instrument for real-world practicality using prespecified criteria, including the ability to distinguish performance over time, objective scoring criteria, validity for use in medical students and residents, and number of items.

The quality of evidence was graded for psychometric properties, taking into account the number of studies, the methodological quality of the studies, the consistency of the results of the measurement properties, and the total sample size.¹⁸ The ratings for the level of evidence for the psychometric properties were as follows:



FIGURE

Flowchart Showing Process for Inclusion and Quality Assessment of Articles

Abbreviations: AACS, Amsterdam Attitude and Communication Scale; EM-HS, Emergency Medicine Humanism Scale; EOS, Education Outcome Service group questionnaire; EPRO-GP, Evaluation of Professional Behavior in General Practice; Pro-D, German Professionalism Scale; PAR, Physician Achievement Review; MSF, multisource feedback; PAI, Professionalism Assessment Instrument; P-MEX, Professionalism Mini-Evaluation Exercise.

- Unknown: No study
- Very low: Only studies of inadequate quality *or* a total sample size < 30 subjects
- Low: Conflicting findings in multiple studies of at least doubtful quality *or* 1 study of doubtful quality *and* a total sample size $\geq$ 30 subjects
- Moderate: Conflicting findings in multiple studies of at least adequate quality *or* consistent findings in multiple studies of at least doubtful quality *or* 1 study of adequate quality *and* a total sample size $\geq$ 50 subjects
- High: Consistent findings in multiple studies of at least adequate quality *or* 1 study of very good quality *and* a total sample size $\geq$ 100 subjects¹⁸

Instrument Utility and Scoring

We developed a utility scale using criteria from other studies.^{19–21} The 4 criteria chosen were (1) the ability to distinguish performance levels over time; (2) the availability of objective scoring criteria; (3) the utility for medical students and residents; and (4) the number of items, with a maximum of 8 points (see TABLE 1) and a higher utility score indicating greater feasibility of implementation.

Results

Search Results

The electronic search yielded 20 676 article titles after removal of duplicates. Articles were reviewed by title and abstract, and 17 971 articles that did not meet inclusion criteria were removed. A second

TABLE 1
Utility Scoring Criteria Checklist

Criteria	0 Points	1 Point	2 Points
Ability to distinguish performance levels over time	Not provided	Unable to distinguish performance levels over time	Able to distinguish performance levels over time
Availability of objective scoring criteria	Not provided	Objective scoring criteria not available	Objective scoring criteria available
Tested on both medical students and residents	Not applicable	Tested on only medical student or resident	Tested on only medical student or resident
Item number	> 30 items	16–30 items	≤ 15 items

review of 92 full-text articles resulted in the selection of 15 articles after the removal of articles that did not examine professionalism but other constructs such as empathy. One article was added after hand-searching published systematic reviews. Sixteen articles assessing 10 observer-based instruments were included in this review and quality assessment (see the FIGURE).

The 16 studies examined 10 instruments: the Amsterdam Attitude and Communication Scale (AACS),²² the Emergency Medicine Humanism Scale (EM-HS),²³ the Education Outcome Service (EOS) group questionnaire,^{24–27} the Evaluation of Professional Behavior in General Practice (EPRO-GP),²⁸ the German Professionalism Scale (Pro-D),²⁹ the modified Physician Achievement Review (PAR),³⁰ the multisource feedback (MSF) questionnaire,³¹ the Nijmegen Professionalism Scale,³² the Professionalism Assessment Instrument (PAI),³³ and the Professionalism Mini-Evaluation Exercise (P-MEX).^{34–37} Four instruments assessed residents and medical students (the EPRO-GP, Pro-D, Nijmegen Professionalism Scale, and P-MEX). Each instrument was assessed in 1 study except for P-MEX and the EOS group questionnaire, which were assessed in 4 individual studies.

All 10 instruments measured professionalism as a single construct with multiple domains (see TABLE 2 and online supplemental material). The instruments varied in item number from 9 to 127. Study sample size ranged from 9 to 442 participants. All instruments used a Likert scale (ranging from 3 to 9 points) to measure professionalism. Four instruments (P-MEX, EPRO-GP, Nijmegen Professionalism Scale, and Pro-D) were tested in medical students and residents.^{13,35–40} The AACS and EM-HS had the lowest number of items at 9, while the EPRO-GP had the most at 127.

COSMIN Methodological Quality Assessment

Methodological quality was generally adequate for 9 studies (provided as online supplemental

material). The structural validity psychometric property was the most commonly assessed, being the focus of 9 studies (56%). Eight studies assessed internal consistency, with 5 (63%) scoring *adequate* or *very good*. The 8 studies that assessed content validity had scores of *doubtful*. *Inadequate* methodological quality was observed for the single study that assessed reliability. Only 1 study assessed measurement error, and there were questions about its methodological quality.

Although translations were performed in 5 studies,^{27,36,37,39,42} no studies assessed cross-cultural validity. Lack of effective interventions was the main reason for the inadequate evaluation of responsiveness, as validating responsiveness required the assessment tool to be able to detect change over time after an intervention.

Psychometric Properties

The quality of psychometric properties varied for the 10 instruments that assessed it (TABLE 3). Internal consistency scored better than other criteria, with *low* or better levels (*low*, *moderate*, *high*) observed for 4 of 6 instruments (the EOS group questionnaire, Pro-D, Nijmegen Professionalism Scale, PAI). For structural validity, the EOS group questionnaire and the P-MEX scored *high*. Content validity had low levels of evidence overall, with the P-MEX scoring the highest with *moderate* quality.

Utility Scores

Utility scoring for the 10 instruments ranged from 2 to 4 points (TABLE 4), with only the Pro-D showing good correlation coefficients between level of training and sum score. The ability of the instrument to distinguish performance level over time was not examined for the other instruments. Only the PAI provided behavioral descriptors/anchors for extreme and selected intermediate anchors. Based on the 4 utility criteria, the Pro-D and PAI had the highest score at 4 points.

TABLE 2
Characteristics of Studies Included in Systematic Review

Instrument	Author	Instrument Language	Domains	No. of Items	Response Scale	Study Sample (n)	Mean Age (y)	Setting	Country
AACS	De Haes et al, ²² 2005	English	2	9	5-point Likert scale	442	N/A	Clerkship	Netherlands
EM-HS	Garra et al, ²³ 2011	English	2	9	9-point Likert scale	9	N/A	Emergency medicine residency	United States
EOS group questionnaire	Bo et al, ²⁴ 2010	English	2	21	5-point Likert scale	148	N/A	Residency	China
EOS group questionnaire	Bo et al, ²⁵ 2012	English	2	21	5-point Likert scale	258	N/A	Residency	China
EOS group questionnaire	Zhao et al, ²⁶ 2013	English	2	21	5-point Likert scale	149	N/A	Surgery residency	China
EOS group questionnaire	Yazdankhah et al, ²⁷ 2015	Persian	2	10	3-point Likert scale	37	N/A	Surgery residency	Iran
EPRO-GP	van de Camp et al, ²⁸ 2006	English	26	127	4-point Likert scale	12	N/A	General practice training	Netherlands
German Professionalism Scale (Pro-D)	Roos et al, ²⁹ 2016	German	4	67	4-point Likert scale	133	33	General practice training	Germany
Modified PAR	Al Ansari et al, ³⁰ 2015	English	3	39	5-point Likert scale	21	N/A	Clerkship	Bahrain
MSF questionnaire	Riveros et al, ³¹ 2016	English	2	15	9-point Likert scale	42	N/A	Anesthesiology residency	United States
Nijmegen Professionalism Scale	Tromp et al, ³² 2010	English	4	106	4-point Likert scale	119	N/A	General practice training	United Kingdom
PAI	Gauger et al, ³³ 2005	English	15	15	7-point Likert scale	103	N/A	Surgical residency	United States
P-MEX	Cruess et al, ³⁴ 2006	English	4	24	4-point Likert scale	74	19.7	Clerkship	Canada
P-MEX	Tsugawa et al, ³⁵ 2009	Japanese	4	24	4-point Likert scale	23	29	Residency	Japan
P-MEX	Tsugawa et al, ³⁶ 2011	Japanese	4	24	4-point Likert scale	165	N/A	Residency	Japan
P-MEX	Karukivi et al, ³⁷ 2015	Finnish	4	21	4-point Likert scale	23	25	Psychiatry program	Finland

Abbreviations: AACS, Amsterdam Attitude and Communication Scale; EM-HS, Emergency Medicine Humanism Scale; EOS, Education Outcome Service group questionnaire; EPRO-GP, Evaluation of Professional Behavior in General Practice; Pro-D, German Professionalism Scale; PAR, Physician Achievement Review; MSF, multisource feedback; N/A, not available; NPS, Nijmegen Professionalism Scale; PAI, Professionalism Assessment Instrument; P-MEX, Professionalism Mini-Evaluation Exercise.

TABLE 3
Levels of Evidence for Combined Measurement Properties for Each Instrument^a

Instrument	Measurement Properties Quality Assessment								
	Content Validity	Structural Validity	Internal Consistency	Cross-Cultural Validity Measurement Invariance	Reliability	Measurement Error	Criterion Validity	Hypotheses Testing for Construct Validity	Responsiveness
AACS	Unknown	Unknown	Unknown	Unknown	Unknown	Low	Unknown	Unknown	Unknown
EM-HS	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Very low	Unknown
EOS group questionnaire	Unknown	High	High	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
EPRO-GP	Very low	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
German Professionalism Scale (Pro-D)	Low	Very low	High	Unknown	Very low	Unknown	Unknown	Unknown	Unknown
Modified PAR	Unknown	Very low	Very low	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
MSF questionnaire	Low	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Nijmegen Professionalism Scale	Low	Very low	High	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
PAI	Unknown	Unknown	High	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
P-MEX	Moderate	High	Very low	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

Abbreviations: AACS, Amsterdam Attitude and Communication Scale; EM-HS, Emergency Medicine Humanism Scale; EOS, Education Outcome Service group questionnaire; EPRO-GP, Evaluation of Professional Behavior in General Practice; Pro-D, German Professionalism Scale; PAR, Physician Achievement Review; MSF, multisource feedback; NPS, Nijmegen Professionalism Scale; PAI, Professionalism Assessment Instrument; P-MEX, Professionalism Mini-Evaluation Exercise.

^a Unknown: no studies; very low: only studies of inadequate quality or a total sample size < 30 subjects; low: conflicting findings in multiple studies of at least doubtful quality or 1 study of doubtful quality and a total sample size ≥ 30 subjects; moderate: conflicting findings in multiple studies of at least adequate quality or consistent findings in multiple studies of at least doubtful quality or 1 study of adequate quality and a total sample size ≥ 50 subjects; high: consistent findings in multiple studies of at least adequate quality or 1 study of very good quality and a total sample size ≥ 100 subjects.

TABLE 4
Utility of Each Instrument

Instrument	Ability to Distinguish Performance Levels Over Time (Utility Score)	Presence of Behavioral Anchors (Utility Score)	For Both Medical Students and Residents (Utility Score)	Length of Instrument (Utility Score)	Total Utility Score
AACS	No (0)	No (0)	Medical students only (1)	9 items, rated on a 5-point Likert scale (2)	3
EM-HS	No (0)	No (0)	Residents only (1)	9 items, rated on a 9-point continuum from <i>needs improvement</i> to <i>outstanding</i> (2)	3
EOS group questionnaire	No (0)	No (0)	Residents only (1)	21 items, rated on a 5-point Likert scale (1)	2
EPRO-GP	No (0)	No (0)	Both medical students and residents (2)	127 items, rated on a 4-point Likert scale (0)	2
German Professionalism Scale (Pro-D)	Good correlation coefficients between level of training and sum score (2)	No (0)	Both medical students and residents (2)	67 items, rated on a 4-point Likert scale (0)	4
Modified PAR	No (0)	No (0)	Residents only (1)	39 items, rated on a 5-point Likert scale (0)	1
MSF questionnaire	No (0)	No (0)	Residents only (1)	15 items, rated on a 9-point Likert scale (2)	3
Nijmegen Professionalism Scale	No (0)	No (0)	Both medical students and residents (2)	106 items, rated on a 4-point Likert scale (0)	2
PAI	No (0)	Behavioral descriptors were determined for extreme and selected intermediate anchors (1)	Residents only (1)	15 items, rated on a 7-point continuous ordinal scale (2)	4
P-MEX	No (0)	No (0)	Both medical students and residents (2)	21 or 24 items, rated on a 4-point Likert scale (1)	3

Abbreviations: AACS, Amsterdam Attitude and Communication Scale; EM-HS, Emergency Medicine Humanism Scale; EOS, Education Outcome Service group questionnaire; EPRO-GP, Evaluation of Professional Behavior in General Practice; Pro-D, German Professionalism Scale; PAR, Physician Achievement Review; MSF, multisource feedback; NPS, Nijmegen Professionalism Scale; PAI, Professionalism Assessment Instrument; P-MEX, Professionalism Mini-Evaluation Exercise.

Discussion

We identified 16 studies assessing 10 instruments for assessing medical professionalism, with instruments showing varying quality. The P-MEX performed best relative to evidence for measurement properties and adequate utility scoring among the available instruments. Considering the psychometric properties and utility, the P-MEX may be the most suitable

instrument for assessing medical professionalism in medical trainees due to evidence to support its measurement properties and higher utility.

For many instruments, methodological quality assessed via the COSMIN checklist and the level of evidence synthesized was *very low* to *low*. Our findings are similar to those reported in a systematic review of instruments for measuring communication skills in students and residents using an objective

structured clinical examination,⁴¹ where the authors identified 8 psychometrically tested scales from 12 studies, often of poor methodological and psychometric quality. Compared with 32 instruments to measure technical surgical skills among residents⁴² and 55 instruments for assessing clinical competencies in medical students and residents,⁴³ the number of professionalism assessment instruments meeting quality criteria was lower. This may reflect challenges educators face in defining and assessing this competency.

Our study has limitations. First, the number of studies available for evidence synthesis was limited, and we may have missed studies published in languages other than English. The utility assessment tool was developed by the authors, based on previous reports, but was not evaluated further for evidence.^{19–21}

Our review showed inadequate investigation of content validity of assessment tools for medical professionalism, and future studies are needed to identify the relevant domains of medical professionalism. It is important for future studies to assess the validity of instruments across different cultural contexts, as definitions of professionalism may differ among national and cultural contexts.

Conclusion

Our review found that the P-MEX has the best evidence for measurement properties and adequate utility scoring among available instruments for assessing medical professionalism. This too may be an option for program directors to adopt as an observer-based instrument for the formative assessment of professionalism in trainees. Further aggregation of validity evidence for instruments is recommended, particularly in the domain of content validity before implementation in a specific cultural setting or for summative assessments.

References

1. Armitage-Chan E. Assessing professionalism: a theoretical framework for defining clinical rotation assessment criteria. *J Vet Med Educ*. 2016;43(4):364–371.
2. Goold SD, Lipkin M. The doctor-patient relationship: challenges, opportunities, and strategies. *J Gen Intern Med*. 1999;14(suppl 1):26–33.
3. Livingston EH, Ginsburg S, Levinson W. Introducing JAMA professionalism. *JAMA*. 2016;316(7):720–721.
4. Hodges BD, Ginsburg S, Cruess R, et al. Assessment of professionalism: recommendations from the Ottawa 2010 Conference. *Med Teach*. 2011;33(5):354–363.
5. Goldie J. Assessment of professionalism: a consolidation of current thinking. *Med Teach*. 2013;35(2):e952–e956.
6. van Mook WN, Gorter SL, O’Sullivan H, et al. Approaches to professional behaviour assessment: tools in the professionalism toolbox. *Eur J Intern Med*. 2009;20(8):e153–e157.
7. Veloski JJ, Fields SK, Boex JR, et al. Measuring professionalism: a review of studies with instruments reported in the literature between 1982 and 2002. *Acad Med*. 2005;80(4):366–370.
8. Passi V, Doug M, Peile JT, et al. Developing medical professionalism in future doctors: a systematic review. *Int J Med Educ*. 2010;1:19–29.
9. ten Cate O. Nuts and bolts of entrustable professional activities. *J Grad Med Educ*. 2013;5(1):157–158.
10. Li H, Ding N, Zhang Y, et al. Assessing medical professionalism: a systematic review of instruments and their measurement properties. *PLOS ONE*. 2017;12(5):e0177321.
11. Lynch DC, Surdyk PM, Eiser AR. Assessing professionalism: a review of the literature. *Med Teach*. 2004;26(4):366–373.
12. Wilkinson TJ, Wade WB, Knock LD. A blueprint to assess professionalism: results of a systematic review. *Acad Med*. 2009;84(5):551–558.
13. Tromp F, Vernooij-Dassen M, Kramer A, et al. Behavioural elements of professionalism: assessment of a fundamental concept in medical care. *Med Teach*. 2010;32(4):e161–e169.
14. Honghe L, Ding N, Zhang Y, et al. Assessing medical professionalism: a systematic review of instruments and their measurement properties. *PLoS ONE*. 2017;12(5):e0177321.
15. Prinsen CAC, Mokkink LB, Bouter LM, et al. COSMIN guideline for systematic reviews of patient-reported outcome measures. *Qual Life Res*. 2018;27(5):1147–1157.
16. Mokkink LB, de Vet HCW, Prinsen CAC, et al. COSMIN risk of bias checklist for systematic reviews of patient-reported outcome measures. *Qual Life Res*. 2018;27(5):1171–1179.
17. Terwee CB, Mokkink LB, Knol DL, et al. Rating the methodological quality in systematic reviews of studies on measurement properties: a scoring system for the COSMIN checklist. *Qual Life Res*. 2012;21(4):651–657.
18. Prinsen CAC, Vohra S, Rose MR, et al. How to select outcome measurement instruments for outcomes included in a “Core Outcome Set”—a practical guideline. *Trials*. 2016;17(1):449.
19. Ferrarello F, Bianchi VAM, Baccini M, et al. Tools for observational gait analysis in patients with stroke: a systematic review. *Phys Ther*. 2013;93(12):1673–1685.

20. Tyson SF, Connell LA. How to measure balance in clinical practice. A systematic review of the psychometrics and clinical utility of measures of balance activity for neurological conditions. *Clin Rehabil.* 2009;23(9):824–840.
21. Tyson S, Connell L. The psychometric properties and clinical utility of measures of walking and mobility in neurological conditions: a systematic review. *Clin Rehabil.* 2009;23(11):1018–1033.
22. De Haes JCJM, Oort FJ, Hulsman RL. Summative assessment of medical students' communication skills and professional attitudes through observation in clinical practice. *Med Teach.* 2005;27(7):583–589.
23. Garra G, Wackett A, Thode H. Feasibility and reliability of a multisource feedback tool for emergency medicine residents. *J Grad Med Educ.* 2011;3(3):356–360.
24. Bo Q, Zhao Y, Sun B. Evaluation of residents in professionalism and communication skills in south China. *Saudi Med J.* 2010;31(11):1260–1265.
25. Bo Q, Zhao YH, Sun BZ. Assessment of resident physicians in professionalism, interpersonal and communication skills: a multisource feedback. *Int J Med Sci.* 2012;9(3):228–236.
26. Zhao Y, Zhang X, Chang Q, et al. Psychometric characteristics of the 360 degrees feedback scales in professionalism and interpersonal and communication skills assessment of surgery residents in China. *J Surg Educ.* 2013;70(5):628–635.
27. Yazdankhah A, Tayefeh Norooz M, Ahmadi Amoli H, et al. Using 360-degree multi-source feedback to evaluate professionalism in surgery departments: an Iranian perspective. *Med J Islam Repub Iran.* 2015;29(1):1088–1094.
28. Van De Camp K, Vernooij-Dassen M, Grol R, et al. Professionalism in general practice: development of an instrument to assess professional behaviour in general practitioner trainees. *Med Educ.* 2006;40(1):43–50.
29. Roos M, Pfisterer D, Krug D, et al. Adaptation, psychometric properties and feasibility of the Professionalism Scale Germany. *Z Evid Fortbild Qual Gesundheitswes.* 2016;113:66–75.
30. Al Ansari A, Al Khalifa K, Al Azzawi M, et al. Cross-cultural challenges for assessing medical professionalism among clerkship physicians in a Middle Eastern country (Bahrain): feasibility and psychometric properties of multisource feedback. *Adv Med Educ Pract.* 2015;6:509–515.
31. Riveros R, Kimatian S, Castro P, et al. Multisource feedback in professionalism for anesthesia residents. *J Clin Anesth.* 2016;34:32–40.
32. Tromp F, Vernooij-Dassen M, Kramer A, et al. Behavioural elements of professionalism: assessment of a fundamental concept in medical care. *Med Teach.* 2010;32(4):e161–e169.
33. Gauger PG, Gruppen LD, Minter RM, et al. Initial use of a novel instrument to measure professionalism in surgical residents. *Am J Surg.* 2005;189(4):479–487.
34. Cruess R, McIlroy JH, Cruess S, et al. The professionalism mini-evaluation exercise: a preliminary investigation. *Acad Med.* 2006;81(suppl 10):74–78.
35. Tsugawa Y, Tokuda Y, Ohbu S, et al. Professionalism mini-evaluation exercise for medical residents in Japan: a pilot study. *Med Educ.* 2009;43(10):968–973.
36. Tsugawa Y, Ohbu S, Cruess R, et al. Introducing the professionalism mini-evaluation exercise (p-MEX) in Japan: results from a multicenter, cross-sectional study. *Acad Med.* 2011;86(8):1026–1031.
37. Karukivi M, Kortekangas-Savolainen O, Saxen U, et al. Professionalism mini-evaluation exercise in Finland: a preliminary investigation introducing the Finnish version of the P-MEX instrument. *J Adv Med Educ Prof.* 2015;3(4):154–158.
38. Cruess R, McIlroy JH, Cruess S, et al. The professionalism mini-evaluation exercise: a preliminary investigation. *Acad Med.* 2006;81(suppl 10):74–78.
39. van de Camp K, Vernooij-Dassen M, Grol R, et al. Professionalism in general practice: development of an instrument to assess professional behaviour in general practitioner trainees. *Med Educ.* 2006;40(1):43–50.
40. Roos M, Pfisterer D, Krug D, et al. Adaptation, psychometric properties and feasibility of the Professionalism Scale Germany. *Z Evid Fortbild Qual Gesundheitswes.* 2016;113:66–75.
41. Cömert M, Zill JM, Christalle E, et al. Assessing communication skills of medical students in objective structured clinical examinations (OSCE)—a systematic review of rating scales. *PLOS ONE.* 2016;11(3):e0152717.
42. Fahim C, Wagner N, Nousiainen MT, et al. Assessment of technical skills competence in the operating room: a systematic and scoping review. *Acad Med.* 2018;93(5):794–808.
43. Kogan JR, Holmboe ES, Hauer KE. Tools for direct observation and assessment of clinical skills of medical trainees: a systematic review. *JAMA.* 2009;302(12):1316–1326.



Yu Heng Kwan, BSc (Pharm) (Hons)*, is an MD-PhD candidate, Program in Health Services and Systems Research, Duke-NUS Medical School, Singapore; **Kelly Png, BSc (Pharm) (Hons)***, is a Pharmacist, National Heart Centre Singapore; **Jie Kie Phang, BSc (Life Science) (Hons)***, is Research Coordinator, Department of Rheumatology and Immunology, Singapore General Hospital, Singapore; **Ying Ying Leung, MBChB, MD**, is Senior Consultant, Department of Rheumatology and Immunology, Singapore General Hospital, and Associate Professor, Duke-NUS Medical School, Singapore; **Hendra Goh** is a BSc (Life Science) Candidate, Faculty of Science, National University of Singapore, Singapore; **Yi Seah** is a BDS Candidate, Faculty of Dentistry, National University of Singapore, Singapore; **Julian Thumboo, MBBS, MRCP, FRCP**, is Senior Consultant, Department of Rheumatology and

Immunology, Singapore General Hospital, Professor, Program in Health Services and Systems Research, Duke–NUS Medical School Singapore, and Adjunct Professor, Yong Loo Lin School of Medicine, National University of Singapore, Singapore; **A/P Swee Cheng Ng, MBBS, MRCP**, is Senior Consultant, Department of Rheumatology and Immunology, Singapore General Hospital, Singapore, and Adjunct Associate Professor, Duke–NUS Medical School, Singapore; **Warren Fong, MBBS, MRCP**, is a Consultant and Program Director of Rheumatology Senior Residency, Department of Rheumatology and Immunology, Singapore General Hospital, Singapore; and **Desiree Lie, MD, MEd**, is Professor, Duke–NUS Medical School, Singapore.

*These authors are considered co–first authors.

Funding: The authors report no external funding source for this study.

Conflict of interest: The authors declare they have no competing interests.

The authors would like to thank Dr Arpana Vidyarti, Head and Senior Consultant, Division of Advanced Internal Medicine Associate Professor, Duke–NUS Medical School, for reviewing the manuscript, and Ms Min Li Toon, MBBS candidate, National University of Singapore, for reviewing the manuscript and scoring the instruments.

Corresponding author: Warren Fong, MBBS, MRCP, Singapore General Hospital, Department of Rheumatology and Immunology, 20 College Road, Singapore 169856, +6563214028, fax +6565348632, warren.fong.w.s@singhealth.com.sg

Received January 24, 2018; revision received August 16, 2018; accepted September 14, 2018.