This is a repository copy of *Development of a competency framework for health technology assessment in India*.

White Rose Research Online URL for this paper:
https://eprints.whiterose.ac.uk/218254/

Version: Published Version

Article:

Development of a competency framework for health technology assessment in India

Simon Dixon ,[1] Kirti Tyagi,[2] Malkeet Singh,[3] Sitanshu Sekhar Kar ,[4] Bhavani Shankara Bagepally ,[5] Shankar Prinja,[2] Andrew Booth ,[1] Chris Carroll ,[1] Aamir Sohail,[6] Abha Mehndiratta [3]

Introduction

Health technology assessment (HTA) has become a key part of assessing evidence to determine which treatments are funded. Early applications were within the centrally funded health systems of high-income countries. Recent years have seen increased use within low-income and middle-income countries, including India.[1–6]

Increased application of HTAs has required corresponding increases in the systems' resources that generate or use them.[7 8] It is not surprising, therefore, that many countries have found it challenging to develop the technical capacity to conduct and use HTA.[3 4]

In 2017, the Government of India established the Health Technology Assessment Unit (HTAIn) to promote value for money within the public health system.[9–11] Regional health departments refer topics to HTAIn for consideration, and these are then assigned to one of 18 independent Regional Resource Centres (RRCs) that are commissioned to conduct HTA studies. The resultant HTA report forms the basis of a recommendation by the HTAIn Board, which is subsequently sent to the nominating department for implementation. Policy briefings, designed to educate and empower the public, are published on the economic evaluation HTAIn website (https://htain.dhr.gov.in/).

HTA capacity development within India has proceeded using ad hoc workshops,[12] a certificate course in economic evaluation for HTA,[13] and the development of a Masters Course in Health Economics and Technology Assessment.[14] However, a competency-based framework for developing HTA skills and knowledge is considered to be important in moving to a more robust and sustainable capacity-building approach.

Here, we define competencies as a combination of attitudes, skills and knowledge that enable an individual to perform tasks or activities successfully for a given role within an organisation. In addition, a competency-based framework aligns organisational roles with a set of competencies and associated assessments.

In this paper, we report on the approach adopted by Indian HTA experts in collaboration with international faculty to identify the HTA-related competencies required to carry out key roles for the different positions within HTAIn. The scope of the work focused exclusively on technical staff within its RRCs and secretariat (defined as those managing the HTAIn appraisal process). The four stages adopted by our approach are summarised in figure 1, with detailed descriptions in the following sections.

Describe roles within mature HTA systems

As a starting point, we identified competencies from mature reimbursement systems. The systems in England, Scotland and Wales were chosen as they offer variations in practice yet share structural similarities with HTAIn (online supplemental figure S1, online supplemental materials).

We searched for role details on the three principal organisations' websites (ie, National Institute for Health and Care Excellence (NICE), the Scottish Medicines Consortium (SMC) and the All Wales Therapeutics and Toxicology Centre (AWTTC)) and one of the evidence assessment groups (EAGs) used by NICE. One of the authors (SD) interpreted this information to develop preliminary lists of the roles and their requirements within those organisations. These descriptions were amended following discussions with staff members within the organisations.

Development of role-specific competencies

Using the previous information, we categorised skill and knowledge requirements for each role into separate topics (eg, 'statistics' or 'evidence review') and different levels of expertise to define the set of competencies.

This work followed the requirements of the Mission Karmayogi (MK) framework, which was launched by the Government of India in September 2020. The MK framework aims to transform capacity building for government employees by enabling them to understand their roles and linking them to required competencies.[15 16] The MK framework categorises competencies into three groups: behavioural (eg, attention to detail), functional (eg, project management) and domain-specific (health data analysis).

For our work to fit into the MK framework, we needed to specify each competency in terms of four levels. These four levels are required to cover the range of competencies required across the entire Indian public sector, not just within the HTA system. Additionally, we were asked to limit our
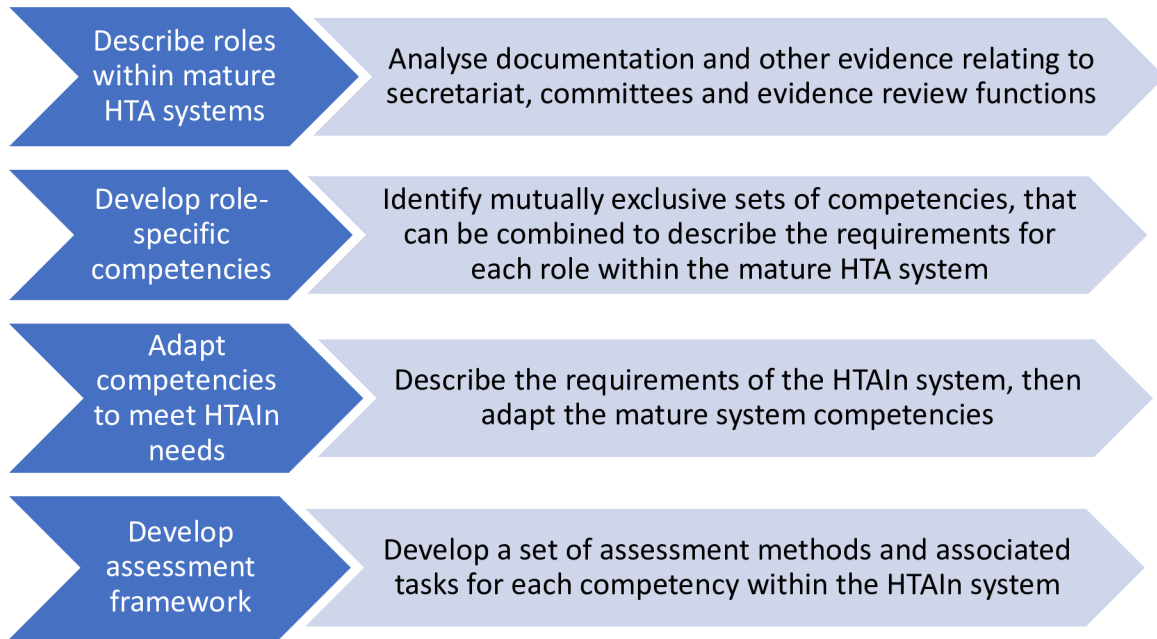
Figure 1 Approach to the development of a competency framework for HTA in India. HTA, health technology assessment; HTAIn, Health Technology Assessment Unit.

scope to domain-specific competencies, as sufficient behavioural and functional competencies had already been defined from previous work relating to MK.

This process produced five domain competencies, covering:
► HTA
► Economic evaluation
► Clinical evidence review
► Information resources
► Statistics and study design

An example of how different competencies and levels align with the skills and knowledge needed for one role within an EAG is shown in figure 2. The same information for all roles within that EAG is given in online supplemental appendix 1 of the online supplemental materials.

Adapt competencies to meet HTAIn needs
The competencies described in the UK HTA systems could not be simply transplanted into the Indian system. Consequently, they were revised by a stakeholder group led by experts from the Indian HTA system. It was composed as follows:
► Three principal investigators from HTAIn Regional Resource Centres (SK, BS and SP)

► Two researchers or staff from the HTAIn Secretariat at the Ministry of Health and Family Welfare (KR and AS)
► One public health practitioner and two HTA practitioners from the Centre for Global Development (AM, KT and MS)
► One health economist, one information specialist and one clinical effectiveness reviewer from the University of Sheffield (SD, AB and CC).

After three iterations, a final set of competencies and levels was agreed upon. The full list of HTA competencies is listed in online supplemental appendix 2 of the online supplemental materials.

Develop assessment framework
An essential part of the MK framework is the assessment of staff undertaking specific roles; however, there is no guidance as to the preferred assessment strategy. Our approach was informed by examining examples of competency-based assessment in a variety of settings. The following assessment methods were identified as most relevant: written examinations, assignments, multiple-choice questions (MCQs), portfolios, oral examinations, presentations and certification.

Further review of these methods identified two forms of MCQs: 'knowledge-based MCQs' and 'task-based MCQs'. Knowledge-based
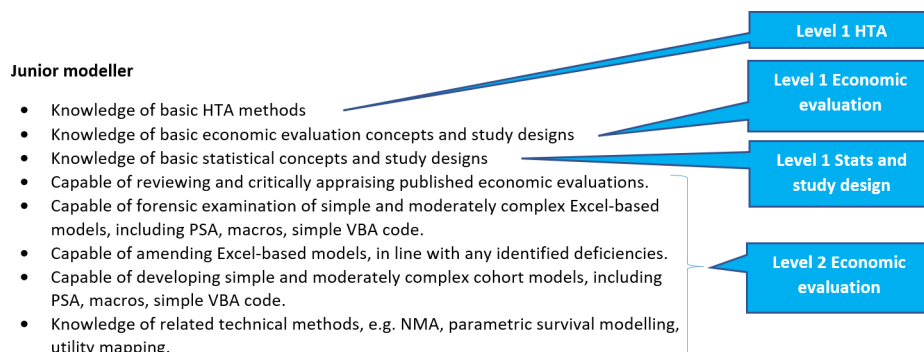
Figure 2 Role, knowledge, skills and assigned competency type/level for economic modellers within the chosen NICE EAG (Insert here)

MCQs ask questions relating to facts that do not require analytical work. An example would be, 'What arithmetical measure of central tendency represents the most frequent observation' (1) mean, (2) median, (3) mode, (4) kurtosis or (5) quartile. Task-based MCQs require students to undertake an analytical task and then answer questions that relate to the outputs of that task. A simple task-based MCQ could provide a single column of numeric data and then ask questions about its mean, median, variance, SD, etc. A complex task would be to provide a dataset and then ask questions about the results of hypothesis tests.

An initial screening of all these approaches was undertaken in order to optimise the mix of assessment methods for both students and assessors. In conjunction with stakeholders, it was agreed to focus on six methods: knowledge-based MCQs, task-based MCQs, assignments, recorded presentations, portfolios, CVs and certification.

Each skill within a competency level was matched to at least one assessment method by an experienced academic (SD, AB or CC). Initial forms of assessment were then discussed to improve consistency between the different competencies. The revised set of assessments was then reviewed by Indian stakeholders to ensure that they were locally relevant and logistically feasible.

The selection of assessment methods was based on:

1. Relevance to the learning outcome. For example, MCQs are not appropriate when assessing a student's ability to write a report.

2. Assessor capacity. In recognising that many more public sector staff would require assessment of Level 1 competencies than those being assessed for Level 4 competencies, less resource-intensive assessment methods were prioritised for lower competency levels.

The types and numbers of assessments identified for each level of competency are summarised in table 1.

Task-based MCQs play a prominent role in the proposed assessment of HTA competencies in India as they can be designed to assess a range of simple and complex tasks, whilst also being easy to mark.

Assignments were considered appropriate for higher-level competencies, as candidates needed to be able to demonstrate critical thinking, identify potential solutions and be capable of communicating specific recommendations. These competencies cannot be assessed through MCQs; they must be assessed through written assignments (or portfolios).

Recorded presentations offer a valuable tool for roles where communication skills are required, and while some of these can be assessed through assignments or portfolios, presentational skills may sometimes be essential. Consequently, in selective cases, presentations need to be assessed directly.

Several competencies not only require demonstration of certain skills but also evidence of experience in applying them in multiple situations; portfolios were considered the most appropriate and feasible method. It is anticipated that the portfolios will

Table 1 Summary of type and number of assessments by competency

| | Number of sub-competencies | Type of assessment* | | | | | |
		Knowledge-based MCQs	Task-based MCQs	Assignments	Presentations	Portfolios	Certification
Economic evaluation							
Level 1	4	3	2				
Level 2	4	3	4				
Level 3	5	1	3	1	1		
Level 4	3			1	1	1	
Health technology assessment							
Level 1	6	3	3				
Level 2	8	4	2	2		1	
Level 3	7	2		2	1	2	
Level 4	6			2	2	2	
Clinical evidence review							
Level 1	6	5	2				
Level 2	5	4	3				
Level 3	4	2	2	1	1		
Level 4	4			2	1	2	
Information resources							
Level 1	5	2	3				
Level 2	5	3	2				
Level 3	6	1	4		1		1
Level 4	4			1	1	1	1
Statistics and study design							
Level 1	5	1	4				
Level 2	4	1	3				
Level 3	6	2	3	1	1		
Level 4	5			3	1	2	

*Any one sub-competency may have more than one form of assessment; therefore, the number of assessment may be greater than the number of sub-competencies.

MCQ, multiple-choice questions.

allow candidates to evidence their own work, perhaps accompanied by a bespoke, overarching critique, reflection or commentary.

Certification was recognised as potentially valuable in two capabilities relating to Levels 3 and 4 Information Resources, which require a staff member to provide proof of their experience. It should be noted that these two levels were considered to extend beyond specific HTA activities; however, they are thought to be relevant to other potential public sector roles. The full set of assessment methods is given alongside the skills and competencies in online supplemental appendix 3 of the online supplemental materials.

Other similar approaches

Other attempts have been made to develop a set of competencies for HTA,[17] as well as in the related but broader topic of health economics and outcomes research.[18] In common with our approach, documentary analysis and expert opinion were used to develop those competencies. These previous attempts also used surveys and workshops to supplement and ensure that their competencies were relevant to a broad range of settings. By contrast, our approach generated competencies for a specific country.

Also of note is a HTA skills assessment tool that has been developed by Bidonde and colleagues.[19] However, this tool is limited to the self-assessment of respondent confidence and experience in conducting the various components of an HTA and, as such, it is of limited use for the summative assessment required by this project.

Next steps

This proposed competency and assessment framework has yet to be applied within Indian organisations. While efforts were made to ensure the operational relevance of the levels, knowledge and skills, the extent to which competencies and assessments match how HTA is delivered 'on the ground' in India remains to be seen.

While acknowledging concern that the framework was initially based on processes found in the UK, we were careful to ensure that those systems aligned closely with those in India and that the final set of competencies was the product of extensive engagement with stakeholders in India. It should also be recognised that the English, Welsh and Scottish processes are not outliers, with other countries having developed similar processes and methods,[20 21] with these being implicitly endorsed by international organisations that support their key features.[22 23] As such, the key features of the proposed competency framework are expected to have widespread relevance to other agencies around the globe. Also, since its completion, the competency framework has been shown to be relevant to India by its use in the development of a short course on 'HTA in decision-making' for India (course report available upon request from the authors).

This framework is expected to be of value to public employees within the HTA ecosystem of India by setting out an explicit set of knowledge and skill requirements needed for the effective performance of any role that has been matched to our HTA competencies. To enable this, our competencies need to be matched to public sector roles in India. Once that is complete, the assessment of an individual's performance against those competencies needs to be undertaken, with training being made available to support the development of staff. With these resources in place, uptake is expected to be encouraged by requiring assessments for recruitment and promotion.

Assessing the impact of the adoption of this framework will be difficult as its aim is to improve job performance and, ultimately, organisational and system performance. However, it should be possible to measure pass rates for the assessments and assess how these change over time as an indicator of improvements in the alignment of staff competencies to their roles. Other methods being considered are self-assessment of employee confidence in undertaking HTAs, perhaps using the work of Bidonde and colleagues,[19] or a documentary analysis of the processes and outputs.

ORCID iDs
Simon Dixon http://orcid.org/0000-0001-7394-7009
Sitanshu Sekhar Kar http://orcid.org/0000-0001-7122-523X
Bhavani Shankara Bagepally http://orcid.org/0000-0003-0856-767X
Andrew Booth http://orcid.org/0000-0003-4808-3880

Chris Carroll http://orcid.org/0000-0002-6361-6182
Abha Mehndiratta http://orcid.org/0000-0003-3045-1649

References

1 **Mueller DT**, Croce D. Health-technology assessment: its role in strengthening health systems in developing countries. *S Afr J Public Health* 2017;2:5.

2 **Falkowski A**, Ciminata G, Manca F, *et al.* How least developed to lower-middle income countries use health technology assessment: A Scoping review. *Pathog Glob Health* 2023;117:104–19.

3 **Nemzoff C**, Ruiz F, Chalkidou K, *et al.* Adaptive health technology assessment to facilitate priority setting in Low- and middle-income countries. *BMJ Glob Health* 2021;6:e004549.

4 **Li R**, Ruiz F, Culyer AJ, *et al.* Evidence-informed capacity building for setting health priorities in Low- and middle-income countries: A framework and recommendations for further research. *F1000Res* 2017;6.

5 **Fasseeh A**, Karam R, Jameleddine M, *et al.* Implementation of health technology assessment in the Middle East and North Africa: comparison between the current and preferred status. *Front Pharmacol* 2020;11.

6 **Dwivedi R**, Athe R, Pati S, *et al.* Mapping of health technology assessment (HTA) teaching and training initiatives: landscape for evidence-based policy decisions in India. *J Family Med Prim Care* 2020;9:5458.

7 **Kaló Z**, Gheorghe A, Huic M, *et al.* HTA implementation roadmap in central and Eastern European countries. *Health Econ* 2016;25 Suppl 1(Suppl Suppl 1):179–92.

8 **Hollingworth SA**, Ruiz F, Gad M, *et al.* Health technology assessment capacity at national level in sub-Saharan Africa: an initial survey of Stakeholders. *F1000Res* 2020;9.

9 **Downey LE**, Mehndiratta A, Grover A, *et al.* Institutionalising health technology assessment: establishing the medical technology assessment board in India. *BMJ Glob Health* 2017;2:e000259.

10 **Kumar M**, Ebrahim S, Taylor FC, *et al.* Health technology assessment in India: the potential for improved Healthcare decision-making. *Natl Med J India* 2014;27:159–63.

11 **Bhatia H**, Dharmagadda S. Health Technology Assessment in India: Necessity, Progress and Future Plans. *J Health Manag* 2022;24:256–9.

12 **Downey LE**, Dabak S, Eames J, *et al.* Building capacity for evidence-informed priority setting in the Indian health system: an international collaborative experience. *Health Policy Open* 2020;1.

13 **Economic evaluation for health technology assessment.** Postgraduate Institute of medical education and research (PGIMER). 2023. Available: https://www.healtheconomics.pgisph.in/school-of-public-health-advanced-course.html [Accessed 30 Aug 2023].

14 Master of science - health economics and technology assessment. In: *Health Technology Assessment India.* New Delhi, Available: https://www.ugc.gov.in/pdfnews/5266370_HTAIn-letter.pdf [accessed 30 Aug 2023].

15 **Sharma SU**, Sharma KR. Debates on Administrative Reform in India: Training. State Capacity Initiative Working Paper. India: Centre for Policy Research, 2022.

16 What is mission Karmayogi; 2020Sep3. Indian express

17 **Mueller D**, Gutierrez-Ibarluzea I, Chiumente M, *et al.* Toward a common understanding of Competencies for health technology assessment: enhancing educational and training programs around the globe. *Int J Technol Assess Health Care* 2020;37:e29.

18 **Pizzi LT**, Onukwugha E, Corey R, *et al.* Competencies for professionals in health economics and outcomes research: the ISPOR health economics and outcomes research Competencies framework. *Value Health* 2020;23:1120–7.

19 **Bidonde J**, Meneses-Echavez JF, Asare B, *et al.* Developing a tool to assess the skills to perform a health technology assessment. *BMC Med Res Methodol* 2022;22.

20 **Fontrier AM**, Visintin E, Kanavos P. Similarities and differences in health technology assessment systems and implications for coverage decisions: evidence from 32 countries. *Pharmacoecon Open* 2022;6:315–28.

21 **Sharma D**, Aggarwal AK, Downey LE, *et al.* National Healthcare economic evaluation guidelines: A cross-country comparison. *Pharmacoecon Open* 2021;5:349–64.

22 **Wilkinson T**, Sculpher MJ, Claxton K, *et al.* The International decision support initiative reference case for economic evaluation: an aid to thought. *Value Health* 2016;19:921–8.

23 **Bertram M**, Dhaene G, Edejer TT. *Institutionalizing health technology assessment mechanisms: a how to guide.* Geneva: World Health Organization, 2021.

Development of a skills and competency framework for HTA in India

Figure S1: Reimbursement bodies and functions in England, Scotland, Wales and India

Appendix 1: Role, skills and assigned competency for staff within the chosen NICE ERG

Appendix 2: The full list of HTA competencies and skills for HTAIn

Appendix 3: The full set of assessment methods for all competencies and skills for HTAIn

Figure S1: Reimbursement bodies and functions in England, Scotland, Wales and India
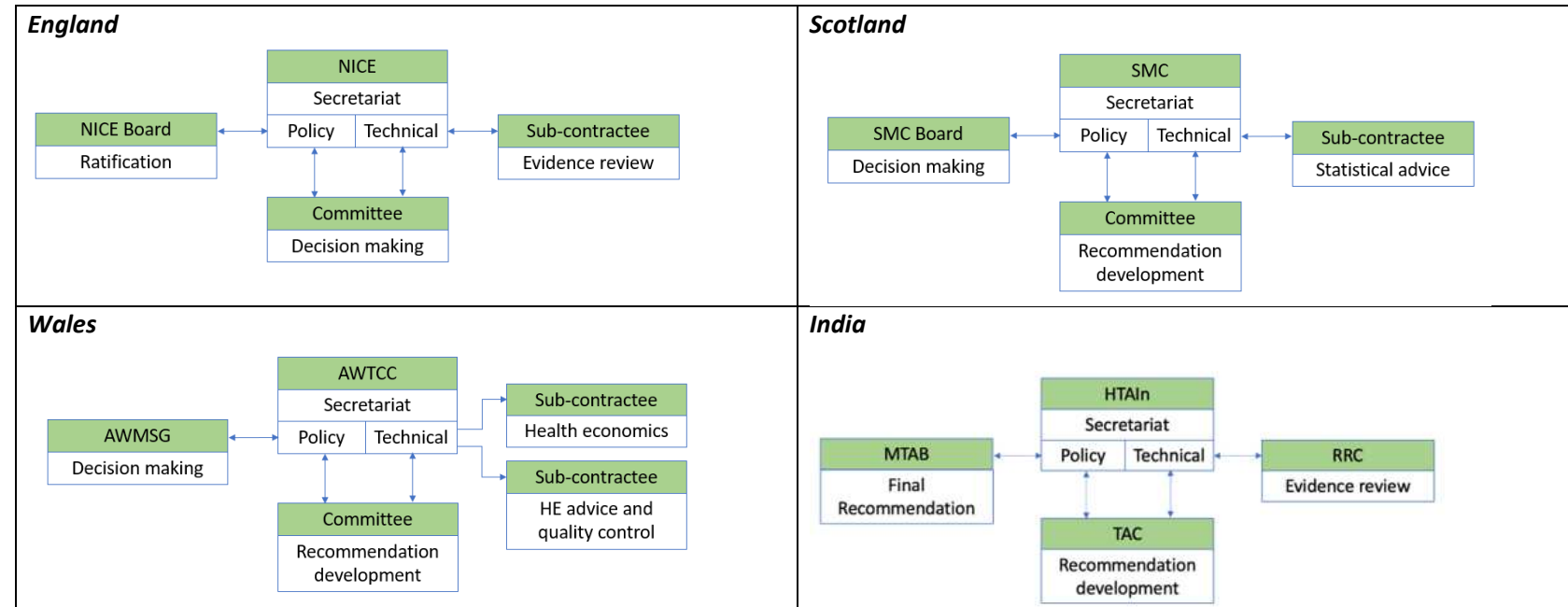
Notes:

Green shading indicates the organisation and/or affiliation. White shading indicates functions.

The secretariat function has been split between "policy" and "technical" to highlight their different purposes, however, these labels are not used within any of the organisations.

Abbreviations:

NICE=National Institute for Health and Care Excellence, SMC=Scottish Medicines Consortium, AWTCC=All Wales Therapeutics and Toxicology Centre, AWMSG=All Wales Medicines Strategy Group, MTAB=Medical Technology Assessment Board, TAC=Technical Appraisal Committee, the RRC=Regional Resource Centres

Appendix 1: Role and competencis for staff within the chosen NICE ERG

Junior information scientist

- Knowledge of basic HTA methods
- Capable of constructing, reporting and undertaking structured search strategies in multiple bibliographic databases using MESH and open text strings
- Capable of undertaking reference and citation searches in multiple bibliographic databases
- Capable of identifying grey literature through multiple methods
- Proficient in the use of common citation management software, Endnote, Reference Manager or Mendeley
- Knowledge of common filters (e.g. Cochrane RCT filters)
- Knowledge of multiple study types and their defining features (e.g. cohort, prognostic, RCT, cost-effectiveness)

> Level 1 HTA

> Level 1 Information

Junior statistician
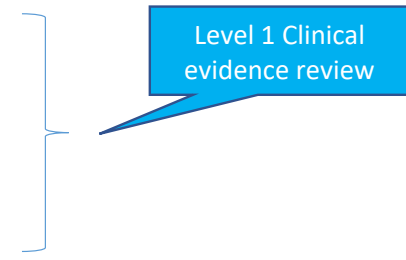
- Knowledge of basic HTA methods
- Knowledge of basic statistical concepts and study designs
- Capable of identifying and undertaking the most appropriate hypothesis test on data of various kinds using R.
- Capable of identifying and undertaking the most appropriate regression method on data of various kinds using R.
- Capable of reporting and undertaking structured critical appraisals of statistical analyses, taking into account the clinical context of the analyses.
- Capable of critically appraising indirect comparisons and network meta-analyses (NMAs).
- Capable of critically appraising complex effectiveness analyses (e.g. matched-adjusted indirect comparisons (MAICs), simulated treatment comparisons (STCs) and treatment crossover analysis).
- Capable of undertaking indirect comparisons and simple NMAs within WinBUGS/OpenBUGS.

> Level 1 Stats and study design

> Level 2 Stats and study design

3

Junior reviewer
- Knowledge of basic HTA methods
- Knowledge of basic statistical concepts and study designs
- Detailed knowledge of the relative merits of different study design (e.g. evidence hierarchy)
- Capable of reporting and undertaking structured critical appraisals of clinical data, for multiple study designs (e.g. observational, case-control, before-after, CRTs, diagnostics)
- Capable of undertaking meta-analyses in Revman.

Level 1 Clinical evidence review

Junior modeller
- Knowledge of basic HTA methods
- Knowledge of basic economic evaluation concepts and study designs
- Knowledge of basic statistical concepts and study designs
- Capable of reviewing and critically appraising published economic evaluations.
- Capable of forensic examination of simple and moderately complex Excel-based models, including PSA, macros, simple VBA code.
- Capable of amending Excel-based models, in line with any identified deficiencies.
- Capable of developing simple and moderately complex cohort models, including PSA, macros, simple VBA code.
- Knowledge of related technical methods, e.g. NMA, parametric survival modelling, utility mapping.
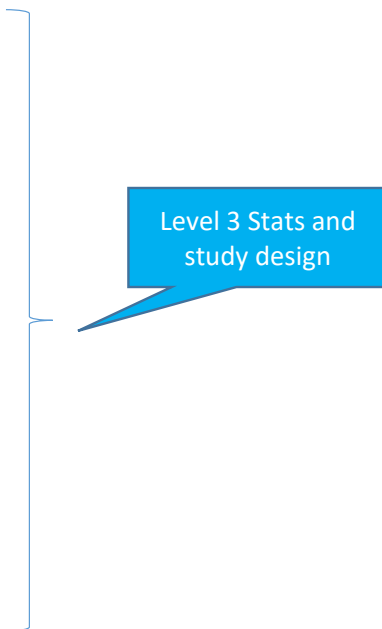
Level 1 Economic evaluation

Level 2 Economic evaluation

4

Senior statistician
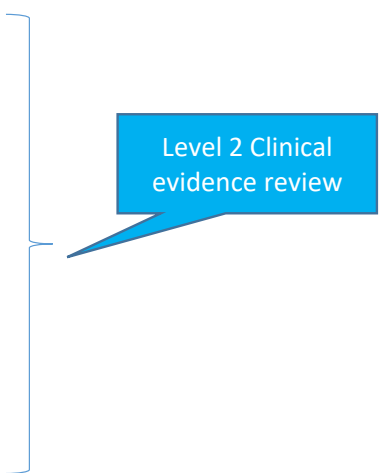
- *Same as Junior statistician, but additionally (<u>underlined</u> for partial changes, otherwise whole bullet point is new):*
- <u>Working knowledge</u> of multiple statistical packages (e.g. STATA, SPSS, WinBUGS/OpenBUGS).
- Knowledge of specialist, topic-specific methodologies (e.g. prognostic modelling, meta-analysis of diagnostics)
- Capable of <u>designing</u>, reporting and undertaking structured critical appraisals of statistical analyses, taking into account the clinical context of the analyses.
- Capable of undertaking indirect comparisons and <u>complex NMAs</u> within WinBUGS/OpenBUGS.
- Capable of <u>undertaking</u> complex effectiveness analyses (e.g. matched-adjusted indirect comparisons (MAICs), simulated treatment comparisons (STCs) and treatment crossover analysis).
- Capable of presenting and discussing complex analyses and critical appraisals in an expert forum.
- Four years postgraduate (or equivalent) experience. This represents greater knowledge of previous appraisals and the related academic literature.

> Level 3 Stats and study design

Senior reviewer

- *Same as Junior reviewer, but additionally (<u>underlined</u> for partial changes, otherwise whole bullet point is new):*
- Knowledge of basic economic evaluation concepts and study designs
- Capable of <u>designing</u>, reporting and undertaking structured critical appraisals of clinical data, for multiple study designs (e.g. observational, case-control, before-after, CRTs, diagnostics)
- <u>Knowledge of</u> specialist, topic-specific methodologies (e.g. meta-analysis of diagnostic tests)
- Capable of presenting and discussing complex analyses and critical appraisals in an expert forum.
- Four years postgraduate (or equivalent) experience. This represents greater knowledge of previous appraisals and the related academic literature.

> Level 2 Clinical evidence review

Senior modeller

- *Same as Junior modeller, but additionally (<u>underlined</u> for partial changes, otherwise whole bullet point is new):*
- Capable of forensic examination of <u>complex</u> Excel-based models, including user-defined functions and simple VBA code.
- Capable of specifying all necessary model amendments needed to overcome deficiencies.
- Capable of developing complex cohort <u>and individual patient simulation models</u>.
- <u>Detailed knowledge</u> of related technical methods, e.g. NMA, parametric survival modelling, utility mapping.
- <u>Knowledge of</u> specialist, topic-specific methodologies (e.g. discrete event simulation, calibration)
- Capable of presenting and discussing complex analyses and critical appraisals in an expert forum.
- Four years postgraduate (or equivalent) experience. This represents greater knowledge of previous appraisals and the related academic literature.

Level 3 Economic evaluation

Lead statistician
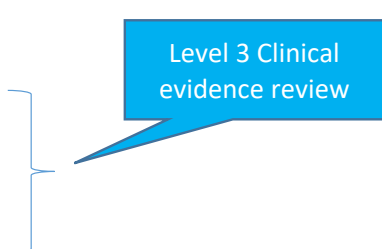
- *Same as Senior statistician, but additionally (<u>underlined</u> for partial changes, otherwise whole bullet point is new):*
- <u>Experience of applying</u> specialist, topic-specific methodologies (e.g. prognostic modelling, meta-analysis of diagnostics)
- <u>Eight years</u> postgraduate (or equivalent) experience. This represents greater knowledge of previous appraisals and the related academic literature.

Level 4 Stats and study design

Lead reviewer

- *Same as senior reviewer, but additionally (<u>underlined</u> for partial changes, otherwise whole bullet point is new):*
- <u>Experience of applying</u> specialist, topic-specific methodologies (e.g. meta-analysis of diagnostics)
- <u>Eight years</u> postgraduate (or equivalent) experience. This represents greater knowledge of previous appraisals and the related academic literature.

Level 3 Clinical evidence review

Lead modeller
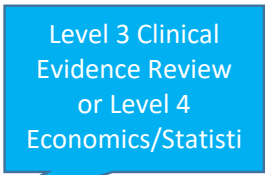
- *Same as Senior modeller, but additionally (<u>underlined</u> for partial changes, otherwise whole bullet point is new):*
- <u>Experience of applying</u> specialist, topic-specific methodologies (e.g. discrete event simulation, calibration)
- <u>Eight years</u> postgraduate (or equivalent) experience. This represents greater knowledge of previous appraisals and the related academic literature.

> Level 4 Economic evaluation

Unit director

- *Same as Lead modeller/reviewer/statistician, but additionally (<u>underlined</u> for partial changes, otherwise whole bullet point is new):*
- <u>Capable of quality assuring all outputs in terms of methods and presentation</u>
- <u>Capable of discussion/negotiation/arguing with the senior management team for the technology appraisal and the highly specialized technologies programmes at NICE</u>
- <u>Ten years</u> postgraduate (or equivalent) experience. This represents greater knowledge of previous appraisals and the related academic literature.

> Level 3 Clinical Evidence Review or Level 4 Economics/Statisti

7

Appendix 2: The full list of HTA competencies and skills for HTAIn

Level 1 HTA
- Knowledge of the principles of HTA; definition, components
- Knowledge of how HTA is used within the Indian Healthcare System
- Knowledge of different study designs and types of bias
- Ability to formulate a topic in terms of PICOS (population, intervention, comparators, outcomes, study type)
- Ability draft the scope of a HTA topic based on its PICOS.
- Ability to assess the relevance of a topic to the requirements of a specific programme (e.g. is it in scope?)

Level 2 HTA
- Basic knowledge of Indian health policy
- Knowledge of critical appraisal principles relating to effectiveness studies
- Knowledge of basic economic principles
- Knowledge of international HTA methods (i.e. other approaches adopted in other countries)
- Ability to read and assess the relevance of a HTA report (i.e. does it meet the requirements)
- Ability to prepare a short summary of a HTA report
- Ability to communicate with all stakeholders relating to a HTA
- Ability to manage a HTA project (i.e. plan timelines and provide everyday advice/guidance)

Level 3 HTA
- Detailed knowledge of Indian health policy
- Ability to effectively present the results of a HTA to senior decision makers
- Detailed knowledge of international health systems and HTA process
- Ability to identify strengths and weakness of Indian HTA system and processes
- Ability to suggest improvements to the Indian HTA system
- Ability to supervise a HTA project (i.e. provide expert advice and solve complex problems)
- Ability to manage a HTA programme (of multiple projects)

Level 4 HTA
- Ability to communicate effectively with regional/national level decision makers and stakeholders
- Ability to communicate with international audiences
- Ability to supervise a HTA programme (of multiple projects)
- Ability to prioritise changes to the Indian HTA system and process
- Ability to implement changes to the Indian HTA system
- Ability to work with stakeholders in order to implement HTA recommendations

Level 1 Statistics and Study Design
- Knowledge of different study designs and types of bias

- Capable of undertaking a simple critical appraisal of a clinical paper
- Capable of calculating summary statistics for a dataset
- Capable of identifying and undertaking the most appropriate hypothesis test in an appropriate software package
- Capable of summarising results appropriately

Level 2 Statistics and Study Design
- Knowledge of more advanced topics such as NMAs and use of non-trial data in HTA
- Capable of identifying and undertaking the most appropriate regression method on data of various kinds using R.
- Capable of reporting and undertaking structured critical appraisals of statistical analyses, taking into account the clinical context of the analyses.
- Capable of critically appraising indirect comparisons and network meta-analyses (NMAs).

Level 3 Statistics and Study Design
- Capable of undertaking indirect comparisons and simple NMAs within an appropriate software package.
- Capable of critically appraising complex effectiveness analyses (e.g. matched-adjusted indirect comparisons (MAICs), simulated treatment comparisons (STCs) and treatment crossover analysis).
- <u>Working knowledge</u> of multiple statistical packages (e.g. STATA, SPSS, WinBUGS/OpenBUGS).
- Basic knowledge of specialist, topic-specific methodologies (e.g. prognostic modelling, meta-analysis of diagnostics)
- Capable of <u>designing</u>, reporting and undertaking structured critical appraisals of statistical analyses, taking into account the clinical context of the analyses.
- Capable of presenting and discussing complex analyses and critical appraisals in an expert forum.

Level 4 Statistics and Study Design
- Capable of undertaking indirect comparisons and <u>complex NMAs</u> within WinBUGS/OpenBUGS.
- Capable of <u>undertaking</u> complex effectiveness analyses (e.g. matched-adjusted indirect comparisons (MAICs), simulated treatment comparisons (STCs) and treatment crossover analysis).
- <u>Experience of applying</u> specialist, topic-specific methodologies (e.g., prognostic modelling, meta-analysis of diagnostics)
- <u>Capable of quality assuring all outputs in terms of methods and presentation</u>
- <u>Capable of discussion/negotiation/arguing with the senior management team for the technology appraisal and the highly specialized technologies programmes at NICE</u>

Level 1 Economic Evaluation
- Knowledge of basic statistical concepts and study designs
- Knowledge of economic evaluation and budget impact methods
- Knowledge of different model types used in economic evaluation

- Capable of reviewing and critically appraising published economic evaluations.

Level 2 Economic Evaluation
- Capable of developing simple cohort models, e.g. decision trees and Markov models
- Capable of examination and amendment of simple and moderately complex Excel-based models
- Ability to identify the most appropriate data to populate an economic model
- Knowledge of related technical methods, e.g. partitioned survival models, network meta-analysis, parametric survival modeling, utility mapping

Level 3 Economic Evaluation
- Capable of developing moderately complex cohort models
- Capable of developing partitioned survival models.
- Ability to undertake parametric survival modeling and utility mapping
- Knowledge of specialist, topic-specific methodologies (e.g. discrete event simulation, calibration)
- Capable of presenting and discussing complex analyses and critical appraisals in an expert forum.

Level 4 Economic Evaluation
- Experience of applying specialist, topic-specific methodologies (e.g. individual patient simulation, discrete event simulation, calibration)
- Capable of quality assuring all outputs in terms of methods and presentation
- Capable of discussion/negotiation/arguing with the senior management team for the technology appraisal and the highly specialized technologies programmes at NICE

Level 1 Clinical Evidence Review
- Knowledge of basic statistical concepts and study designs
- Knowledge of basic HTA methods (to understand the role of clinical effectiveness review within HTA and decision-making);
- Detailed knowledge of the relative merits of different study designs (e.g. evidence hierarchy)
- Capable of understanding and applying eligibility criteria to an evidence base to identify relevant studies;
- Capable of extracting the appropriate data from relevant included studies;
- Capable of selecting the appropriate tool, and undertaking and reporting simple structured critical appraisals of clinical data for the principal study design (e.g. RCTs)

Level 2 Clinical Evidence Review
- Capable of selecting the appropriate tool, and undertaking and reporting simple structured critical appraisals of clinical data, for the main study designs (e.g. RCTs, observational studies, case-control, before & after, mixed method studies);
- Capable of identifying and conducting the appropriate methods of simple evidence synthesis, e.g. narrative synthesis and meta-analysis in an appropriate software package (e.g. Revman)

- Capable of writing reports relating to simple structured critical appraisals and straightforward synthesis (narrative synthesis and meta-analysis)
- Capable of understanding the evidence and its findings in relation to the decision problem (strengths and weaknesses)
- Ability to identify the most appropriate data to populate an economic model

Level 3 Clinical Evidence Review
- Capable of selecting the appropriate tool, and undertaking and reporting structured critical appraisals of clinical data for complex study designs (e.g. diagnostic studies, prognostic studies) and safety outcomes;
- The ability to conduct or support the conduct of topic-specific methodologies of evidence synthesis (e.g., understanding of and statistical analysis of accuracy of diagnostic tests; understanding of network meta-analysis (NMA) and what is required for NMA from the review);
- Capable of writing reports relating to evidence identification, critical appraisal, analysis and their findings and implications;
- Capable of presenting and discussing complex analyses and critical appraisals (and the implications of their findings) in an expert forum in relation to the decision problem.

Level 4 Clinical Evidence Review
- Experience of conducting and critiquing multiple specialist, topic-specific methodologies (e.g. meta-analysis of diagnostics)
- Capable of coordinating a team of reviewers working on a single topic
- Capable of quality assuring all outputs in terms of methods and presentation
- Capable of discussion/negotiation/arguing with the senior management team of the national HTA body in relation to specific projects and/or a programme of work

Level 1 Information Resources
- Knowledge of basic HTA methods
- Capable of constructing, reporting and undertaking structured search strategies in multiple bibliographic databases using subject headings and open text strings
- Capable of undertaking reference and citation searches in multiple bibliographic databases
- Capable of identifying grey literature through multiple methods
- Proficient in the use of common citation management software

Level 2 Information Resources
- Knowledge of different review types and the types of questions they seek to address
- Knowledge of common methodological filters
- Knowledge of the implications of resource-constrained syntheses (i.e. rapid reviews) in terms of time savings and risks of bias/risk to rigour
- Knowledge of multiple study types and their defining features
- Capable of manipulating bibliographic data in multiple formats and of designing purpose-specific capture files or output styles.

Level 3 Information Resources
- Knowledge of strategies for enhancing the sensitivity or specificity of information retrieval as appropriate to project objectives
- Capable of designing, reporting and evaluating methodological filters for multiple study designs
- Knowledge of and familiarity with specialist, purpose-specific resources (e.g. trial registers, institutional repositories etc.)
- Capable of project planning and design of resource-constrained syntheses (e.g. rapid reviews) within a preset timetable.
- Capable of presenting and providing justification for selection or evaluation of information retrieval methods in an expert forum.
- Four years postgraduate (or equivalent) experience. This represents greater knowledge of information retrieval methods and related information resources.

Level 4 Information Resources
- Experience of designing, constructing and developing specialist and purpose-specific collections and information resources
- Capable of delivering a variety of synthesis products to meet customer and user requirements (e.g. scoping reviews, mapping reviews, rapid reviews, umbrella reviews)
- Capable of organising and delivering a service that produces a variety of timely and appropriate synthesis products
- Eight years postgraduate (or equivalent) experience. This represents greater knowledge of information storage, retrieval and dissemination and related information resources.

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance
placed on this supplemental material which has been supplied by the author(s)

BMJ EBM

Appendix 3: The full set of assessment methods for all competencies and skills for HTAIn

Competency and level-specific assessments for Economic Evaluation

Level/competency	Type of assessment	Additional information
Level 1 Economic Evaluation		
Knowledge of basic statistical concepts and study designs	Knowledge-based MCQs	Introductory medical statistics (e.g. data types, statistical concepts, summary statistics, types of statistical analysis, hypothesis testing).
Knowledge of economic evaluation and budget impact methods	Knowledge-based MCQs	Introductory economic evaluation (e.g. definition, types, pros and cons, stages of an economic evaluation, outcome valuation methods, budget impact analysis methods).
	Task-based MCQs	Basic calculations (e.g. discounting, annuitisation, price adjustment, currency adjustment, QALYs, ICERs, incremental analysis).
Knowledge of different model types used in economic evaluation	Knowledge-based MCQs	Introductory decision analytic modelling (e.g. types of models, pros and cons, principles of adaptation)..
Capable of reviewing and critically appraising published economic evaluations.	Task-based MCQs	Identification and interpretation of information in an economic evaluation paper.
Level 2 Economic Evaluation		
Capable of developing simple cohort models, e.g. decision trees and Markov models	Task-based MCQs	Development and analysis of a decision tree (introductory) Development and analysis of a state transition model (introductory). Each with questions relating to intermediate calculations and model results.
Capable of examination and amendment of simple and moderately complex Excel-based models	Task-based MCQs	Amendment of a pre-existing model in Excel, with questions relating to intermediate calculations and model results.
Ability to identify the most appropriate data to populate an economic model	Knowledge-based MCQs	Knowledge of key principles of parameter selection.
	Task-based MCQs	Identification of model parameters from multiple sources using specified criteria, e.g. which meet reference case criteria.
Knowledge of related technical methods, e.g. partitioned survival models, network meta-analysis, parametric survival modelling, utility mapping	Knowledge-based MCQs	Intermediate decision analytic modelling (e.g. partitioned survival models, network meta-analysis, parametric survival modelling)
	Knowledge-based MCQs	Intermediate economic evaluation (e.g. generic preference based measures, mapping)

13

	Task-based MCQs	Identification and interpretation of information in a NICE economic submission
Level 3 Economic Evaluation		
Capable of developing moderately complex cohort models	Task-based MCQs	Development and analysis of 'cohort'? model (moderate complexity), with questions relating to intermediate calculations and model results.
	Assignment	Write a short report describing the model, its results and discussing their policy implications. This could be undertaken, alternatively, for a partitioned survival model.
Capable of developing partitioned survival models.	Task-based MCQs	Development and analysis of partitioned survival model, with questions relating to intermediate calculations and model results.
Ability to undertake parametric survival modelling and utility mapping.	Task-based MCQs	Estimation of survival functions from data, and identification of most appropriate model. Estimation of mapped utilities from data and specified mapping function.
Knowledge of specialist, topic-specific methodologies (e.g. discrete event simulation, calibration).	Knowledge-based MCQs	Advanced decision analytic modelling (e.g. e.g. discrete event simulation, calibration).
Capable of presenting and discussing complex analyses and critical appraisals in an expert forum.	Recorded presentation	Undertaking a critical appraisal, presenting it and discussing areas of contention.
Level 4 Economic Evaluation		
Experience of applying specialist, topic-specific methodologies (e.g. individual patient simulation, discrete event simulation, calibration)	Portfolio	Examples of previous work covering all relevant topics, together with an overarching summary or critique.
Capable of quality assuring all outputs in terms of methods and presentation	Assignment	Quality assurance of a report to identify potential errors (e.g. 'quirky' results), deviations from template (e.g. method or report or omissions), deviations from recommended methods, and clarity (e.g. avoidance of repetition, grammar, spellings).
Capable of discussion with the senior management team of reimbursement agency in relation to methods and processes relating to HTA	Presentation	Respond to a critique of a HTA report (taking the role of the lead economist for the team that produced the report).

14

Competency and level-specific assessments for Health Technology Assessment

Level/competency	Type of assessment	Additional information
Level 1 Health Technology Assessment		
Knowledge of the principles of HTA	Knowledge-based MCQs	Definition, stages, components and their basic principles (e.g. defining the decision problem, why we need a systematic review, how do we assess bias, what is an economic evaluation, what legal and ethical issues may be relevant)
Knowledge of how HTA is used within the Indian Healthcare System	Knowledge-based MCQs	Organisations involved, technologies involved, how the individual components are undertaken, and basic understanding of the methods involved.
Knowledge of different study designs and types of bias	Knowledge-based MCQs	Introductory critical appraisal (e.g. hierarchy of evidence, pros and cons, the role of checklists/tools)
Ability to formulate a topic in terms of PICOS (population, intervention, comparators, outcomes, study type)	Task-based MCQs	Applying PICOS to a list of titles/abstracts and full text papers. Identifying comparators for a particular population and intervention (i.e. searching for technologies in the same part of the treatment pathway).
Ability to draft the scope of a HTA topic based on its PICOS.	Task-based MCQs	For differing HTA methods, select the most appropriate text for a particular PICOS. This also includes an assessment of whether a PICOS is well enough developed to produce an appropriate scope.
Ability to assess the relevance of a topic to the requirements of a specific programme (e.g. is it in scope?)	Task-based MCQs	Identifying technology types, disease classes, disease prevalence and likely costs in order to assign the technology to a set of specified HTA programmes. Note: this will require searching for information relating to these characteristics (e.g. prevalence).

Level 2 Health Technology Assessment		
Basic knowledge of Indian health policy (beyond HTA)	Knowledge-based MCQs	In order to understand the broader policy context, questions should be related to recent and current organisational structures, policies and debates.
Knowledge of critical appraisal principles relating to effectiveness studies	Knowledge-based MCQs	Understanding the process of critical appraisal, study features that are assessed and knowledge of prominent critical appraisal tools.
Knowledge of basic economic principles	Knowledge-based MCQs	Understand of what makes an economic evaluation, types, stages of an economic evaluation, utilities, budget impact analysis.
Knowledge of international HTA processes and methods (i.e. other approaches adopted in other countries)	Knowledge-based MCQs	In order to understand the international context and alternative processes/methods, questions should relate to prominent countries. Further discussion is needed when selecting these for training purposes, but we would suggest England (NICE and other processes/methods), United States (patchwork/free-market processes and methods), and maybe two others from low- or middle-income countries that illustrate different methodologies and degrees of complexity.
Ability to read and assess the relevance of a HTA report (i.e. does it meet the requirements)	Task-based MCQs	For differing methods, potentially relating to different types of technologies, several short HTA reports need to be assessed against those methods/requirements.
Ability to prepare a short summary of a HTA report	Assignment	Read a HTA report, then write a summary mirroring the academic/technical language of the report (say, 300 words).
Ability to communicate with all stakeholders relating to a HTA	Assignment	Read a HTA report, then write a lay summary for the public/media (say, 100 words) and a non-technical summary for health service personnel health service managers (say, 300 words).
Ability to manage a HTA project (i.e. plan timelines and provide everyday advice/guidance)	Task-based MCQs plus knowledge based MCQs	Calculations of project duration for a project based on estimated timings for specific tasks and number of staff. Calculation of numbers of staff required to meet a deadline, given task timings. These tasks would be interspersed with a selection of MCQs taken from all previous knowledge-based tests.
	Portfolio	Example of a previous project plan and reflection on the actual delivery of the project in terms of timings, staff numbers, setbacks and solutions.

16

Level 3 Health Technology Assessment		
Detailed knowledge of Indian health policy	Knowledge-based MCQs	In order to understand the broader policy context, questions should be related to recent and current organisational structures, policies and debates.
Ability to effectively present the results of a HTA to senior decision makers	Recorded presentation	Present a summary of a HTA to a set of slides mirroring the academic/technical language of the report.
Detailed knowledge of international health systems and HTA process	Knowledge-based MCQs	In order to understand the international context and alternative processes/methods, questions should relate to prominent countries. Further discussion is needed when selecting these for training purposes, but we would suggest England (NICE and other processes/methods), United States (patchwork/free-market processes and methods), and maybe two others from low- or middle-income countries that illustrate different methodologies and degrees of complexity.
Ability to identify strengths and weakness of Indian HTA system and processes	Assignment	Produce a report describing the overall HTA system briefly, then one specific programme within it. Identify two strengths and weakness of the overall system, and two strengths and weakness of the processes within the specific programme and two strengths and weakness of the methods within the specific programme.
Ability to suggest improvements to the Indian HTA system	Assignment	Produce a report describing the overall HTA system, followed by the identification of two weakness of the system, the processes of a specific programme and the methods of a specific programme. Improvements to these 6 problems should then be described and justified.
Ability to supervise a HTA project (i.e. provide expert advice and solve complex problems)	Portfolio	Examples of previous projects, including project plans, reflection on the actual delivery of the project in terms of setbacks and solutions, together with a reflection on your personal contribution.
Ability to manage a HTA programme (of multiple projects)	Portfolio	Example of a programme, including project plans, reflection on the actual delivery of the programme in terms of setbacks and solutions.

17

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance
placed on this supplemental material which has been supplied by the author(s)

BMJ EBM

Level 4 Health Technology Assessment		
Ability to communicate effectively with regional/national level decision makers and stakeholders	Presentation	Presentation relating to a set of six suggested improvements to the Indian HTA system.
Ability to communicate with international audiences	Presentation	Presentation describing the Indian HTA system (or a specific programme), together with a comparison with another country's system (or analogous programme).
Ability to supervise a HTA programme (of multiple projects)	Portfolio	Examples of a programme, including project plans, reflection on the actual delivery of the programme in terms of setbacks and solutions, together with a reflection on your personal contribution.
Ability to prioritise changes to the Indian HTA system and processes	Assignment	Produce a report describing the overall HTA system and the main programmes within it. Identify ten weakness across the system/programmes and rank the five most important, providing justifications for your results.
Ability to implement changes to the Indian HTA system	Portfolio	Examples of changes to the system in terms of their plans, the processes put in place to realise those changes, the outcome and a critical review of the implementation.
Ability to work with stakeholders in order to implement HTA recommendations	Assignment	Produce a report detailing plans for the implementation of two disparate HTAs. This should include a summary of the technology and associated services, the development of a stakeholder map, a description of implementation procedures, how the two map onto one another and recommendations for improvements

Competency and level-specific assessments for Clinical Evidence Review

Level/competency	Type of assessment	Additional information
Level 1 Clinical Evidence Review		
Knowledge of basic statistical concepts and study designs	Knowledge-based MCQs	Introductory medical statistics (e.g. data types, statistical concepts, summary statistics, types of statistical analysis, hypothesis testing).
Knowledge of the principles of HTA	Knowledge-based MCQs	Definition, stages, components and their basic principles (e.g. defining the decision problem, why we need a systematic review, how do we assess bias, what is an economic evaluation, what legal and ethical issues may be relevant)
Detailed knowledge of the relative merits of different study designs (e.g. evidence hierarchy)	Knowledge-based MCQs	Introductory materials on: Understanding of the different types of study design; understanding strengths and weaknesses of each type; understanding which types are best at answering what sort of questions
Capable of understanding and applying eligibility criteria to an evidence base to identify relevant studies;	Knowledge-based MCQs	Introductory materials on: Understanding the PICOS framework in relation to clinical decision problems / review questions;
	Task-based MCQs	Applying PICOS to a list of titles/abstracts; applying PICOS to a number of full text papers
Capable of extracting the appropriate data from relevant included studies;	Task-based MCQs	Introductory materials on: Understanding the application of the PICOS framework to clinical data in a set of included studies; identifying and selecting the appropriate text in a set of studies; identifying and selecting the appropriate numbers in a set of studies
Capable of selecting the appropriate tool, and undertaking and reporting simple structured critical appraisals of clinical data for the principal study design (e.g. RCTs)	Knowledge-based MCQs	Introductory materials on: Understanding the purpose of critical appraisal; knowledge of most common critical appraisal tools; selecting an appropriate tool for appraising an RCT
	Task-based MCQs	Understanding how to conduct, complete and report a critical appraisal of an RCT using one or more appropriate tools

Supplemental material
BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ EBM

Level 2 Clinical Evidence Review		
Capable of selecting the appropriate tool, and undertaking and reporting simple structured critical appraisals of clinical data, for the main study designs (e.g. RCTs, observational studies, case-control, before & after, mixed method studies);	Knowledge-based MCQs	Introductory materials on: Selecting an appropriate tool for appraising common quantitative study designs
	Task-based MCQs	Understanding how to conduct, complete and report a critical appraisal of a up to three different study designs using one or more appropriate tools
Capable of identifying and conducting the appropriate methods of simple evidence synthesis, e.g. narrative synthesis and meta-analysis in an appropriate software package (e.g. Revman)	Knowledge-based MCQs	Introductory materials on: The two principal types of synthesis; purpose of narrative synthesis; purpose of meta-analysis; strengths and weaknesses of the two approaches; when to do meta-analysis, when not to do a meta-analysis; software for conducting meta-analysis (RevMan)
	Task-based MCQs	Summarising data and findings in narrative synthesis; conduct of fixed and random effects model meta-analysis; production of forest plots; funnel plots
Capable of writing reports relating to simple structured critical appraisals and straightforward synthesis (narrative synthesis and meta-analysis)	Task-based MCQs	Understanding what information needs to be reported and why. Introductory materials on: PRISMA reporting guidelines and checklist; AMSTAR checklist; generating risk of bias tables and funnel plots for publication bias) (including in RevMan)
Capable of understanding the evidence and its findings in relation to the decision problem (strengths and weaknesses)	Knowledge-based MCQs	Understanding external validity: the fit between the evidence and the decision problem (review question); understanding the strengths and limitations of the evidence base (in terms of PICOS and critical appraisal) and its implications; consideration of subgroups, length of follow-up, clinical vs statistical significance.
Ability to identify the most appropriate data to populate an economic model	Knowledge-based MCQs	Knowledge of key principles of parameter selection.

20

Level 3 Clinical Evidence Review		
Capable of selecting the appropriate tool, and undertaking and reporting structured critical appraisals of clinical data for complex study designs (e.g. diagnostic studies, prognostic studies) and safety outcomes;	Knowledge-based MCQs	Introductory materials on: Selecting an appropriate tool for appraising complex study designs (e.g QUADAS-2, QUIPS)
	Task-based MCQs	Understanding how to conduct, complete and report a critical appraisal of a up to three different study designs using one or more appropriate tools
The ability to conduct or support the conduct of topic-specific methodologies of evidence synthesis (e.g. understanding of and statistical analysis of accuracy of diagnostic tests; understanding of network meta-analysis (NMA) and what is required for NMA from the review);	Knowledge-based MCQs	Introductory materials on: The principal types of synthesis for diagnostic and prognostic data; strengths and weaknesses of the approaches; when to do meta-analysis, when not to do a meta-analysis; Understanding and supporting network meta-analysis;
	Task-based MCQs	Summarising diagnostic and prognostic data and findings in narrative synthesis; conduct of meta-analysis for diagnostics and prognostics; production of forest plots; funnel plots
Capable of writing reports relating to evidence identification, critical appraisal, analysis and their findings and implications;	Assignment	Write a report of a search, critical appraisal, data extraction and evidence synthesis (including use of RevMan). that demonstrates, appropriate use of PRISMA guidelines
Capable of presenting and discussing complex analyses and critical appraisals (and the implications of their findings) in an expert forum in relation to the decision problem.	Recorded presentation	Presentation of an evidence review and the uncertainties most relevant to decision-making. This should demonstrate appropriate knowledge of the fit between the evidence and the decision problem; understanding the strengths and limitations of the evidence base and its implications; consideration of subgroups, length of follow-up, and the concepts of clinical and statistical significance.

Level 4 Clinical Evidence Review		
Experience of conducting and critiquing multiple specialist, topic-specific methodologies (e.g. meta-analysis of diagnostics)	Assignment	Complete a report describing the conduct, reporting and critique of two or more types of synthesis. This should demonstrate an understanding of how to conduct, report and critique multiple types of synthesis, including an understanding of the uncertainties in the evidence base for each type of synthesis
Capable of coordinating a team of reviewers working on a single topic	Portfolio	Provide documentary evidence relating to internal leadership and management at the HTA programme level. Evidence could include reports, team profiles, timetables and meeting notes.
Capable of quality assuring all outputs in terms of methods and presentation	Assignment	Understanding what information needs to be reported and why across all sections of the report and whether the review has performed its tasks in relation to all analyses, including economic evaluation, the decision problem and broader decision-making
Capable of discussing and negotiating with the senior management team of the national HTA body in relation to specific projects and/or a programme of work	Recorded presentation	Presentation demonstrating external leadership and management at the HTA programme level. This should demonstrate a knowledge of the HTA management structure, their expectations, the relevant contract, budgets, staffing and timelines.
	Portfolio	Provide documentary evidence relating to the presentation given above.

22

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ EBM

Competency and level-specific assessments for Information Resources

Level/competency	Type of assessment	Additional information
Level 1 Information Resources		
Knowledge of basic HTA methods	Knowledge-based MCQs	Identify the three main types of Health Technology Assessment Methods (i.e. primary data methods (e.g. RCT or cohort study), integrative methods (e.g. systematic review or meta-analysis), and economic analysis methods (e.g. cost effectiveness or cost utility analysis).
Capable of constructing, reporting and undertaking structured search strategies in multiple bibliographic databases using subject headings and open text strings	Task-based MCQs	(1) Work from a two concept Population-Intervention search question (e.g. Atrial Fibrillation-Defibrillators) and construct a search strategy with subject headings and text synonyms, syntax and truncation. (2) Run the search on a database of their choice and report results for each result line. (3) Use an abbreviated template of the PRISMA-S reporting standard to document their search process.
Capable of undertaking reference and citation searches in multiple bibliographic databases	Task-based MCQs	Identify a suitably core reference from the assessed subject search (above). Obtain a copy of the full text. Review the reference list for eligible articles and document all references that meet the inclusion criteria. Search for citations from the core reference and identify and document all references that meet the inclusion criteria.
Capable of identifying grey literature through multiple methods	Knowledge-based MCQs	Characteristics of grey literature (e.g. types of grey literature, different sources of grey literature, strengths and weaknesses of different types of grey literature, principles of publication bias).
Proficient in the use of common citation management software	Task-based MCQs	To upload results from the previous subject and citation searches to a reference management database, to add a record manually and then output a bibliography in a designated common reference output.

Level 2 Information Resources		
Knowledge of different review types and the types of questions they seek to address	Knowledge-based MCQs	Matching of review questions to review types. Identification of distinguishing characteristics of different review types.
Knowledge of common methodological filters	Task-based MCQs	Identification, selection, use, documentation and evaluation of an appropriate methodological filter to match a review type/purpose.
Knowledge of the implications of resource-constrained syntheses (i.e. rapid reviews) in terms of time savings and risks of bias/risk to rigour	Knowledge-based MCQs	Identification of appropriate methods for limiting or constraining review tasks according to defined periods of available time e.g. (2 weeks, 3 months, 6 months). Recognition of limitations associated with each choice.
Knowledge of multiple study types and their defining features	Knowledge-based MCQs	Identification of study types from their descriptions. Identification of study types from the type of question that they seek to address.
Capable of manipulating bibliographic data in multiple formats and of designing purpose-specific capture files or output styles.	Task-based MCQs	Converting bibliographic data for input into spreadsheet software. Design of a capture file for a regional or local resource. Design of an output style for a national or regional journal or report publication.

Level 3 Information Resources		
Knowledge of strategies for enhancing the sensitivity or specificity of information retrieval as appropriate to project objectives	Task-based MCQs	Starting with a basis search strategy (e.g. search fulfilled for Level 1) develop a number of specific strategies to increase or decrease the numbers of included references. Evaluate the efficiency and yield of each strategy.
Capable of designing, reporting and evaluating methodological filters for multiple study designs	Task-based MCQs	Critique of a previously published methodological filter. Development of a methodological filter that seeks to improve the previous filter. Comparison of efficiency and yield of the previous and novel filter against a gold standard set of relevant studies.
Knowledge of and familiarity with specialist, purpose-specific resources (e.g. trial registers, institutional repositories etc.)	Knowledge-based MCQs and Task-based MCQs	Identification of different types of purpose-specific resource. A critique of one exemplar resource against a formal evaluation framework.
Capable of project planning and design of resource-constrained syntheses (e.g. rapid reviews) within a preset timetable.	Task-based MCQs	Adapt a 12 month review timetable and Gantt chart to a specified (reduced) time period with accompanying rationale and identification of implications for rigour/bias.
Capable of presenting and providing justification for selection or evaluation of information retrieval methods in an expert forum.	Recorded presentation	Use either the enhanced search strategy (Level 3 task 1), the filter critique (Level 3 task 2) or the critique of a purpose-specific resource (Level 3 task 3) as the topic for a presentation; explaining the context, the work accomplished and anticipating possible criticisms or needs for justification.
Four years postgraduate (or equivalent) experience. This represents greater knowledge of information retrieval methods and related information resources.	CV or certification	Submission of a CV or provision of certification (both to a specification developed by HTA India).

Level 4 Information Resources		
Experience of designing, constructing and developing specialist and purpose-specific collections and information resources	Portfolio	Describe an existing collection or information resource (physical or electronic) including the background to its original development, recent trends and current initiatives. Critique the service EITHER from the perspective of "what we would do differently if designing and constructing this service today" OR "where we would take the collection/resource within the next five years (assuming that realistic funds were available)".
Capable of delivering a variety of synthesis products to meet customer and user requirements (e.g. scoping reviews, mapping reviews, rapid reviews, umbrella reviews)	Assignment	Identify a key customer/user service, critique existing service provision and propose an innovative synthesis product to meet an existing or anticipated need.
Capable of organising and delivering a service that produces a variety of timely and appropriate synthesis products	Recorded presentation	Produce and present a brief business plan (either for initiation, continuation or extension) of a review service with appropriate acknowledgement of local patterns of service use and international models of service delivery (e.g. NICE, CADTH).
Eight years postgraduate (or equivalent) experience. This represents greater knowledge of information storage, retrieval and dissemination and related information resources.	CV or certification	Submission of a CV or provision of certification (both to a specification developed by HTA India).

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance
placed on this supplemental material which has been supplied by the author(s)

BMJ EBM

Competency and level-specific assessments for Statistics and Study Design

Level/competency	Type of assessment	Additional information
Level 1 Statistics and Study Design		
Knowledge of different study designs and types of bias	Knowledge-based MCQs	Introductory medical statistics (e.g. data types, statistical concepts, summary statistics, types of statistical analysis, hypothesis testing).
Capable of undertaking a simple critical appraisal of a clinical paper	Task-based MCQs	Identification and interpretation of information in a clinical effectiveness paper.
Capable of calculating summary statistics for a dataset	Task-based MCQs	Producing specified summary statistics (e.g. means, medians, correlations), manually, from data supplied to the staff member.
Capable of identifying and undertaking the most appropriate hypothesis test in an appropriate software package	Task-based MCQs	Undertaking hypothesis tests relating to comparisons using different types of data, correlations and analysis of variance.
Capable of summarising results appropriately	Task-based MCQs	Generating a table of baseline characteristics (with differences between study arms tested for) and answering study questions in relation to a study dataset.
Level 2 Statistics and Study Design		
Knowledge of more advanced topics such as NMAs and use of non-trial data in HTA	Knowledge-based MCQs	Knowledge of concepts and terminology, problems associated with non-trial data and potential solutions to those problems.
Capable of identifying and undertaking the most appropriate regression method on data of various kinds using R.	Task-based MCQs	Undertaking appropriate regressions relating to different data types from a study data set (e.g. continuous, binary, rank and count data).
Capable of reporting and undertaking structured critical appraisals of statistical analyses, taking into account the clinical context of the analyses.	Task-based MCQs	Read excerpts from statistical analyses of HTA reports, then answer specific questions relating to the adequacy of the methods. This may require students to look-up information on the clinical measurements (e.g. what are the measurement properties of the Health Assessment Questionnaire?)
Capable of critically appraising indirect comparisons and network meta-analyses (NMAs).	Task-based MCQs	Identification and interpretation of information in a NMA paper.

27

Level 3 Statistics and Study Design		
Capable of undertaking indirect comparisons and simple NMAs within an appropriate software package.	Task-based MCQs	Undertaking appropriate analyses for multiple outcome measures, based on a dataset.
Capable of critically appraising complex effectiveness analyses (e.g. matched-adjusted indirect comparisons (MAICs), simulated treatment comparisons (STCs) and treatment crossover analysis).	Knowledge-based MCQs	Detailed knowledge of methods, assumptions, strengths and limitations.
	Task-based MCQs	Read excerpts from statistical analyses of HTA reports, then answer specific questions relating to the adequacy of the methods. This may require students to look-up information on the clinical measurements (e.g. what are the measurement properties of the Health Assessment Questionnaire?)
Working knowledge of multiple statistical packages (e.g. STATA, SPSS, WinBUGS/OpenBUGS).	Task-based MCQs	Undertake a series of basic statistical analyses in multiple packages, using multiple datasets.
Basic knowledge of specialist, topic-specific methodologies (e.g. prognostic modelling, meta-analysis of diagnostics)	Knowledge-based MCQs	Knowledge of methods, assumptions, strengths and limitations.
Capable of designing, reporting and undertaking structured critical appraisals of statistical analyses, taking into account the clinical context of the analyses.	Assignment	Critically appraise the statistical analyses undertaken in an (hypothetical) HTA report. Provide and justify an alternative set of analyses based on the data associated with the report.
Capable of presenting and discussing complex analyses and critical appraisals in an expert forum.	Recorded presentation	Present the results of the critical appraisal undertaken in the preceding assignment.

Level 4 Statistics and Study Design		
Capable of undertaking indirect comparisons and complex NMAs within WinBUGS/OpenBUGS.	Assignment	Produce a report and its associated code, relating to a dataset with multiple outcome measures.
Capable of undertaking complex effectiveness analyses (e.g. matched-adjusted indirect comparisons (MAICs), simulated treatment comparisons (STCs) and treatment crossover analysis).	Assignment	Produce a report and its associated code, for datasets relating to different decision problems.
Experience of applying specialist, topic-specific methodologies (e.g., prognostic modelling, meta-analysis of diagnostics)	Portfolio	Examples of previous projects, together with an overarching summary of the methods and your personal contribution.
Capable of quality assuring all outputs in terms of methods and presentation	Assignment	Understanding the requirements of a specific assessment, then assessing whether the research meets those requirements in terms of scope, presentation and whether the most appropriate methods have been used. The assignment would be in the form of an internal report relating to a draft HTA report prior to its submission to a national decision-making body.
	Portfolio	Examples of previous projects, together with descriptions of your role, changes requested by you, and the methods used to identify the changes.
Capable of discussion/negotiation/arguing with the senior management team for the technology appraisal and the highly specialized technologies programmes at NICE	Recorded presentation	Presentation demonstrating knowledge of the appropriate HTA programmes, their methods and processes, ways in which they could be improved and the resource requirements for such changes.

29