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Original Research Article

Validation and refinement of an outcome-based postgraduate medical genetics residency curriculum in Bangladesh: findings from a questionnaire survey and expert consensus workshop

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ABSTRACT

Background: Curriculum validation by relevant stakeholders is essential before implementing a new postgraduate training program. This study aimed to validate and refine a preliminary outcome-based postgraduate Medical Genetics residency curriculum developed for Bangladesh Medical University (BMU), Bangladesh.
Methods: A descriptive study was conducted at BMU from March 2023 to February 2024. A self-administered semi-structured questionnaire with a five-point Likert scale was distributed purposively to 75 geneticists, biotechnologists, anatomists, medical educationists, clinicians, and residents. Questionnaire reliability was acceptable (Cronbach's α=0.78). Components achieving a mean score ≥3.5 or acceptance ≥60% were considered acceptable. Survey findings informed a proposed curriculum, which was subsequently reviewed in a five-hour expert workshop involving 12 participants representing genetics, biotechnology, anatomy, medical education, and clinical disciplines.
Results: Sixty-five participants responded (response rate, 87%); 83.0% had teaching experience and 80.0% had research experience. Acceptance was high for the program concept (100%; mean 4.91±0.29), program learning outcomes (100%; 4.74±0.44), individual course learning outcomes (100%; 4.75±0.43), teaching-learning methods (100%; 4.78±0.41), clinical collaboration (98.5%; 4.89±0.36), and proposed courses (97.0%; 4.65±0.67). Guided practical training was preferred by 90.8%, while 93.8% preferred interactive OSPE for practical assessment. Although 93.8% accepted the initial in-course assessment system, 52.31% recommended restructuring it into formative and summative assessment.
Conclusions: Multidisciplinary stakeholder validation demonstrated strong acceptance of the proposed curriculum, while sequential questionnaire and expert review enabled targeted refinement toward a practical, clinical, research-oriented, outcome-based postgraduate Medical Genetics residency curriculum.

Keywords: Medical Genetics, curriculum validation, Outcome-based education, Expert consensus, Bangladesh

INTRODUCTION

Outcome-based education (OBE) has become increasingly important in medical education because it defines the competencies learners should achieve and aligns curriculum content, teaching methods, and assessment with those outcomes. Competency-based approaches similarly emphasize demonstrable performance rather than completion of prescribed training alone.[1] Effective curriculum design therefore requires explicit alignment between learning outcomes, educational activities, and assessment strategies.[2] Recent implementation of outcome-based curricular models has demonstrated their potential to improve the coherence of medical training and learner performance.[3]

This approach is particularly relevant to Medical Genetics, where rapidly evolving genomic technologies require graduates to integrate scientific knowledge with laboratory competence, clinical decision-making, counselling, ethical practice, and research. Persistent gaps in genetics and genomics education among healthcare professionals have been documented internationally.[4-6] Contemporary genetics competency frameworks advocate measurable learning outcomes encompassing knowledge, clinical application, communication and professional responsibilities.[7] Curriculum analyses and longitudinal educational initiatives further demonstrate the importance of structured, clinically relevant genetics education.[8,9]

Developing a curriculum, however, does not establish its appropriateness for implementation. Validation should incorporate evidence from relevant stakeholders regarding curricular content, learning outcomes, teaching-learning approaches and assessment. Combining quantitative and qualitative feedback can strengthen content validity and contextual relevance.[10]

Consensus methods are widely employed in medical education for curriculum development, competency definition, and assessment design.[11] Rigorous consensus approaches emphasize appropriate expert selection, predefined criteria, and transparent refinement processes.[12]

Recent genomics-education research likewise emphasizes stakeholder engagement and iterative evaluation across curriculum development and implementation.[13,14]

Accordingly, following development of a preliminary postgraduate Medical Genetics curriculum, this study aimed to evaluate stakeholder acceptance through a multidisciplinary questionnaire survey and refine the curriculum through an expert consensus workshop, producing a contextually appropriate outcome-based residency curriculum for Bangladesh. The preliminary curriculum had been developed from international benchmarking, institutional feasibility assessment and expert needs analysis.

METHODS

Study design and setting

A descriptive study was conducted at the Department of Anatomy, Bangladesh Medical University (BMU), Dhaka, from March 2023 to February 2024. Following development of the preliminary outcome-based postgraduate Medical Genetics curriculum, a self-administered semi-structured questionnaire was used to obtain stakeholder feedback. The questionnaire contained five sections and included five-point Likert-scale items, single- and multiple-response questions, and two open-ended questions regarding proposed modifications. Seventy-five participants comprising geneticists, biotechnologists, anatomists, medical educationists, clinicians, and residents were selected purposively. Questionnaire reliability was assessed using Cronbach's alpha and was acceptable (α=0.78).

Expert consensus workshop

Feedback from the questionnaire was incorporated into a revised "Proposed Curriculum." This curriculum was subsequently evaluated through a five-hour expert workshop involving 12 purposively selected participants: three geneticists, one biotechnologist, three anatomists, three medical educationists, and two clinicians. Participants were divided into three multidisciplinary groups and received the proposed curriculum and supporting documents seven days before the workshop. Each group reviewed assigned curriculum components and provided written and oral recommendations. Workshop discussions were audio-recorded and supplemented by written notes. The recommendations were qualitatively reviewed and used to refine the proposed curriculum into the final suggested outcome-based postgraduate Medical Genetics curriculum.

Data analysis

Questionnaire responses were entered and analyzed using Statistical Package for the Social Sciences (SPSS), version 27. Responses to five-point Likert-scale statements were coded in ascending order as 1=Undecided, 2=Disagree, 3=Tend to disagree, 4=Tend to agree, and 5=Agree. Descriptive statistics were used to summarize the findings. Categorical and multiple-response items were expressed as frequencies and percentages, while Likert-scale responses were summarized using mean scores and standard deviations where appropriate. A mean score of $\geq$3.5 and/or an acceptance frequency of $\geq$60% was regarded as indicating stakeholder acceptance of a curriculum component. Open-ended comments concerning minor or major modifications were analyzed separately and considered during curriculum revision. Data generated during the expert workshop were analyzed qualitatively by identifying recommendations related to curriculum structure, learning outcomes, teaching-learning strategies, course content, assessment, instructional resources, and

academic organization. Relevant recommendations were incorporated into the final curriculum.

Ethical considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of Bangladesh Medical University before commencement of the study. All questionnaire respondents and workshop participants received adequate information regarding the purpose and procedures of the research, and written informed consent was obtained before participation. Participation was entirely voluntary, and participants were informed of their right to withdraw at any stage without consequence. Confidentiality of individual responses and opinions was maintained throughout data collection, analysis, and reporting. Study data were securely preserved in the Department of Anatomy, BMU, and participants were informed that the findings could be disseminated through scientific publications.

Operational definitions

Preliminary curriculum: The initial outcome-based postgraduate Medical Genetics curriculum prepared before stakeholder validation. It served as the document evaluated through the questionnaire survey and included program structure, courses, learning outcomes, teaching-learning methods, assessment systems, credit distribution, and other curricular components.

Curriculum acceptance: For this study, a curriculum component was considered accepted when the corresponding questionnaire statement achieved a mean Likert score ≥3.5 and/or an acceptance frequency ≥60%. Higher Likert scores represented greater agreement with the proposed component.

Proposed curriculum: The revised version of the preliminary curriculum prepared after incorporating relevant quantitative and qualitative feedback obtained through the questionnaire survey. This version subsequently underwent expert workshop review.

Expert consensus workshop: A structured five-hour multidisciplinary review session involving 12 purposively selected experts from genetics, biotechnology, anatomy, medical education, and clinical disciplines. Participants reviewed the proposed curriculum in three groups and provided written, oral, and recorded recommendations for refinement.

5. Final suggested curriculum: The final outcome-based postgraduate Medical Genetics residency curriculum was produced after incorporating relevant recommendations arising from both the questionnaire validation and the expert workshop. It represented the final refined curriculum developed through the sequential validation process.

RESULTS

A total of 75 professionals were approached for evaluation of the preliminary outcome-based postgraduate Medical Genetics curriculum, of whom 65 completed the questionnaire, giving a response rate of 87.0%. Respondents represented genetics, biotechnology, anatomy, medical education, clinical disciplines, and postgraduate residency training, thereby providing multidisciplinary perspectives on the proposed program. Most respondents had previous academic experience, with 83.0% reporting teaching experience. Research experience was reported by 80.0% of respondents, indicating substantial familiarity with academic and scientific activities. Genetics was among the major areas of research experience and was reported by 61.5% of respondents. In the subsequent expert consensus workshop, 12 multidisciplinary experts participated, comprising geneticists (3; 25.0%), anatomists (3; 25.0%), medical educationists (3; 25.0%), clinicians (2; 16.7%), and a biotechnologist (1; 8.3%). As this curriculum validation study enrolled multidisciplinary academic and clinical stakeholders rather than patients, the demographic and professional characteristics of both participant groups are summarized in Table 1.

Stakeholder acceptance of the major components of the preliminary curriculum was consistently high. All 16 evaluated curriculum domains fulfilled the predefined acceptance criterion of a mean score ≥3.5 and/or an acceptance frequency ≥60%. Complete acceptance was observed for the overall concept of the program, PEOs and PLOs, individual course learning outcomes, teaching-learning methods, and teaching strategies. The highest mean score was recorded for acceptance of the overall program (4.91±0.29), followed by collaboration with relevant clinical departments (4.89±0.36). Even the comparatively lower-rated domains, including marks distribution and grading system, received acceptance frequencies of 87.7% and 92.3%, respectively. Thus, the survey demonstrated broad agreement with the overall structure of the preliminary curriculum while also identifying specific areas requiring refinement (Table 2).

The survey explored respondents' preferences regarding specific approaches to theoretical learning because the preliminary curriculum included multiple educational strategies. Interactive tutorials or exercises conducted in small groups of up to five learners were the most frequently selected theoretical learning method, chosen by 55 respondents (84.6%). Interactive lectures were selected by 44 respondents (67.7%), while self-directed learning using textbooks or electronic resources was supported by 42 respondents (64.6%). Interactive discussions and seminar-based teaching were selected by 49.2% and 46.2%, respectively. Facilitator-guided self-assessment was the least selected option, although it was still preferred by approximately one-third of respondents. These findings favored an interactive and learner-engaged approach rather

than exclusive reliance on conventional didactic teaching (Table 3).

Practical skill acquisition received particularly strong support from stakeholders. Guided use of laboratory equipment under supervision was selected by 59 of 65 respondents (90.8%), making it the most preferred practical learning approach. Genetic counselling sessions were also strongly supported, with 52 respondents (80.0%) selecting this method, indicating the perceived importance of direct clinical and communication-based experience. Report writing and interpretation of cytogenetic and molecular genetic investigations were selected by 61.5% of respondents. Learning through illustrations and electronic sources was supported by 53.8%, while independent equipment-based self-learning was selected by 49.2%. Only 10.8% selected a referral-system approach, suggesting that stakeholders strongly favored direct supervised participation over indirect exposure (Table 4).

Assessment was one of the principal areas in which stakeholder feedback resulted in substantive curriculum refinement. Although 93.8% of respondents accepted the proposed in-course assessment concept, 52.31% specifically recommended restructuring the system into formative and summative examinations in accordance with the postgraduate assessment approach then practiced at BMU. For written assessment, short-answer questions were preferred by 90.8% of respondents, followed by structured essay questions at 70.8%. For oral-practical assessment, interactive OSPE was the dominant preference and was selected by 61 respondents (93.8%). Semi-structured card-based oral examinations were selected by 63.1%, whereas long-case assessment received the lowest support at 7.7%. The findings therefore favored structured, objective, and performance-oriented assessment over predominantly traditional essay or long-case examinations (Table 5).

Respondents also evaluated the proposed marks distribution, grading system, and supporting documents required for transparent implementation of the curriculum. Overall acceptance of the proposed marks distribution was 87.7%, with a mean score of 4.40±0.84, while the grading system achieved 92.3% acceptance and a mean score of 4.48±0.79. Among supporting documents, the strongest preference was for detailed course descriptions and learning outcomes, selected by 62 respondents (95.4%). An OSPE format or checklist was selected by 76.9%, while proposed reading materials were selected by 72.3%. Educational strategies were considered necessary by 61.5%, whereas approximately half supported a structured checklist for seminar assessment. The written examination test matrix was selected by 40.0%, indicating comparatively lower but still substantial support for explicit examination blueprints (Table 6).

Following questionnaire-based revision, the proposed curriculum underwent a second-stage expert review through a multidisciplinary workshop involving 12 participants. The participants comprised three geneticists, one biotechnologist, three anatomists, three medical educationists, and two clinicians, and were divided into three review groups. The Paul Berg group concentrated primarily on the overall program framework, vision, mission, program educational objectives, and program learning outcomes. The Linda Buck group focused principally on course content, individual course learning outcomes, practical opportunities, and prescribed learning resources. The Francis Crick group reviewed teaching-learning methods, instructional tools, assessment, and the academic calendar. The workshop produced several targeted recommendations, most of which were subsequently incorporated into the final suggested curriculum (Table 7).

The combined survey and workshop findings resulted in progressive refinement rather than wholesale replacement of the preliminary curriculum. Questionnaire respondents demonstrated strong acceptance of the program structure, three-year duration, PEOs/PLOs, course learning outcomes, teaching-learning approaches, rotations, and clinical collaboration, while identifying assessment as the most important area requiring modification. Consequently, the proposed assessment structure was revised toward formative and summative assessment. The subsequent workshop strengthened research competencies, measurability of program learning outcomes, practical exposure, course organization, electronic learning resources, and outcome-based assessment. The final curriculum retained a three-year MD Residency Program in Medical Genetics while incorporating the refined mission statements and other modifications arising from the two validation stages. This sequential process demonstrated how quantitative stakeholder agreement and qualitative expert review complemented each other during curriculum refinement (Table 8).

Table 1: Demographic and professional characteristics of study participants.

Participant category / characteristic	Result
Questionnaire survey participants (Stage 1)	
Specialists approached (N)	75
Completed responses (N)	65
Response rate (%)	87.0%
Respondents with teaching experience (%)	83.0%
Respondents with research experience (%)	80.0%

Continued.

Participant category / characteristic	Result
Respondents reporting genetics among research fields (%)	61.5%
Professional groups represented	Geneticists, biotechnologists, anatomists, medical educationists, clinicians, and residents (with genetics research experience)
Expert consensus workshop participants (Stage 2, n=12)	
Geneticists, N (%)	3 (25.0%)
Anatomists, N (%)	3 (25.0%)
Medical educationists, N (%)	3 (25.0%)
Clinicians, N (%)	2 (16.7%)
Biotechnologist, N (%)	1 (8.3%)
Total workshop participants, n (%)	12 (100.0%)

This curriculum validation study enrolled academic and clinical stakeholders rather than patients. Percentages for Stage 1 are based on completed questionnaire responses (n=65); percentages for Stage 2 are based on total expert workshop participants (n=12).

Table 2: Overall stakeholder validation of major components of the preliminary postgraduate Medical Genetics curriculum (n=65).

Curriculum component	Acceptance (%)	Mean±SD
Acceptance of the program	100.0	4.91±0.29
Program duration	93.8	4.65±0.69
Vision and mission	98.5	4.82±0.43
PEOs and PLOs	100.0	4.74±0.44
Intended participants	93.8	4.72±0.67
Credit hours	95.4	4.54±0.85
Proposed courses	97.0	4.65±0.67
Individual course learning outcomes	100.0	4.75±0.43
Teaching-learning methods	100.0	4.78±0.41
Teaching strategies	100.0	4.71±0.46
Extra-departmental rotation	95.4	4.60±0.74
Collaboration with relevant clinical departments	98.5	4.89±0.36
Seminar presentation	98.4	4.88±0.38
In-course assessment system	93.8	4.62±0.76
Marks distribution	87.7	4.40±0.84
Grading system	92.3	4.48±0.79

Acceptance was defined as a percentage frequency ≥60% and/or mean score ≥3.5.

Table 3: Stakeholder preferences for theoretical teaching-learning methods (n=65).

Teaching-learning method*	N	%
Interactive tutorials/exercises in small groups of up to 5	55	84.6
Interactive lectures	44	67.7
Self-learning using textbooks/CD/DVD/online sources	42	64.6
Interactive discussions	32	49.2
20-minute seminar followed by questioning	30	46.2
Facilitator-guided self-assessment	22	33.8

Multiple responses were allowed; therefore, percentages do not total 100%.

Table 4: Stakeholder preferences for practical and clinical learning methods (n=65).

Practical/clinical learning method*	N	%
Use of equipment under supervision	59	90.8
Conducting genetic counselling sessions	52	80.0
Report writing and delivery/interpretation of genetic tests	40	61.5
Use of illustrations and CD/DVD/online resources	35	53.8
Independent self-learning using equipment	32	49.2

Continued.

Practical/clinical learning method*	N	%
Referral-system-based learning	7	10.8

*Multiple responses were allowed; therefore, percentages do not total 100%.

Table 5: Stakeholder preferences regarding assessment of postgraduate medical genetics residents (n=65).

Assessment domain/method*	N	%
Acceptance of proposed in-course assessment	61	93.8
Recommended modification to formative and summative assessment	34	52.31
Written assessment methods		
Short-answer questions (SAQ)	59	90.8
Structured essay questions (SEQ)	46	70.8
Single-type true/false questions	33	50.8
Multiple-choice questions	30	46.2
Fill-in-the-gap questions	21	32.3
Essay questions	11	16.9
Oral/practical assessment methods		
Interactive OSPE	61	93.8
Semi-structured card-based oral examination	41	63.1
Short case	20	30.8
OSPE without examiner interaction	17	26.2
Long case	5	7.7

Multiple responses were allowed for written and oral-practical assessment options.

Table 6: Stakeholder feedback on assessment organization and curriculum-support documents.

Item	N*	% / Mean±SD
Assessment organization		
Acceptance of marks distribution	57	87.7%; 4.40±0.84
Acceptance of grading system	60	92.3%; 4.48±0.79
Documents recommended for residents/teachers/examiners		
Detailed course description and learning outcomes	62	95.4%
OSPE format/checklist	50	76.9%
Proposed reading materials	47	72.3%
Educational strategies	40	61.5%
Checklist for assessment of seminar presentation	32	49.2%
Test matrix for written examination	26	40.0%

*Multiple selections were permitted for curriculum-support documents.

Table 7: Major recommendations from the expert consensus workshop for refinement of the proposed curriculum.

Expert group	Curriculum areas reviewed	Major recommendations
Paul Berg	Introduction; vision; mission; PEOs; PLOs; intended participants; program structure; courses and credit distribution	Add BMU vision and mission; incorporate research-related skills into mission, PEOs and PLOs; number mission statements systematically; make PLOs measurable
Linda Buck	Course learning outcomes; teaching-learning opportunities; prescribed resources	Increase practical components; reduce structure-related content and emphasize enzymes in Basic Biochemistry; include more diseases in Neurogenetics and Cardiac Genetics; reorganize prenatal diagnosis and neonatal dysmorphology within Genes and Diseases; standardize the pattern of Genes and Diseases; remove physical-examination and management-related objectives; increase credits

Continued.

Expert group	Curriculum areas reviewed	Major recommendations
		for Genes and Diseases; remove Sanger sequencing and NGS from Metagenomics
Francis Crick	Teaching-learning methods; strategies; instructional tools; assessment; academic calendar	Replace "relevant websites" with E-library/E-resources; make assessment explicitly outcome-based; distribute marks within formative assessment; develop a detailed academic calendar incorporating classes, duration, and examination dates

Table 8: Evolution of selected curriculum components through the validation and refinement process.

Curriculum component	Questionnaire-stage finding	Expert workshop refinement	Final direction
Program duration	93.8% acceptance; mean 4.65±0.69	No change recommended	Three-year program retained
PEOs/PLOs	100% acceptance; mean 4.74±0.44	Research skills strengthened; PLOs made measurable	Refined outcome-based PEOs/PLOs
Course learning outcomes	100% acceptance; mean 4.75±0.43	Selected outcomes revised and reorganized	More measurable and course-specific outcomes
Practical learning	Guided equipment use preferred by 90.8%	Greater practical exposure recommended	Practical component strengthened
Clinical/genetic counselling exposure	Clinical collaboration accepted by 98.5%; counselling exposure strongly supported	Retained and reinforced	Clinical and counselling exposure maintained
Assessment system	93.8% accepted initial concept, but 52.31% requested formative/summative restructuring	Outcome-based assessment and formative mark allocation recommended	Formative and summative, outcome-aligned assessment
Learning resources	Multiple conventional and electronic tools supported	"Relevant websites" replaced by E-library/E-resources	Formal electronic resources incorporated
Academic organization	Curriculum structure broadly accepted	More detailed academic calendar requested	Detailed scheduling and examination planning incorporated where feasible

DISCUSSION

The present study demonstrated strong multidisciplinary acceptance of the preliminary outcome-based Medical Genetics curriculum. All 16 evaluated components met the predefined acceptance threshold, with 100% acceptance for the overall program, PEOs/PLOs, individual course learning outcomes, and teaching-learning methods. The high response rate (87%) and participation of professionals from diverse academic and clinical backgrounds strengthened the contextual relevance of the validation process. Such stakeholder-based curriculum evaluation is consistent with contemporary medical education practice, where well-designed surveys and consensus approaches are recommended to ensure that curricular decisions reflect relevant expertise and implementation contexts.[11,12,15]

Respondents strongly favored interactive and experiential learning. Small-group tutorials were preferred by 84.6%, supervised use of laboratory equipment by 90.8%, and genetic counselling sessions by 80.0%. These preferences support a shift from predominantly knowledge-based genetics teaching toward applied competency development. Systematic reviews have shown that genetics/genomics education benefits from interactive, clinically relevant and skill-oriented approaches.[4,16] Longitudinal genetics programs have also demonstrated the value of integrating clinical exposure and research opportunities.[8]

Assessment emerged as the most important area of refinement. Although 93.8% accepted the original in-course assessment system, 52.31% recommended conversion to formative and summative assessment. This modification is educationally important because formative assessment provides repeated opportunities for feedback and competency development.[17] Programmatic assessment further integrates multiple observations for both learning and progression decisions.[18] Interactive OSPE was preferred by 93.8%, supporting structured assessment of practical competence; contemporary studies similarly report advantages of OSPE in objectivity, practical-skill assessment and learner acceptance.[19,20]

The multidisciplinary workshop provided a second validation layer, strengthening measurable PLOs, research competencies, practical training, course organization, e-resources and outcome-aligned assessment. This iterative refinement accords with emerging genomics-education evaluation frameworks advocating needs assessment, stakeholder involvement and continuing evaluation across development and implementation stages.[13,14]

Nevertheless, purposive sampling and relatively small numbers within individual professional groups limit generalizability. Future implementation should therefore include longitudinal evaluation of resident competencies, stakeholder experience and clinical impact.

CONCLUSION

The validation process demonstrated strong multidisciplinary acceptance of the proposed outcome-based postgraduate Medical Genetics curriculum for BMU. Questionnaire feedback supported the overall program structure, learning outcomes, teaching-learning methods, clinical exposure, and assessment framework, while identifying specific areas requiring refinement. The expert workshop further strengthened measurable outcomes, research competencies, practical training, electronic learning resources, and outcome-aligned assessment. The resulting curriculum therefore represents a contextually relevant, practical, clinical and research-oriented framework suitable for postgraduate Medical Genetics training in Bangladesh.

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