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RESEARCH ARTICLE
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BLUEPRINTING FOR SUMMATIVE THEORY ASSESSMENT IN COMMUNITY MEDICINE FOR UNDERGRADUATE MEDICAL STUDENTS.

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Abstract:
Context: Competency-based medical education emphasizes outcome-driven learning and requires robust assessment to ensure students achieve the defined competencies required by an Indian Medical graduate. The study aims to prepare a blueprint for summative theory assessment in Community Medicine for undergraduate MBBS students**.**
Material and methods: Study was conducted at a private medical college in Navi Mumbai. Steps involved in preparation of blueprint were followed including listing of subject topics, marks allocation, assigning impact and frequency factors, calculation of topic weightage and integrating Bloom's taxonomy. The suggestions from experts were reviewed and changes were made.
Results: A comprehensive blueprint was prepared integrating Bloom's taxonomy (recall, comprehension, analysis, application) across questions of both papers. Certain topics like Epidemiology of Communicable and Non-communicable diseases, Emerging/re-emerging infections, Epidemiological principles, National health programs, Health care of community, MCH and Nutrition with higher I and F factors, teaching hours had proportionally more marks weightage.
Conclusions: The developed blueprint offers a structured framework for assessment including proportional topic representation according to public health importance and application in clinical practice.

Key-words: Blue print, Summative assessment, Community Medicine, Competency based

Introduction:

Competency based medical education (CBME) has been defined as an outcome-based approach to the design, implementation, assessment and evaluation of a medical education program using an organized framework of competencies.[1] Much more than a different style of teaching, competency-based curriculum obligates a vastly different perspective on assessment. Assessment in competency-based curriculum plays a crucial role in its implementation.[2] At most of the medical colleges or

institutes, the traditional pattern of theory assessment tool is followed. Such traditional or conventional pattern of theory assessment tool in the medical education has many drawbacks such as subjectivity of the paper setter, lack of uniformity, lack of pre-validation of theory assessment tool by peer reviewers and not stating Specific Learning Objectives (SLO).[3] Thus, such types of errors result in a biased question paper and thus affects the assessment of medical undergraduate students. Blue printing in assessment can overcome these problems, if not completely, to a large extent and hence make assessment more valid.[4] Designing of question paper should take into consideration all levels of knowledge domain e.g. Bloom's taxonomy of cognitive domain and use appropriate verbs for the questions at each level to assess higher levels of learning.[5] Despite it being a resource intensive process, it will provide the utmost benefit to both teachers and learners. This is because a well-constructed blueprint is a valuable educational tool that can improve the quality of assessment in medical education, and thus will ensure the highest quality of graduates produced.[6] With the aim of preparing an appropriate blueprint, the current study was conducted. The objectives were to prepare a blueprint for summative theory assessment in Community Medicine Paper I and Paper II for undergraduate MBBS students**.**

Materials and methods:

The study was conducted at a Deemed to be University, Medical college in Navi Mumbai.The Medical Education unit (MEU) of the College had conducted an orientation session for the faculty regarding the need and steps for blue printing of question paper. Faculty with minimum 5 years of undergraduate teaching experience were involved in the process. Ethical committee approval was obtained.

As per National Medical Commission (NMC) Guidelines and Curriculum, all the topics and competencies of Community Medicine were listed. These topics were divided in to Paper I and Paper II as per the curriculum of the university. As per the university guidelines, the total mark allotted for Community Medicine summative theory assessment is 200. Paper I and Paper II of 100 marks each include, Multiple Choice Questions (MCQs), Long answer questions (LAQs) and Short answer questions (SAQs) with options. Hence, total marks for each paper including options will be 120.

Question Paper pattern for each paper is as follows.[7]

Section	Type of question	Number of Questions	Marks allotted	Marks including options
A	MCQs	20	20(01mark each)	20
B	LAQ	1(1 out of 2)	10	20
	SAQs	6(6 out of 7)	30(05Marks each)	35
C	LAQ	1	10	10
	AETCOM SAQ	1	05	05
	SAQs	5(5 out of 6)	25(05marks each)	30
Total Marks			100	120

Grouping of competencies and teaching hours (H) calculation- In order to streamline the assessment, related competencies were grouped together. Teaching hours (H) of group competencies were calculated by adding the teaching hours of individual competencies in that group.

Assigning Impact factor and frequency- Each competency group was assigned an Impact Factor (I) score ranging from 1 to 3 taking in to consideration the perceived public health importance of the topic. 3 means topic has significant public health importance (must know), 2 means moderate (desirable to know) and 1 means less public health importance (good to know). Frequency score (F) was also assigned to each competency group with scores ranging from 1 to 3, based on the application of the topic in clinical practice. F of 1 means rarely applied in clinical practice, F of 2 means commonly applied in clinical practice and F of 3 means frequently applied in clinical practice. The I and F scores were assigned to each topic using Delphi method by involving internal and external subject experts.

Calculation of Total Weightage and percentage weightage- The weightage (t) for each competency group was calculated using the formula, t= H/4 x I X F.
The weightage for all the topics were added together to get the Total weightage(T). Percentage weightage (W) for each topic was calculated by dividing weightage of individual topic(t) by total weightage (T) and multiplying it by 100.
Percentage weightage W= (t/T x 100).
Converting percentage weightage to marks- The percentage weightage for each competency group was converted to marks allotted for each topic out of 120 marks by using the formula-
Percentage weightage (W) x 120/100. The calculated marks allotted were rounded off.
Determine Cognitive Level (Based on Bloom's Taxonomy)- As per CBME guidelines designing of question paper should take into consideration all levels of knowledge domain e.g. Bloom's taxonomy (BT) of cognitive domain. (2) [Cognitive levels as follows: Knowledge- recall/concepts, Comprehension - Understand and explain, Application- Use information in new situations, Analysis- Examine & break down information.]
Questions should be of different types: R – Recall/ Remembering (BT 1)- 35%, C – Comprehension/ Understanding (BT 2) - 40%, A – Application/Analysis (BT 3/4) - 25%. After deciding the proportion of questions for each type of Bloom's taxonomy, the marks allotted to each group of competencies was distributed among this.
Preliminary presentation- The blue print of question papers was presented to a group of experts. Regrouping of certain competencies was suggested. The suggestions received were incorporated and the final blue print was prepared.

Results:

The topics distribution with relevant subject competencies, calculation of proportionate weightage and marks allotted topic- wise for Paper I and II are shown in Tables 1 and 2 respectively. The total teaching hours of Community medicine distributed in Paper I and II were 107 and 96 respectively. From the total teaching hours, proportionate teaching hours was calculated by dividing it by 4 i.e H/4, for the ease of calculation. Certain topics like Epidemiology of Communicable and Non-communicable diseases, Emerging/re-emerging infections, Epidemiological principles, National health programs, Health care of community, Preventive medicine related to maternal and child health and Nutrition with more teaching hours and higher I and F factors had proportionally more marks weightage.
Tables 3 and 4 show the final blueprint for summative theory assessment in Community Medicine Paper I and Paper II. Blooms taxonomy has been incorporated across all the questions. Hence, certain SAQs and LAQs questions have components of R (recall), C (comprehension) as well as A (analysis, application).

Discussion:

The present study aimed to design a comprehensive blueprint for question paper preparation in Community Medicine for summative assessment, ensuring alignment with CBME competencies and equitable coverage of the syllabus. Topics such as Epidemiology and National Health Programs were given higher weightage due to their broader scope and importance in public health practice. A mix of cognitive levels—ranging from knowledge recall to application—was incorporated to ensure a holistic assessment of student learning. Cognitive level determination was not included in the previous studies. Nayar KR opining on public health as an academic discipline, highlights the need for creative efforts including reading critical and other salient literature. [8]
Studies done by Gujarathi AP et al and Landge et al had used the total number of questions/items available to calculate the proportionate weightage while we used the proportionate teaching hours for the same.[9,10] Teaching hours distribution takes into consideration topic public health importance as well as magnitude so we used this measure.
In the study by Kaur M et al importance of a particular competency (I) depicted the subjective/clinical implication of the topic (Must know, Desirable to know, good to know) whereas

frequency (F) showed how many times the topic has been/should be asked in the examinations.[11]Another study done by Yadav A et al showed that the topics Principles of Health Promotion and Education, Occupational Health, Epidemiology of Communicable Diseases, Demography and Vital Statistics, and Health Care of the Community collectively represent more than half of the total weightage.[12] While our study found that topics like Epidemiology of Communicable and Non-communicable diseases, Emerging/re-emerging infections, Epidemiological principles, National health programs, Health care of community, Preventive medicine related to maternal and child health and Nutrition with more teaching hours and higher I and F factors had proportionally more marks weightage. A subject expert also opined F should be determined by number of times topic has been previously asked in questions papers. However, recognising community medicine and public health as a dynamic field with evolving trends having vast implications in clinical practice, we considered F as topic application in clinical practice. Previous studies have highlighted the lack of structured planning in question paper design. The current blueprint addresses this gap by incorporating Bloom's taxonomy and distributing questions proportionally across competencies. Blueprinting ensures transparency, prevents over-representation of certain topics, and aligns assessment with learning objectives, making it a valuable tool for competency-based education. This blueprint can serve as a model for other departments aiming to adopt structured assessment methods. Further research can explore student performance and feedback to refine the blueprinting process.

Strength and Limitations: The current blueprint incorporated Bloom's taxonomy and distributed questions proportionally across competencies. One limitation of this study was the reliance on estimated teaching hours, which may vary between institutions and instructors. The allotment of the I and F factors involves a degree of professional judgement, may vary in few instances depending on perspective of the individual faculty or reviewer. The blueprint may require periodic revisions based on curriculum changes and feedback.

Conclusion:

The present study successfully developed a detailed and structured blueprint for summative theory assessment in Community Medicine, aligning with CBME competencies and ensuring proportional representation of key topics of public health importance, and application in clinical practice. By integrating Bloom's taxonomy and a scientific approach to weightage calculation, the blueprint enhances objectivity, transparency, and alignment of assessments with learning outcomes. Regular updates based on curriculum changes and feedback will further enhance its utility and effectiveness in medical education.

Key Messages:

Relevance to preventive medicine:

Blueprinting of question papers with Bloom's taxonomy, proportional representation of topics by public health importance enhances validity and balance in the assessment for the Community Medicine competencies as per the NMC's Competency-Based Medical Education Programme.

Implications for clinical practice:

Future Indian Medical Graduate trained in applying high levels of learning, critical thinking and competent in topics applied in clinical practice and of public health importance.

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TABLES

Table 1. PAPER – I- Calculation of proportionate weightage and marks allotted

Competency number	Group of Competencies	Core Y/N	Teaching hours (H)	H/4	Impact /Perceived importance (I)	Frequency of occurrence (F)	t= H/4XIxF	% Weightage (W)	Marks Allotted out of 120	
CM 1.1 - 1.10,17.4	Concepts of Health & Disease, MDG, SDG	Y	13	3.25	3	3	29.25	13.85	16.62	17
CM 7.1-7.5, 7.7-7.9	Principles of Epidemiology & Epidemiological Methods, Infectious disease Epidemiology	Y	18	4.5	3	3	40.5	19.17	23.01	23
CM 7.6	Screening for Disease	Y	6	1.5	3	3	13.5	6.39	7.67	8
CM 2.1-2.5, A 3.1 (3.5)	Medicine & Social Sciences, AETCOM	Y	8	2	3	3	18	8.52	10.22	10
CM 3.1-3.8	Environment & Health	Y	17	4.25	3	2	25.5	12.07	14.5	15
CM 13.1-13.4	Disaster Management	Y	4	1	3	2	6	2.84	3.41	3
CM 14.1-14.3	Hospital Waste Management	Y	4	1	3	3	9	4.26	5.11	5
CM 8.1, 8.4-8.7,20.2	Epidemiology of Communicable Diseases, Emerging & Re-emerging Infectious Diseases	Y	15	3.75	3	3	33.75	15.98	19.17	19

CM 8.2,8.4-8.7	Chronic Non-Communicable Disease & Conditions	Y	11	2.75	3	3	24.75	11.72	14.06	14
CM 9.7, 6.1-6.4	Health information & Basic Medical Statistics	Y	11	2.75	2	2	11	5.21	6.25	6
	TOTAL		107				211.25 (T)	100.00	120.00	120

Table 2. Paper II-Calculation of proportionate weightage and marks allotted

Competency number	Group of Competencies	Core Y/N	Teaching Hours (H)	H/4	Impact /Perceived importance (I)	Frequency of occurrence (F)	t= H/4XIxF	% Weightage(W)	Marks Allotted out of 120	
CM 17.1-17.5, 19.1-19.3	Health Care of the Community, Essential medicines	Y	12	3	3	3	27	15.10	18.13	18
CM 5.1-5.8	Nutrition & Health	Y	12	3	3	3	27	15.10	18.13	18
CM 4.1-4.3, A 3.1(3.5)	Communication for Health Education & AETCOM	Y	10	2.5	2	3	15	8.39	10.07	10
CM 9.1-9.6, 10.6,10.7	Demography & Family Planning	Y	10	2.5	3	2	15	8.39	10.07	10
CM 10.1-10.5, 10.8, 10.9, 12.1-12.4	Preventive Medicine in Obstetrics, Pediatrics and Geriatrics	Y	14	3.5	3	3	31.5	17.62	21.15	21
CM 11.1-11.5	Occupational Health	Y	7	1.75	3	2	10.5	5.87	7.05	7
CM 15.1-15.3	Mental Health	Y	5	1.25	3	2	7.5	4.20	5.03	5
CM 3.6,5.6,8.3,10.4,10.5,10.7,12.4,15.3	National health Programs & Policies	Y	13	3.25	3	3	29.25	16.36	19.64	20
CM 16.1-16.4	Health Planning & Management	Y	7	1.75	2	2	7	3.92	4.70	5
CM 18.1, 18.2, 20.1, 20.3, 20.4	International Health and Recent Advances	Y	6	1.5	3	2	9	5.03	6.04	6
	TOTAL		96				178.75 (T)	100.00	120.00	120

Table 3. Blueprint of Paper I

Competency number	Topics	Marks	Section A			Section B						Section C					
			MCQ (20m)			LAQ (20m)			SAQ (35m)			LAQ (10m)			SAQ (35m)		
			R	C	A	R	C	A	R	C	A	R	C	A	R	C	A
CM 1.1 - 1.10,17.4	Concepts of Health & Disease, MDG, SDG	17	2												2(5m)	1(5m)	
CM 7.1-7.5, 7.7-7.9	Principles of Epidemiology & Epidemiological Methods	23	3									1(3m+	4m+	3m)			2(5m)
CM 7.6	Screening for Disease	8	1	1	1											1(5m)	
CM 2.1-2.5, A 3.1 (3.5)	Medicine & Social Sciences & AETCOM	10														1(5m) + Aetcom 1(5m)	
CM 3.1-3.8	Environment & Health	15	3	1	1										1(5m)	1(5m)	
CM 13.1-13.4	Disaster Management	3	1	1											1 (5m)		
CM 14.1-14.3	Hospital Waste Management	5		1													

CM 8.1, 8.4-8.7,20.2	Epidemiology of Communicable Diseases, Emerging& Re-emerging Infectious Diseases	19	1		1	1(1m+	7m+	2m)		1(5m)	1(5m)						
CM 8.2,8.4-8.7	Chronic Non-Communicable Disease & Conditions	14	1			1(1m	7m+	2m)									
CM 9.7,6.1-6.4	Health information & Basic Medical Statistics	6	1														1(5m)
	Total	120	13	4	3	2	14	4	0	5	5	3	4	3	20	25	15

Table 4. Blue Print of Paper II

Competency number	Topics	Marks	Section A			Section B						Section C					
			MCQ (20m)			LAQ (20m)			SAQ (35m)			LAQ (10m)			SAQ (35m)		
			R	C	A	R	C	A	R	C	A	R	C	A	R	C	A
CM 17.1-17.5, 19.1-19.3	Health Care of the Community, Essential medicines	18	2	1		1(3m+	4m+	3m)								1(5m)	
CM 5.1-5.8	Nutrition & Health	18	1	1	1	1(2m+	6m+	2m)			1(5m)						
CM 4.1-4.3, A 3.1(3.5)	Communication for Health Education & AETCOM	10								1(5m)						Aetcom 1(5m)	
CM 9.1-9.6, 10.6,10.7	Demography & Family Planning	10								2(5m)							
CM 10.1-10.5, 10.8, 10.9, 12.1-12.4	Preventive Medicine in Obstetrics, Pediatrics & Geriatrics	21	3	2	1						1(5m)	1(2m+	5m+	3m)			
CM 11.1-11.5	Occupational Health	7	1	1												1(5m)	
CM 15.1-15.3	Mental Health	5													1(5m)		
CM 3.6, 5.6, 8.3, 10.4, 10.5,10.7,12.4,15.3	National health Programs & Policies	20	4	1							2(5m)				1(5m)		
CM 16.1-16.4	Health Planning & Management	5													1(5m)		
CM 18.1, 18.2, 20.1, 20.3, 20.4	International Health, Recent advances	6	1												1(5m)		
	Total	120	12	6	2	5	10	5	0	15	20	2	5	3	20	15	0