Globalization has penetrated into each and every part of human life including medical field. Medical doctors in this millennium are the members of a global community in a global village. World Health Organisation (WHO) and Education Commission for Foreign Medical Graduate (ECFMG) have jointly justified in the year 1994 the setting up of Global Medical Education standards. These standards emphasize, besides the general core competencies viz. Medical Knowledge and Clinical Skill, the other competencies specific to the science of medicine such as Communication Skills, Team Work, Critical Reasoning, Ethics, Self Assessment and Self Directed Learning. Since the Medical Profession, through a global perspective cannot be a reality without a set of clear core competencies which define what a medical doctor is, irrespective of his / her place of training, it was suggested to install a mechanism to develop global recommendations on core competencies and evaluation methods.

The International Institute of Medical Education consisting of working groups of educational and health policy experts and representatives of major international Medical Education organizations has precisely defined in 1999 competencies to be necessarily possessed by the medical graduate at the completion of his/her MBBS program. These competencies have been classified under seven domains as described earlier in the Review of Literature section and the two domains viz., ‘Management of Information’ and ‘Critical Thinking and Research’ are the newer
ones which need to be incorporated in the existing undergraduate medical curriculum.

They have further envisaged i) *Curriculum Standards*- describing knowledge, skills, attitudes and values that teachers are supposed to 'teach' and students are expected to learn. ii) *Assessment* - defining the degrees of attainment of level of competencies in compliance with the professional requirements.

The Government of India recognizes ‘health for all’ as a national goal and expects the Medical Colleges in the country to produce an Indian Medical graduate, who will be the ‘Physician of First Contract’, who is a skilled and motivated basic doctor, capable of catering to the ever changing health care needs of the society, throughout his professional career.

However the Indian Health care system and also the medical education system in the country are facing unique but serious challenges of content and competencies, peculiar to our country.

Innovations and progress in medical technologies, continuously growing elderly population, many a times with chronic illnesses and the ever growing need for high quality patient care have lead to various increasingly complex professional, legal and educational issues within the patient care environment. Hence, medical graduates need creativity and critical thinking skills to take optimal patient care decisions in day to day practice. The regulating and accrediting bodies of health science education across the globe have declared the necessity of inclusion of the concept of critical thinking in the core curriculum and also its measurement as an outcome while evaluating health science
education. Each curriculum’s effectiveness can be evaluated by indexing critical thinking dispositions and skills, as CT can be said to include cognitive skills and affective the disposition.\textsuperscript{62}

The large gaps in health care accessibility in many parts of the country and the need for enhanced clinical competency for a medical graduate are the major concerns; both need to be addressed at the root itself, by all those concerned. The burden of diseases both of the old ones and also of the new emerging ones in the country is very large. Though there has been some improvement, national statistics reveal, wide disparities exist between different parts of the country and also between rural and urban areas with regard to access to basic medical services and the quality of health care available. These are attributed to inadequate infrastructure and lack of competent human resources. With the improvement in national economy, the creation of adequate infrastructure is possible though time consuming. But the task of improving the quality of medical education in order to produce clinically competent human resource needs not only time but also measures to be taken at the root level and also deep commitment by all the stake holders. In this regard, the challenges faced by the regulating body viz., MCI has to balance the need to approve for establishment of more number of medical colleges and also maintenance and improvement of quality of medical education in the existing colleges. The globalization of education and health care and India’s potential as a destination of choice for quality education and health care, has brought the issue into sharper focus.
Curricular reforms to systematically address these issues and develop strategies to strengthen the medical education and health care system are the next logical steps.

Curricular reforms in undergraduate medical education are being addressed with great vigour by the regulating council. The ‘Undergraduate Medical Education working group-2010’ has been constituted long back and is functional. The group has already prepared a ‘Vision-2015’ document, which has spelt out explicitly the details of the proposed curricular reforms, in the undergraduate medical education; the important ones being.\textsuperscript{18}

- To evolve strategies and futuristic plans so that medical education in India is innovative and is able to prepare undergraduate to perform in the ever changing scenario of medical science.
- To work on parallel tracks for immediate solutions and long term improvement in a steady phased manner.

For improving the quality of medical training it has been proposed to restructure the undergraduate medical course in the following ways.

1. Introduction of Foundation Course immediately after admission to 1\textsuperscript{st} MBBS course, with the aim of orienting the student to national health scenarios, medical ethics, health economics, learning skills and communication, computer learning, community orientation etc.
2. Facilitation of horizontal and vertical integration between the disciplines, bridging of the gaps between theory and practice, between hospital based medicine and community based medicine.
3. Early clinical exposure during foundation course itself, focussing on communication, basic clinical skills and professionalism.

4. Bringing frame shift in method of clinical training by focussing on common problems encountered in outpatient setting, learning through student doctor method by involvement in patient care as team member, performance of basic investigatory or management procedures.

5. Addition of electives to allow flexible learning options in the curriculum, thereby providing opportunities to enhance self directed learning, critical thinking and research facilities.

6. Skill development and training through a mandatory and desirable comprehensive list of skills.

7. Secondary hospital exposure through links with CHCs, PHCs, for imparting training.

8. Adoptions on contemporary education technologies like skill lab, E-learning through digital laboratory and simulation lab etc.

The impact of all these measures shall be reflected in creation of a new generation of medical graduate of global standard thereby bringing up the quality of medical education in the country.

The fresh Indian Medical Graduate will have the necessary competencies to assume the roles as the ideal health care provider who will be able to function in the following roles appropriately and effectively.

1) Clinician who understands and provides preventive, promotive, curative, palliative and holistic care with compassion.
2) Leader and member of health care team and system with capabilities to collect, analyse and synthesize health data.

3) A good communicator.

4) Self directed Lifelong learner and EBM practitioner committed for improvement of knowledge and skill, throughout the professional career.

5) A true professional.

To accomplish all of the above, the MCI proposes to implement a Competency Based Learning curriculum wherein the focus is on development of desirable and observable ability in the real life situations.

In order to effectively fulfil the above roles the medical student would have obtained a set of competencies at the time of graduation from the MBBS program.

Amongst all the competencies those are necessarily, to be possessed by a fresh graduate, the one which renders him a lifelong learner (who is committed for continuous improvement of skills and knowledge) is the new competence which has to be emphasized, during the reform. Self assessment, ability to search (through electronic means) the medical literature, critically appraise the literature, and to apply the newly gained knowledge or skill to the care of the patient, all need to be incorporated in the curriculum and the medical student has to be taught and trained in all of these competencies. Hence great emphasis has been given both to ‘Competency Based Learning’ and on ‘Self Directed Learning’ in the new MBBS curriculum, with a rationale that the student acquires these core
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competencies to effectively function as a basic doctor and the student is encouraged to learn “life long learning” skills.

Ever since its introduction into the practice of medicine in 1960s, Evidence Based Medicine has been envisioned as a new paradigm of teaching medicine to the students. It teaches new set of competencies or skills, allows a method of critical thinking and reasoning that allows a medical doctor to translate the findings of new scientific research into clinical practice.

Hence, if the Principles and Practice of EBM are incorporated into the UG medical curriculum and the medical student is taught and trained as how to practice EBM correctly, it will help him to develop many of the competencies as described by IIME/ACGME. The final outcome of this endeavor will be the creation of a self directed learner.

Here in this study, all the students belonging to II MBBS 2nd term who fulfilled our study inclusion criteria were enrolled, and they were divided into 3 different groups viz., Group I - (EBM) Group II – (Email) and Group III – (Traditional) by stratified sampling method.

Participants of Group I received the intervention in the form of a course on EBM, the participants in Group II received the intervention through email and the participants in Group III received no intervention of any kind.

The effects of the intervention in the form of development of competence of critical thinking was assessed by California Critical Thinking Disposition Inventory, comparing the mean score before and after intervention viz., Pre-term
test score Vs Post-term test score. The other effect of intervention viz., change of attitude towards the practice of EBM was judged by the Alan’s Evidence Based Medicine Attitude Survey Questionnaire (AEBM ASQ) by comparing Pre-test and Post-test scores.

In this study though all the 120 students belonging to the class II MBBS / 2nd term who fulfilled our study inclusion criteria were enrolled, two students, who could not attend initial introductory classes were excluded from the study; hence Group I, Group II and Group III contained 40, 39 and 39 students respectively.

The demographic data viz., age and sex distribution between the 3 groups were comparable; sex wise distribution and the age distribution between the groups was not statistically significant.

The basal computer literacy of all the study participants was assessed using a computer literacy scale in the beginning itself. Irrespective of their percentage of score in the first MBBS examination, the computer literacy of all the students was found to be excellent and uniform (>95% score).

The computer literacy scale used in the study was aimed mainly at finding out the students’ capability of browsing the internet, their capability of checking / answering the emails, ability to visit various websites including biomedical databases, effective usage of search engines like pubmed etc., With the explosion of information and communication technology in each and every facet of life, and also the availability of home computers / laptops at very much affordable prices, every student is very well versed with usage of the same. Moreover the computer
science is being taught at higher secondary levels itself, because of the inclusion of computer science subject in the respective curricula.

The excellent computer literacy of all the study participants facilitated the conduct of our study in a very smooth and hassle free way.

The ‘means’ of overall CCTDI Pre-Test scores in the three groups viz., Group I, Group II and Group III was found to be 273.03, 273.36 and 274.85 respectively. Similarly the means of AEBM-ASQ Pre test score in Group I, Group II and Group III were found to be 119.08, 115.74 and 117.15 respectively. The overall average CCTDI score of 274 in this study falls short of the established mean score of 280 set by Facione et. al (who described CCTDI). The low score can be a result of the authoritarian educational system existing in the country, which emphasizes, obedience to elders and authority, rather than autonomous thought of individuals as standards. Such influences can limit the development of creative and critical thinking in students.\textsuperscript{62}

The mean values of both of these Pre-Test scores in all the 3 Groups were found to be very much comparable and there was no statistically significant difference amongst the three groups. These values which are indicative of uniform level of thinking and attitude can be justified by the fact that all the 3 groups are uniform or identical as regards the quality or type of the participants in each of the group is concerned. The stratified sampling method adopted in the study has ensured that all 3 types of performers viz., high performers, intermediate performers and average performers (in the first MBBS examination) are evenly and equally distributed amongst all the 3 groups.
Discussion

The overall CCTDI Pre test score of more than 270 in all the 3 groups indicate ambivalent nature of the attributes or attitudes on the part of all participants; score of less than 240 is considered as low score and individuals who score in this range never seek any additional educational activity / opportunity. They exhibit collection of attributes as being the opposite of desired attribute of an average individual. Hence none of the participants in our study were found to be hostile to the educational opportunity that was offered to them. The overall range of score though was between 214 and 335, there were only 9 students who had score less than 240, and they were found to be distributed evenly equally (3 each) in 3 groups.

The overall CCTDI Post-test score was 287.00, 272.08 and 272.49 in Group I, Group II and Group III respectively.

The educational opportunity (intervention) in the form of a course on EBM was administered to Group I which resulted in enhancement of score to 287 indicating the change of attitude towards positive habit of mind which may have factored into their approach to High Order Thinking Skills (HOTS). The email group received intervention in the form of educative emails only. It was left to the students to go through them or not. There was no other supervision or monitoring except for the fact that the sender will get an acknowledgement of the receipt, the moment the student receives and opens the email. The emails were received and opened by the majority of the students within 24 hours of sending them the same. The third group, Group III received absolutely no intervention of any kind and hence there was no difference between Pre and Post CCTDI scores.
Even though educational material supplied to both Group I and Group II was same, the mode of instruction (i.e teaching methodology) made the difference. All the participants in Group-1 had opportunity of getting exposure to mentors who would have modeled the critical thinking dispositions while conducting the course on EBM which would have strengthened the attitudes and attributes of critical thinking in the participants of Group I.

The means of overall CCTDI Post-test scores in three groups viz., Group I, Group II and Group III were found to be 287.00, 272.08 and 272.49 respectively.

Similarly the means AEBM-ASQ Post-test score in Group I, Group II and Group III were found to be 145.82, 126.44 and 119.31 respectively.

The difference in mean post scores of both CCTDI and AEBM-ASQ between Group I and Group II and between Group I and Group III respectively were found to be statistically significant.

The mean scores of both CCTDI and AEBM ASQ between Group II and Group III when compared were found to be statistically non significant.

The higher scores of both CCTDI and AEBM ASQ in Group I can be explained by the fact that after undergoing the course on EBM, their (students of Group I) critical thinking ability and also their attitude towards EBM have enhanced considerably whereas there has been a marginal or negligible change in both the scores of CCTDI and AEBM ASQ in the students belonging to Group II and Group III indicating no change in critical thinking power nor the attitude
towards EBM. Thus the significant difference in scores of Group I when compared with scores of Group II and Group III can be explained. Obviously the difference in scores between Group II and Group III when compared were found to be statistically not significant. The emails sent in Group II have caused marginal improvement in change of attitude towards EBM as indicated by marginal rise of AEBM ASQ scores.

The Pre-test scores and the post-test scores of both CCTDI and AEBM were compared in all the 3 groups. The mean difference in score of both CCTDI and AEBM ASQ of Group I [which was found to be 13.97 (CCTDI) and 26.75 (AEBM – ASQ) respectively] when compared with the same of Group II and Group III [which were -1.28 (CCTDI) and 10.69 (AEBM-ASQ) for Group II and -2.36 (CCTDI) and 2.15 (AEBM-ASQ) for Group III respectively] were found to be statistically significant, where as the same values compared between Group II and Group III were found to be statistically not significant. This indicates that both the critical thinking ability and attitude towards EBM were enhanced significantly in Group-I whereas change was not significant Group-II and Group-III. This enhancement in Group-I when compared with the same change in Group-II and Group-III were also found to be statistically significant, whereas the enhancement when compared between Group II and Group III was found to be non significant.

Even on intra group comparison, the enhancement of scores of both CCTDI and AEBM ASQ in Group I after intervention (difference between Pre and Post test scores of same group) were found to be significant (when compared with Pre test scores), whereas the same in Group II and Group III were found to
be not significant. These results indicate the intervention in the form a course on EBM if done properly (here in this study using different modes of instruction) for a particular period/duration of time can bring about significant or noticeable changes proportional to the period of exposure to intervention both in critical thinking ability as well as attitude towards EBM, in the students.

The course on EBM has brought in significant enhancement in critical thinking power and positive change of attitude in all the participants belonging to Group I. The repeated preaching and advocacy of principles and practice of EBM through various modes of instruction viz., brain storming sessions, interactive lecture, small group activities etc., has not only enhanced the competence of critical thinking but has also caused positive change of attitude in the students of Group I.

The ability to formulate a pertinent, focused, relevant question when faced with a clinical dilemma, (step I of EBM), trying to answer the formulated question by tracking down the best external evidence, (Step 2 of EBM), performing the critical appraisal of literature (Step 3 of EBM), integrating internal evidence (expertise) with external (best) evidence (Step 4 of EBM) and feedback / evaluation (Step 5 of EBM) all teach as how to perform and do deep logical thinking. The students of Group I had the opportunity of getting exposed to all of these methods which stimulate High Order Thinking Skills (HOTS) whereas the participants of Group II and Group III did not have this opportunity and so no change has been observed in both of these groups. Even though the students belonging to Group II were provided with Email information about EBM quite often (as often as active interventions in Group I) it did not bear much effect
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on the students. Students are always required to be supervised and guided whenever anything new is to be taught to them. Left alone majority of them don’t show any interest in getting involved in a new thing. Moreover the burden of their course of study (MBBS) may also be a deciding factor. Another important factor for acceptance of EBM as one of the useful learning tool is the attitude of the student. For change of attitude, change of behavior is required and for change of behavior deep learning (understanding) has to take place, which did not occur in students of Group II and Group III.

**Intra group Analysis of various components of CT of EBM Group :-**

Intra Group analysis shows significant improvement in Truth seeking, Open Mindedness, Systematicity and Cognitive Maturity domains of CT whereas there was Marginal improvement in Analytical skills. There was no change in Confidentiality and there was decrease in Inquisitiveness.

Scale scores of CCTDI which were in the low range(10-29) and ambivalent range (30-40) prior to intervention got enhanced to positive range(40-50) in the above 4 domains after the EBM. This course indicates definite enhancement of the attitude towards positive side. It is the development of the positive habit of the mind which is likely to factor in to the individual approach to all high order thinking skills like clinical decision making and problem solving.

The significant increase in the Post test scores (when compared with respective Pre-test scores) as regards the attributes of Truth Seeking, Open mindedness, Systematicity and Cognitive Maturity indicate the shift towards more positivity of habit of mind in each of these attributes.
Discussion

Truth seeking:

The average Pre-test score (28-80) in the Truth seeking domain was in the low range (i.e between 10-29) and has moved to (34-67) next higher range (i.e between 30-40); it clearly demonstrates gaining of strength on the attribute on the part of the group, after participating in the educational activity or opportunity which was aimed at the scale construct.

One more thing to note is that the average Pre-test score of 28.80 of the EBM (which is in the upper limit of the low range) is the result of only two participants (of the total 40 in the group) who has scored very low i.e 18 and 19 respectively. Otherwise the average Pre-test score of the group would have fallen in the next higher range, enabling them to move to next higher range (as is the characteristic of next range).

Truth seeking is the good habit of always desiring the best possible solution of any given dilemma and the paradigm of EBM teaches and trains the student in tracking down the best and the truthful evidence to answer the query that is raised.

Truth seeking subscale measures the disposition to evaluate alternatives or differing thoughts.

A high score in this subscale shows that the individual has a greater tendency to seek the truth, to question, to be objective even in the face of information that is contrary to his/her own thoughts. It is believed that the difference between student scores may be due to emphasis in EBM on developing
students’ questioning and information seeking skills and their discussion and application of new information.

A medical professional encounters several clinical dilemmas/queries in his day to day medical practice. Whether the query is Aetiology related (trying to find out the true cause of the disease), or Therapy related (trying to find out best treatment for a disease) or Diagnosis related (trying to arrive at correct true diagnosis) or Prognosis related (trying to find out the correct/true future course of the disease) the only goal of the physician is to find out only the truth and nothing else but the truth.

Hence attribute of Truth seeking is very important for the medical graduate to be inculcated during the course of the medical training.

**Open mindedness:**

The average Pre-test score for the attribute of open mindedness was 34.02 which was in the ambivalent range which has shown a statistically significant rise to Post-test score of 38.50 after the course on EBM. Open-mindedness is the tendency to allow others to voice their views. Open-mindedness is also to be tolerant to the opinion of others. Open-mindedness reflects a person’s tolerance of different approaches and sensitivity to one’s own mistakes. The fundamental logic in open-mindedness involves the individual’s considering not only his/her own thoughts but also thoughts of others in the decision making process. Open-mindedness may be related to the focus on small group work, where students work closely with peers and giving and receiving feedback is an expectation.
In the practice of EBM, when the tracked external evidence is scientifically valid but is totally against the internal evidence or expertise prevailing upon the practitioner by virtue of his personal experience, it is quite essential for the practitioner to have the positive attitude of open-mindedness to tolerate, accept and respect the opinions of others, lest the very purpose of EBM shall be defeated and the patient will never get the best care.

The current concept of the practice of EBM is to take into consideration the non documentary evidence while making the patient care decisions. Hence the physician has essentially to have the attitude of open-mindedness, so that the patient is not denied of the benefits of any non documentary evidences like intuitions or blind beliefs etc,

**Systematicity:**

The average Pre-test score for the attribute of systematicity (38:00) was in the ambivalent range of 30.40. which got enhanced to (45.35) the next higher positive range (between 40-50). The attribute of systematicity is the tendency or habit of striving to approach to the problem in a disciplined, orderly and systematic way.

The practice EBM in each and every strip trains the student in approaching the problem in a well disciplined and systematic manner, be it the formulation of a pertinent, focussed relevant question using the PICO model, or be it the tracking down systematically of the best evidence from the available resources or be it the procedure of appraisal of the literature in an orderly manner.
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or be it the systematic integration of internal and external evidences with patients unique values.

The paradigm EBM impregnates the students’ mind with the positive attitude of Systematicity.

**Cognitive Maturity:**

The average Pre-test score for the attribute of Maturity (34.70) was again in the ambivalent range which got enhanced to (38.82) in a statistically significant way.

Cognitive maturity is the habit of taking decision or making judgement in a very matured, timely way (not Pre-maturely or after making undue delay). It is the ability of standing firm on decision when there is a valid reason or evidence to do so. In medical science, what is true or valid today may not hold good tomorrow as the best evidence is never static but is always dynamic. The science is never stagnant and is always changing and expanding or progressing by continuous research. The practice of EBM teaches the practitioner to change his mind when that is the most appropriate thing to do because of the evidence available at that point of time which is considered as the best. Cognitive maturity is the ability to revise the decisions, ability to suspend the earlier belief. It is also being aware that multiple solutions may be acceptable for the same problem under different environmental conditions or for different personnel facing the identical problem. The practice of EBM teaches and trains the student to take tailor made decision, specific or unique to each and every patient. EBM never teaches cook book practice. The important thing that is taught by the practice of
EBM is to develop the cognitive maturity of combining or forging an alliance between internal evidence (i.e. expertise) and best external evidence that is tracked down from the available sources of scientific literature and the patients values, beliefs and expectations to take correct or optimal patient care decision. As per the new changed concept of EBM, the non documentary evidence also has to be taken into consideration while taking patient care decisions. The practising medical professional essentially has to have Cognitive Maturity of incorporating non documentary evidences like blind beliefs, intuition etc into the patient care decision in such a manner that the patient is always benefitted and is never harmed in any other manner. The course on EBM has helped the students of Group-I to enhance this attribute in a significant way.

**Analyticity:**

The average Pre-test scores as regards the attribute of analyticity was 44.20 and was in the positive range which also has been increased following the intervention though in a non significant way. Analyticity is the tendency to be alert always with a capacity to anticipate as to what happens next (may be good or bad) after taking a decision or making a plan.

This attribute is also addressed by the practice of EBM but in a marginal way. Hence there is a change following intervention but in a non significant way. More over the pre-test itself as regards this attribute is in positive range.

**Self confidence:**
Discussion

The average pre test score of self confidence was 45.27, the 2\textsuperscript{nd} highest of all the attributes which got reduced in a non-significant way or we can say remained almost same. It is the tendency to trust the use of reason, evidence and reflective thinking to solve the problem. All the study participants to whom the EBM was taught are novices to EBM and it might take some time for some of the individuals to develop confidence to take decision based on the practice of EBM. If we analyse the individual scores of all the 40 participants of EBM group the individual scores of each of the participants have enhanced though marginally but for 5 participants who have scored 28 each(in the low range) bringing the overall post test score of the group marginally lower than the pre-test score. Loss of confidence in these students though cannot be explained, confidence in EBM may be reinforced definitely by some more sessions on EBM. The practice of EBM no doubt helps any professional to develop self confidence as the decision he takes is always based on valid scientific evidence.

Inquisitiveness:

The pre-test scores as regards the attribute of inquisitiveness were highest (i.e 48:02) amongst all the 7 attributes and were in the positive range (i.e between 40-50).

Inquisitiveness the intellectual curiosity is the tendency to want to know things even if they are not immediately or obviously useful at the moment. It is the positive state of mind to acquire new knowledge. Evidence based medicine inspires the practitioner to be a self directed learner. The paradigm inspires the practitioner to seek always the new scientific information, to keep himself always
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updated, to keep up breast in the field of medicine and to be in a position to offer the patients always a best available care.

After the intervention, despite the fall in the average score, all the 40 participants of the EBM group were in the positive habit of the mind to acquire new knowledge. Moreover movement of scores within a particular range is an indication of change of attitude which itself is a welcome sign because over all critical thinking is a complex process involving titration of different components of Critical thinking in different proportions at different times.

Though there have been scarce or no study done as it, to determine the effects of EBM or any other method of education on the development of the competence of critical thinking in undergraduate medical students, as assessed using CCTDI, several other studies are available wherein critical thinking dispositions have been studied and compared between the two groups of nursing students viz one who received Problem Based Learning method and the other one received Traditional education.

In a descriptive analytic study done by Candan O and others, the levels of critical thinking amongst senior nursing students in two educational programs one of which used Problem Based Learning (PBL) model while the other used a traditional model have been compared using the CCTDI as data collection or an evaluating tool.

Comparison between two groups were made using t-test analysis. There was a significant difference (P<0.05) between critical thinking disposition scores of the seniors in the PBL school and those in the school implementing the
traditional model. Analysis of subscale-scores showed significant difference in truth seeking and open mindedness. These findings according to the authors of that study add to the evidence that the active and self directed nature of PBL encourages students’ ability to think critically, be tolerant of the ideas of others and evaluate conflicting information before reaching a conclusion. In a similar way EBM based learning also primarily teaches the students to be self directed learners enhances their ability to think critically, be tolerant to the ideas of others evaluate conflicting information before reaching a conclusion thereby finally make them to think critically before taking any clinical decision.

Critical Thinking is widely accepted as being associated with the provision of quality care. Medical graduates can offer the community, better quality care only, if they have capabilities to adopt to the steadily increasing complexities of the health care environment, to rapidly changing health care demands and to advances in technology (Distler, 2007). All of these issues are addressed by the paradigm of EBM and the medical graduate will develop, these capabilities only if he / she is exposed and trained to practice EBM during the course of his / her study in the medical school. EBM through the enhancement of Critical Thinking, is seen to encompass the ability to recognise an existing problem as well as an inquisitive attitude that seeks proof of the evidence, involving gathering of knowledge about the accuracy of this proof and making the use of this knowledge attitude.

In a practice oriented medical profession where rapid changes are expected and decision making is of vital significance, Critical Thinking is of great importance. Developing critical thinking skills is quite essential in
establishing a scientific foundation for the profession, for creating a discipline in which truth is sought and implemented and where use of theoretical perspectives are increasingly being tested and utilized. The power of critical thinking can allow medical graduate to logically assess his/her own experiences and training i.e. his/her expertise (internal evidence) and to combine the same with the best external evidence that is tracked down from the valid scientific literature and then to apply them to the benefit of the patients. The ability of a medical graduate to cope with the medical problems, his skill in determining the patient needs and providing an updated patient care in a systematic manner are all dependent upon his/her critical thinking skills.

Competence in Critical Thinking is one of the expectation of medical education. It is a part of professionalism and needs to be included in the medical curriculum.

It has already been included within the nursing school curricula and is a part of the criteria for the accreditation and assessment of undergraduate and graduate nursing education programs (Daly 1998).65

An ideal medical educational program should always seek to promote changes in students’ professional practice not simply in amount of medical knowledge but also in their roles and behaviour. CT and professional attitudes are important concepts those need to be addressed by any ideal medical curriculum which aims at inculcating professional practice amongst the students during the time of their professional training.
There are not many studies available linking medical curriculum and teaching strategies that promote critical thinking. As a result CT is seen as an important but intangible concept for inclusion in the medical curriculum.

Several researchers have examined the development of CT skills as students progressed through their educational programs. Mc Carthy et. al., reported significant increases in both skills and dispositions to CT in the scores of senior nursing students compared to their sophomore counter parts.\(^{66}\)

Other studies have examined the effects on CT of different education models, particularly PBL compared to traditional education. In a qualitative study conducted in Australia, Nursing students who completed a four week PBL experience, within a ‘traditional’ discipline- structured program reported that they developed their critical thinking skills. They stated that PBL approach promoted CT and problem solving, active participation in the learning process and the integration and synthesis of a variety of knowledge.\(^{67}\)

Beckie et al found the CT scores of nursing students working with a new curriculum that incorporated clinical decision making and socratic thinking skills, group activities and active participation in the program were significantly higher than their counter parts in traditional programs.\(^{68}\)

Tiwari et. al, established that the CT scores of Australian nursing students were higher than those of Chinese students and they attributed the same to both the active educational model used in Australian school and to cultural differences.\(^{69}\)
The EBM interventional model used in our study is also an active educational model incorporating various modes of ‘instruction, viz., brain storming session, small group discussion, interactive lecture etc which certainly would have brought in changes in the CT abilities in the students belonging to EBM group.

There have been lot many similarities between PBL and the practice of EBM. Both the paradigms are student or learner centered models, involving usage of various models of instruction, both aiming to inculcate the concept of self directed learning in the minds of the students. Both PBL and EBM attempt to trigger the critical thinking abilities there by helping them to become competent physicians or professionals.

A recent study by Tiwari et. al used experimental design where students in first year of B.Sc Nursing Programme were randomized to PBL or traditional program. The PBL students scored significantly higher on CT compared to those educated in the traditional stream of the program.70

In a similar way, in our study, students of EBM group were exposed to the paradigm of EBM (in the early part of their MBBS program) which may possibly have effects on development CT abilities for them to have higher CCTDI post scores.

Altogether in general, all of the above studies suggest a generally positive influence of PBL on the development of CT in different educational programs. In the traditional program the education occurs primarily in the class room in the lecture format and it is usually non-interactive. Traditional approach is viewed as
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an efficient way to cover a large body of knowledge, although there are acknowledged limitations to this method of instruction. The implementation of such an educational program relies largely on memorized knowledge offering the student readymade information with limited incentive to stimulate the student’s thinking process. There is the suggestion that this often stifles creativity in students and can adversely affect the development of CT skills.\textsuperscript{71}

The practice of EBM is a student or learner centered method that uses an integrated approach, where students work with problems selected from real life situations, in small groups, discuss amongst themselves to track down the best evidence to answer their query. Thus EBM course is designed to strengthen students’ abilities to analyse, synthesize and develop individual problem solving and critical thinking skills. EBM enhances the ability of the students to integrate theory with practice and engage in Critical thinking.

Development of professional attitude is another commonly desired outcome for a medical student. Enhancement of the professional attitude should occur as the students move ahead in the medical curriculum from technical focus to a professional one. The results in our study did indicate a definite change in attitude as measured by the difference in Pre and Post test Alans EBM Survey Scores, though it is to accepted that quantifying the change in attitude remains elusive.

EBM has been accepted as a very useful tool of both teaching and learning medicine in the recent years, and several schools have already included the same in medical curricula.
The college of medicine at King bin Abdul Aziz University of Health Science’s (KSAU-HS) has adopted PBL curriculum involving web based graduate medical program adopted from University of Sydney Australia. One additional semester was added to the beginning of this curriculum to prepare the students in English language skills, PBL, Information Technology and EBM. EBM is a part of Personal and Professional Development (PPD) theme of medical curriculum and is integrated into each stage of the medical curriculum. Adding EBM to medical curriculum enabled students to develop EBM skills from the outset of their clinical training and fostered an ongoing desire to practice using EBM. The main purpose of integration was to reinforce to the students, EBM as a learning process. EBM is to be considered as an expertise, a health care provider must have to help in day to day decision making. Thus integration of EBM within curriculum is important, so as not to isolate it as separate discipline.

Physicians and other health care providers need to understand and implement EBM principle to improve patient care. Interactive and integrated clinical teaching and learning activities provide the basis for best educational practice. Teaching EBM requires an educational paradigm shift, as students need to possess additional skills that are not usually part of medical training. These include the ability to answer rather than just knowing the answer to questions. This ability is critical to the development of lifelong learners an important objective of a PBL curriculum.
Discussion

An EBM curriculum should foster critical thinking where by students learn to frame questions, analyze the data and understand the uncertainties that remain.

The faculty development in understanding the principles and practice of EBM is quite essential for acceptance of the EBM curriculum only after which implementation is possible. The staff and students should be encouraged to practice EBM as a culture not just a course to teach or a course to pass.

Challenges for Integration of EBM in Medical Curriculum:

Integrating EBM in the medical curriculum can be met by a few challenges, some educational and others administrative. Students admitted to MBBS course would have completed XII standard and the first year in the medical school would have been spent in learning only basic sciences viz Anatomy, Physiology and Biochemistry and with no chance to learn or understand EBM. Thus introducing EBM at the early stages of medical school as well as highlighting the importance of EBM in a physician's career is real educational challenge.

The administrative challenges viz getting the approval of Curriculum Committee, Board of studies, Academic Council etc. may be time consuming and at times may be difficult. The other administrative issues related to providing of the needed logistics, viz., computers and internet connectivity etc, also need to be addressed.
The important challenge of faculty barrier of bringing an attitudinal change has to be overcome very intelligently lest, the curricular change may suffer a set back in the initial phases itself.

With the optimal integration of EBM in the medical curriculum both in terms of time and curricular content, in a phased manner, a self directed, problem solving and up to date competent physician can be created.

**Limitations of the Study:**

The students enrolled in the study had the clinical (hospital) exposure for a period of only one term of 6 months. During this short period, the students may not have understood the principles of clinical practice, requirements of the patients etc. The terminology EBM itself could have been totally new for them, making it difficult for them to understand EBM. Instead, if the students were to have PBL curriculum, in place of the existing traditional curriculum, or an integrated curriculum, wherein clinical exposure could have been there from day one, they could have had distinct advantage in understanding or accepting EBM.

All the 118 students who were enrolled in the study were randomly grouped into 3 groups who received 3 different modes of intervention. The possible contamination which could have occurred (which could not be prevented) amongst 3 groups outside college hours, in their hostels could have had some effect especially in traditional group, which received no intervention at all.
Interventions were spread over a period of almost an year and the measures taken in the study to prevent decay could have been inadequate and may have borne some effects in the summative evaluation.

Even though there were no significant differences in the demographic data between the 3 groups, the students in the class belonged to heterogeneous backgrounds as regards their nationality, culture, language and the qualifying examination, which could have had indirect effects, apart from those due to planned interventions.

Even though all the student enrollments in the study were voluntary and informed consent was obtained from all of them, there could be a small fraction of subjective bias. An unwilling student may have got enrolled with the fear of getting identified / isolated for future consequences from the rest of the class for refusing to participate in the study.

Informing the participants that the results of the study will not have any bearing/effect on their University examinations could have made some of the participants to have a casual attitude without total involvement, towards the study, which could have affected the post test results.

**Future Scope:**

The relationship between an academic curriculum and critical thinking needs to researched although it is believed that low CCTDI scores are due to lack of educational atmosphere specially promoting CT.
The various attributes of CT viz, Open mindedness, Truth seeking, Analytical skill, Cognitive maturity, Inquisitiveness, Systematicity and Self Confidence are to be evaluated & studied independently both before and after EBM intervention with adequate sample sizes.

The effects of early introduction of EBM in the PBL medical curriculum needs to be studied in order to explore the true effects of EBM as the educational environment in PBL curriculum will be more conducive as compared to traditional curriculum in terms of staff and student interactions, sharing of problems etc.,

Rather than course an EBM extending over a period of 6-8 months, EBM is to be incorporated in the entire medical curriculum, in each and every subject of the MBBS program and the effects there upon, after the medical graduate starts his/her clinical practice, have to studied to document the distinct advantages of EBM.