Systematic Approach to Remediation in Basic Science Knowledge for Preclinical Students: a case study

by

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Dedication

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Abstract

Remediation of pre-clerkship students for deficits in basic science knowledge should help them overcome their learning deficiencies prior to clerkship. However, very little is known about remediation in basic science knowledge during pre-clerkship. This study utilized the program theory framework to collect and organize mixed methods data of the remediation plan for pre-clerkship students who failed their basic science cognitive examinations in a Canadian medical school. This plan was analyzed using a logic model narrative approach and compared to literature on the learning theories. The analysis showed a remediation plan that was strong on governance and verification of scores, but lacked: clarity and transparency of communication, qualified remedial tutors, individualized diagnosis of learner's deficits, and student centered learning. Participants admitted uncertainty about the efficacy of the remediation process. A remediation framework is proposed that includes student-centered participation, individualized learning plan and activities, deliberate practice, feedback, reflection, and rigorous reassessment

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Chapter I: Introduction

Basic Sciences in Medical Curricula

Medical students are expected to study the basic sciences, including anatomy, physiology, and pharmacology, as a prerequisite for their preparation to become doctors. As knowledge of the basic sciences grew, biochemistry, bacteriology, epidemiology, pathology, and others were added. These sciences were, for the most part, taught by physicians within their interests and preoccupations. However, after Flexner (1910) wrote his now famous report calling for reform in medical education in the early 1900s that gave rise to modern medical education, medical schools increasingly became affiliated with universities. The education of medical students became the concern of both busy physicians and laboratory teachers working in the basic sciences. This reform was followed by separation of the medical curriculum into two parts, with the preclinical followed by the clinical years. This separation resulted in a division between those who are medically qualified and those who are not. Usually the preclinical/pre-clerkship is the first 2 years, and the clinical period a further 2 or 3 years. Some clinical topics are regularly taught in the early years of medical curricula, which are mainly reserved for teaching the basic sciences. However, it is rare for the basic sciences to be included as a separate course in the later years of the curricula, which are usually for clinical teaching time (Putnam, 2006; Weatherall, 2006). This approach to managing the curricula has been successful for many years, and there is no doubt that it has led to improvement in teaching standards (van Gessel, Nendaz, Vermeulen, Junod, & Vu, 2003; Rudland & Rennie, 2003). However, in recent years, medical educators have begun to question the manner in which the curriculum has been divided

into these two parts and are constantly looking for ways in which science learning can progress in parallel with clinical learning, rather than preceding it in what is sometimes perceived as a remote and unrelated discipline (Rudland & Rennie, 2003). In my opinion, the debate about what science medical students ought to learn (Bloom, 1995; Woods, 2007) is not as important as the purpose for learning basic sciences.

Role of Basic Science knowledge in Clinical Reasoning

Although the learning of basic sciences is generally considered a crucial aspect of medical education, there is little agreement regarding its precise role in clinical reasoning and medical professionalism (Wolf, Gruppen, & Billi, 1985; Patel, Groen, & Scott, 1988). Clinical reasoning depends on a critical balance of different types of knowledge, including knowledge of the clinical symptoms of disease and of the biomedical mechanisms underlying the functioning of the human body (Schmidt, Norman, Boshuizen, 1990). Although few will doubt the importance of clinical knowledge or that a novice should be exposed to a variety of cases to be competent in clinical reasoning, clinical teachers continue to question the role of basic science knowledge in routine clinical reasoning (Woods, 2007). Whereas basic scientists may proudly highlight the importance of their discipline, some clinicians view the basic sciences as only peripherally relevant to daily practice. Interestingly, even medical students continue to debate the actual importance of basic science knowledge even if it is integrated in organ systems with clinical cases (Custers & Ten Cate, 2002), and some have an unfavorable opinion of basic scientists compared to clinical teachers (Stevenson, Bowe, Grandour-Edwards, & Kumari, 2005). Nevertheless, what the public thinks of medicine, most think

of medicine as a science since the mid-1800s (Ludmerer, 1985). This could have led, in my opinion, to the development of academic medical centers as we currently know them.

At a first glance of the issue of the relevance of basic science knowledge in clinical reasoning, it is easy to understand both sides of the debate. On one side, patients imagine that their doctors routinely consider the fundamental principles of anatomy, biochemistry, immunology, and physiology; on the other side we are all aware of situations where theories do not necessarily reflect practice. Some medical educators argue that the value and credence given to basic science knowledge in routine clinical reasoning may be overstating its importance. Those educators who are in favor of such an argument can point to ample evidence in the clinical literature, which suggests that expert clinical reasoning is seemingly independent of basic science knowledge (Patel, Evans, & Groen, 1989; Patel & Groen, 1986; Joseph & Patel, 1993; Taylor & Albo, 1993). Also, pattern recognition (Elstein, Schwartz, Higg, & Jones, 2000) and other forms of non-analytical reasoning can lead to accurate clinical decisions with little-to-no biomedical knowledge (Norman & Brooks, 1997). However, it may be naive to conclude from this evidence and anecdotal reports by practicing clinicians that basic science is of little value in making clinical decisions.

Lack of awareness of the impact of basic science knowledge in clinical reasoning may be explained by Schmidt's encapsulation theory (Rikers, Schmidt, & Moulaert, 2005). According to this theory, "biomedical knowledge and clinical facts becoming increasingly integrated as t the clinician gains experience" (Woods, 2007, p. 1173**).** For the medical expert, basic science concepts become encapsulated under clinical facts in the mental representation of disease. With time, clinicians can seamlessly recognize a

group of disease symptoms linked by biomedical knowledge, without needing to overtly describe the underlying pathophysiology. This encapsulation of biomedical knowledge explains why there is little mention of basic science principles or mechanisms in explicit recall or clinical reasoning measures in clinical decision making. Instead, the impact of biomedical knowledge will be revealed only through indirect means. However, the lack of awareness of the impact of basic science knowledge as explained by the encapsulation theory does not diminish its actual significance.

Although clinical learning may have the most obvious impact on expert medical reasoning, basic science still plays a subtle, yet important, role. This view is consistent with several supports from the medical education literature. For example, students who learned a mechanism relating signs and symptoms to disease showed better diagnostic performance than students who learned by pattern recognition **(**Woods, Brooks, & Norman, 2005**).** There is also support for a theoretical model of diagnostic or clinical reasoning that clearly treats the basic science and clinical knowledge of medical students as equally important and distinct domains (Donnon & Violato, 2006). In addition, in a study by Rudland & Rennie (2003), preclinical students were found to consider most learning objectives of the basic sciences relevant to clinical practice, and the basic sciences important for developing clinical reasoning in clerkship programs transitional learning unit (van Gessel, Nendaz, Vermeulen, Junod, & Vu, 2003). Several studies using educational psychology to compare the role of basic science knowledge and pattern recognition in clinical reasoning suggest that understanding the underlying mechanism of disease can allow a more coherent interpretation of signs and symptoms of clinical features (Woods, Neville, Levinson, Howey, Ockowski, & Norman, 2006;

Woods, Brooks, & Norman, 2007 a; Woods, Brooks, & Norman, 2007 b). These studies suggest that students trained using just clinical symptoms have difficulty diagnosing cases, or when presented with a novel case where the clinical symptoms are disorganized.

Taken together, these findings clearly indicate that to prepare students for clerkship rotations in hospital wards, and eventually residency and clinical practice, they should have achieved competency in basic science knowledge. Although preclinical medical education is supposed to prepare students for clinical education, there are signs that medical schools are not entirely successful in this respect (Windish, Paulman, Goroll, & Bass, 2004). The transition periods from preclinical to the clinical years are fraught with causes of stress (Radcliffe & Lester, 2003). Causes of stress include the difficulty of applying theoretical knowledge in clinical practice and the perceived shortcomings in basic science knowledge (Prince, Boshuizen, van der Vleuten, & Scherpbier., 2005). There is also growing concern among faculty staff that students in the clinical years are unable to retain or apply basic science knowledge in problem solving or clinical reasoning (Ling, Swanson, Holtzman, & Bucak, 2008; Greb, Brennan, McParlane, Page, & Bridge, 2009). Therefore medical schools need to identify and remediate students who have not achieved these competencies.

A study examining medical school attrition has found that most students (pre-clerkship and clerkship students) delay or discontinue their medical education because they experienced academic difficulties (Fogleman & Vander Zwagg, 1981). The increased risk of academic difficulty in the preclinical years is associated with low science GPA among other factors (Huff & Fang, 1999). Also, some premedical science courses are predictive of medical school performance (Forester, McWhorter, & Maria,

2001). A study showed that early measures of grades in pre-clerkship medical degree examinations, including the basic science examinations, can predict subsequent performance of later undergraduate grades, on licensing examinations (Cleland, Milne, Sinclair, & Lee, 2008), and clinical competence after medical school (Hojat, Gonnella, Veloski, Erdmann, 1993; Gonnel, Erdmann, & Hojat, 2004). These findings indicate an association between basic science knowledge and performance of medical students in the pre-clerkship years. They also underscore the importance of early identification of preclinical students who are more likely to be at risk of experiencing difficulty with the basic sciences and who would benefit from targeted remedial (intervention, support, and pastoral) programs. For those students early formative feedback to identify their strengths and weaknesses and to improve their subsequent performance would help to ensure a positive long-term outcome (Ende, 1983).

Unfortunately, poorly performing students may not seek out guidance and support (Malik, 2000) because of lack of insight into their performance, or because they may make overly optimistic judgments of their own assessment even in the face of evidence to the contrary (Cleland, Arnold, & Chesser, 2005; Langendyk, 2006). Students may also perceive that the culture of the medical school is unsupportive towards those with difficulties, and they may believe that asking for remediation may be noted as a stigma against them (Cleland, Arnold, & Chesser, 2005). Medical schools cannot, therefore, assume that at-risk students will seek support appropriately. Even, those students that would like to seek support are discouraged to do so because of very few and no optimal remediation strategies (Saxena, O'Sullivan, Teherani, Irby, & Hauer, 2009).

This thesis reflects my serious concern about the lack of strategies for identifying at risk-students and providing them with remedial support in pre-clerkship medical education. As a tenured associate professor in a Canadian medical school, I significantly contribute to both teaching and administrative services in the undergraduate medical curriculum. Specifically, I teach at all levels of the preclinical program (Medicine Year 1 & 2) in various blocks covering subject areas mainly in the basic sciences. More importantly, as the Chair, Committee of Evaluation Medicine I and Director of Remediation, I am responsible for providing leadership in designing and implementing effective remedial programs. The lack of a structured remedial program, students' limited awareness of need for remediation and limited resources has, indeed, hindered my ability to appropriately provide support for at risk/struggling students.

Purpose of the Study

Medical schools have the responsibility to ensure the competence of their students in basic science and clinical knowledge, and the services they will eventually provide after their residency training. Residents who perform below a level appropriate for their stage of training compromise the ability of health care teams to provide excellent patient care and to avoid medical errors through unsafe practices (Reamy & Harman, 2006). These competencies, which are outlined and described as educational standards, are mandated by medical accreditation organizations. The Association of Faculties of Medicine in Canada (AFMC) in its most recent commissioned report stated in educational standard (ED) 7 that:

Given that medicine is rooted in fundamental scientific principles, both human and biological sciences must be learned in relevant and immediate clinical contexts

throughout the MD education experience. In addition, as scientific inquiry provides the basis of advancing health care, research interests and skills must be developed to foster a new generation of health researchers (The Future of Medical Education in Canada, 2009). Also, the Liaison Committee on Medical Education (LCME) has mandated in ED 11 that:

The curriculum of a medical educational program must include content from the biomedical sciences that supports students' mastery of the contemporary scientific knowledge, concepts, and methods fundamental to acquiring and applying science to the health of individuals and populations and to the contemporary practice of medicine (LCME, 2010).

These accreditation standards clearly emphasized the importance and role of basic science knowledge in the education of tomorrow's doctors. Clinical directors are concerned that preclinical education is not adequately preparing students for the core clerkship programs. Some of these inadequacies, as referenced above, are due to deficiencies in basic science knowledge (Windish, Paulman, Goroll, & Bass, 2004). Consequently, weak medical students go on to become weak doctors, whose colleagues are left with the responsibility of spotting dangers, and reporting clinical errors and malpractice (Challis, Fleet, & Batstone, 1999; Papadakis, Teherani, Banach, Knettler, Rattner, Stern, Veloski, & Hodgson, 2005). Therefore, early identification and remediation of students for weak performance in both basic science and clinical knowledge and skills could help them minimize or overcome their learning deficiencies, before these cause problems in clinical practice. Interestingly, there are several remedial programs for poor and weak performance in clinical skills and knowledge for medical students and residents (White, Ross, & Gruppen, 2009; Saxena, O'Sullivan, Teherani, A.,

Irby, & Hauer, 2009; Ratan, Pica, & Berkowitz, 2008; Hauer, K. E., Teherani, A., Irby, Kerr, & O'sullivan, 2008**;** Rosenblatt & Abrams, 2002; Sayer, M., Saintonge, Chaput De Saintonge, Evans, & Wood, 2002), and for nursing students at risk for clinical failure (Gallant, MacDonald, & Higuschi, 2006; Zuzelo, 2000). In contrast to several studies on remediation after clinical examinations, only one published study has described intervention in addressing poor scores on written examinations that led to improving knowledge during a preclinical year (Schwartz & Loten, 1998). However, in this study (Schwartz & Loten, 1998), although there was a significant improvement in scores after a remedial tutorial activity, no guidelines, optimal remediation strategies, or remediation framework for deficits in basic science knowledge was described. Thus, medical educators are often left to implement unstructured and ineffective remediation strategies on an ad hoc basis in individual institutions.

To address this gap in the literature of approaches to remediation in basic science knowledge deficits, this study will apply the principles of Program Theory (Lipsey, 1993; Freddollino, 1999; Schmitz & Parsons, 1999; Sidani & Sechrest, 1999) to describe the remediation plan for pre-clerkship students who fail their cognitive basic science examinations in a Canadian medical school. Specifically, the remediation program components at one Canadian medical school will be discussed utilizing a logic model (McLaughlin & Jordan, 2004), and compared to existing evidence on intervention education (Malik, 2000; Poorman, Webb, & Mastorovich, 2002), student-centered learning (McAllister, 1996) and the 'capacity to change performance' (Hays, Jolly, Caldon, McCorrie, McAvoy, McManus, & Rethans, 2002). This comparison will illustrate what works and what learning theories support their program. Subsequently, a

framework for remediation in basic science knowledge deficits will be proposed. This framework will be based on the best practices that incorporate student-centered learning, intervention education, and the "capacity to change performance."

Significance of the Study

Students in preclinical years have to be well prepared for core clerkship rotations in hospital wards. In order to do so, they must have a thorough understanding of basic science knowledge. Basic science knowledge is important for clinical reasoning and diagnosis (Woods, 2007). Therefore, remediation for poor performance in basic science knowledge is necessary. Unfortunately, it is difficult to identify struggling students who fail specific disciplines within a course but nevertheless have an overall passing grade. It happens at this medical school because the basic science course contents are grouped into blocks rather than testing discipline specific content. The result is poor grades in some disciplines can be offset by high grades in other disciplines within the same course examination. This complex system of multiple examinations and their compensatory effects make it difficult to remediate students at this medical school before progressing to their clinical rotations. In general, across medical schools in North America there is reluctance on the part of instructors and clinical preceptors to fail students or even document poor performance in written evaluations, despite their ability to identify an obvious deficit in knowledge or skills (Speer, Solomon, Fincher, 2000). This reluctance is partially driven by lack of effective remediation options, notably in the basic sciences, insufficient documentation of deficiencies to support a failing grade, fear of legal action or appeal by trainees (Dudek, Marks, Regehr, 2005). Students who do not receive remediation may complete their preclinical programs without mastering defined

competencies and may never receive adequate feedback on knowledge and skills that require improvement. To address this problem, medical schools need to develop comprehensive and effective remedial programs in basic science knowledge deficits. These programs should be based on the belief that the use of additional support and appropriate resources enhances the potential of students to be successful. Tutoring and counseling have been shown to have a positive effect on examination grades, student retention and program completion rates, levels of psychological distress and student satisfaction (Rickinson & Rutherford, 1995; Rickinson, 1998). A recent search of the education research index collection (ERIC) data base, Medline, and PsychoInfo database, from 1970-2009, revealed no literature research regarding remediation programs for basic science knowledge in undergraduate medical curricula. Therefore, it is proposed that a framework for a remediation that is tailored on examining best practices of intervention education (Malik, 2000; Poorman, Webb, & Mastorovich, 2002), student-centered learning (McAllister, 1996), and the 'capacity to change performance'(Hays et al., 2002) may be most appropriate for struggling students, and indirectly benefits patients and health professions.

On a personal level, as Director of Remediation in this medical school, this study could have impact on how I provide leadership in encouraging faculty to 'buy into" remediation of medical students with academic difficulties. It has been a frustrating experience for me to convince my colleagues of the importance of remediation without being able to provide any model of remediation plan to implement. Therefore, proposing a visual representation (logic model) of a remediation plan provides an image of how the program outcomes are linked with the program activities and inputs, and the theoretical

assumptions of the cause-effect relationships. The logic model approach helps guide program planning, evaluation, and improvement. Above all, it creates a shared understanding of program goals, procedures, and in relating activities to expected outcomes (Sidani & Sechrest, 1999).

Chapter II: Literature Review

Assessing Students with Learning Difficulty: causes of learning deficiency

In medical schools, not all students will continue to be highly motivated and academically successful. Some students will have academic difficulties in basic science knowledge, clinical reasoning and skills, or in any course for that matter. These students represent a continuing concern for faculty, who must correctly identify them and make appropriate decisions, weighing concerns about future patient care and their obligation to society. Students with academic difficulties have been described in the literature as "weak students," "challenging students," "at-risk students," "strugglers," "marginal students," and "difficult/problem learners," (Parenti, 1993; Hendrickson & Kleffner, 2002; Cleveland, Arnold, & Chesser, 2005). Students who struggle with routine assignments, show poor or marginal performance in examinations, fall behind their classmates in completing assigned learning objectives, are distracted, lack of personal responsibility, difficult to work with, and do not appear to be motivated to learn (Cleveland, Arnold, & Chesser, 2005). There are several potential causes of inadequate student performance, which can serve as a diagnostic framework and help teachers identify reasons for students' poor performance. These causes include:

Cognitive factors.

Cognitive factors including poorly integrated, compartmentalized information, poor meta-cognition that hinders student's ability to self-monitor and self-correct his/her performance. Difficulties can occur related to how the student acquires processes, stores and retrieves, information. This is common among students who may advance to the clinical phase of the curriculum with poorly integrated basic science knowledge. These

students have difficulty retrieving information needed to answer conceptual problems or "thinking on their feet" to cope with disorganized clinical symptoms that occur during patient encounter. "People with poor metacognition cannot distinguish accuracy from error and have inflated impressions of their abilities" (Hendricson & Kleffner, 2002, p. 45). These students can be challenging to teach, rarely receive feedback, and do not learn by observing how other people function. It is unreasonable to expect that these students will improve their performance by simply observing clinical teachers as they interact with patients, or improve their knowledge network (relationships between isolated bits of information) in basic science. However, there is evidence that conducting debriefings with these students in which their decisions are carefully analyzed and compared to an ideal will help them develop meta-cognitive skills (Krugger & Dunning, 1999; Gilbert, Giesler, & Morris, 1994).

Ineffective study habits.

It is unlikely that a large number of students will reach an advanced level of professional training in medical schools with poor study habits. However, teachers routinely find students who have sufficient intelligence to get by with ineffective study methods for much of their academic career, but who struggle when they run into conceptually difficult material (Brown, 1983; Newble & Clarke, 1986; Sayer, Chaput De Saintonge, Evans, & Wood, 2002). The study habits of high-achieving and underachieving medical students are most of the time remarkably different. "High-achieving students, for example, tend to be persistent and schedule a specific time block daily for reading, review, and completion of assignments" (Hendrickson & Kleffner, 2002, p. 52). These students are confident with high expectations, open to criticism of

their work, accept feedback without arguments, and have a good impulse control. In contrast, underachievers rarely study regularly and seem to easily loose control on focusing on assigned tasks. Underachievers read passively, do not take notes or self quizzing when studying, avoid feedback, and are defensive and primarily concrete thinkers (Martenson, 1986; Arnold & Feighny, 1995)

Inadequate teaching and educational experience or punitive environment.

The sad truth is that substandard student performance is frequently associated with a substandard educational experience (Hendren, 1988). When confronted with a consistent pattern of inadequate performance by a significant number of students, the educational environment needs to be assessed. This is a hard fact for teachers to accept. However, there are well-recognized ingredients for good practice in higher education (Sorcinelli, 1991), and quality teaching in the patient care environment of health facilities have been identified in several studies (Wright, Kern, & Kolodner, 1998; Speer & Elnicki, 1999). Although several questions can be asked to assess the learning environment, some questions are more useful than others. Negative responses to some of these useful questions may be indicative of potentially substandard learning environment. For example: "Do teachers communicate clear learning objectives to the students? Is course work well organized and presented in a stimulating manner that includes variety, fun, opportunities for frequent student interaction, including peer teaching?" (Hendricson & Kleffner, 2002, p. 53). Is course work structured so that students have opportunities to promptly use new information and employ active learning strategies such as analysis of cases or research projects? Are instructors enthusiastic, available, and approachable, so that students are not afraid to request help or ask questions?

Critical factors for the development of expertise for teachers and students.

Difficulties in learning can also be as a result of lack of expertise for both learners and teachers. Expertise implies expectation of changes for both teachers and learners. Such changes involve cognitive and meta-cognitive processes, self-directed learning, deep and surface learning, acceptance of feedback, adapting to context, and self-concept of developmental learning, and reflective practices (Hendricson & Kleffner, 2002). These changes are important if teachers are to appropriately remediate students. To help guard against unreasonable expectation of students performance, several models been developed showing desirable levels of performance that can be expected of learners as they progress through the educational continuum (Pangaro, 1999; Hendricson & Kleffner, 2002). These models depict that students acquire several separate bits of information that are integrated to make connections between ideas, which eventually leads to more complex cognitive thinking and behavior that mediates higher levels of adaptive learning and synthesis of new knowledge in an intuitive manner. These models are useful for faculty development so that learner stages of training are identified even before help is provided to address their learning difficulties. The changes in students learning experience are affected by several factors, such as their epistemological (knowledge) beliefs (Buehl & Alexander, 2005). For example, students' beliefs about the importance of knowledge in a specific domain have been related to their decisions to take courses in that domain (Qian & Alverman, 1995). Also, students' beliefs about their ability to accomplish a specific task successfully are related to their task choice, persistence, and performance (Schunk, 1991). Students' self efficacy to accomplish tasks successfully can be nourished through self-directed learning. Effective teaching matches the learner's

stage of self-directed learning and helps the learner advance towards greater self-direction (Grow, 1991; Zimmerman, 2008). Educators can also foster competence in self-directed learning by providing opportunities for students to develop critical thinking (Kreber, 1998). However, the development of self-directed learning and changes in students' learning is influenced by their motivation and social influences characterized by peer interactions, expert modeling and scaffolding (Ge & Hadré, 2009). Changes in students alone are not sufficient to support their academic enhancement for addressing their learning deficiencies. This also requires faculty to develop the changes in teaching expertise. The changes includes shift from internal focus towards students' needs and deliberate practice. Expertise is seen as state of superior performance achieved after many years of deliberate practice and experience (Ericsson, Krampe, Tesch-Römer, 1993; Tsui, 2009). While experience is a necessary condition for the development of expertise, it is not a sufficient condition. Other factors are also important in developing expertise, such as being goal oriented (Sosniak, 2006), receptive to informative feedback (Kinchin, Cabot, & Hay, 2008), reflective to correct errors and improve by scaffolding of difficulties (Glaser & Chi, 1988; Zimmerman, 2006), and responding to and looking for changes (Ericsson & Lehmann, 1996).

Stress due to family related health, financial issues, social relationships, and life styles.

Does medical student stress matter? It could be argued that a certain amount of stress is necessary for students to perform well. An overly relaxed attitude could lead to complacency and a failure to do sufficient work. Students who are present in body but not in mind or spirit are easily distracted away from routine tasks. Studies which have tried to

identify the sources of stress among medical students generally point to three main areas: academic pressures; social issues; and financial problems (Vitaliano, Russo, Carr, Heerwagen, 1984). These students have so much going on in their nonacademic lives that they cannot fully attend to the academic component. Medical students have been thought to have more university-related concerns and stresses (Moffat, Macconnachie, Ross, Morrison**,** 2004), and personal issues (Sayer et al., 2002). Debt and family under excessive financial pressure were rated as the most significant causes of stress by medical students. "Students who worried about money had higher debts and performed less well than their peers in examinations" (Ross, Cleland, Macleod, 2006, p. 588). Apart from financial concerns, domestic conflict with a spouse or partner, health of spouse, children, or parents, outside employment, unplanned pregnancy, and drug and alcohol abuse can become major sources of distraction (Firth, 1986; Wolf, 1994). The key symptoms of dysfunctional nonacademic distraction are: sudden request for time off; unexplained absences; dramatic changes in demeanor; unproductive time (day dreaming); moodiness; concentration errors; and away from the clinical facility during work hours.

Bona fide learning disabilities that require professional assessment and treatment.

"Learning disabilities (LD) are a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical skills" (Roseburgh, 2000, p. 994). The definitions and diagnostic criteria for LD are not objective but ambiguous and their causes are debatable (Horgan, 1996). Medical students with LD compensate effectively during undergraduate course work, but the volume and pace of material they encounter in medical school,

exposes their disability (Walters & Croen, 1993). In medical schools for many of these students, a pattern develops in which the harder they work the more inefficient their studying becomes, and the end results only continue to worsen. This becomes a vicious cycle until the student loses self-esteem and sometimes become clinically depressed (Rosebraugh, 2000). It must be emphasized that LD have nothing do with intelligence. Some of these students with superior overall intelligence can nevertheless exhibit dramatic academic deficiencies in reading and written language (Accardo, Haake, & Whitman, 1989). Despite scholastic difficulties, these students gained admission to medical school through their tenacity and their ability to compensate (Brinckerhoff, 1996).

Underlying medical and psychological conditions.

Numerous studies have demonstrated that a substantial proportion of medical students experience a significant burden of depression symptoms during their medical years. A variety of stressors associated with career training in medicine may contribute to the experience of depression in medical students **(**Rosal, Ockene, Ockene, Barrett, Ma, Hebert, 1997). These stressors include pressure to learn a large quantity of new information, encountering serious diseases and death in clinical patient care, time pressure, loss of social activities, and going into debt, as outlined above. Previous studies have also identified a number of personality traits that may have an impact on the emotional adjustment and/or academic performance of medical students. Personality variables such as enthusiasm, resourcefulness and imaginativeness have been shown to correlate with academic success of preclinical medical students (Peng, Khaw, & Edariah, 1995). Also, conscientiousness, agreeableness, extroversion and, to a lesser extent,

neuroticism have been associated with intellectual satisfaction in medical school (Lieberman, Stroup-Benham, Peel, 1998). Perfectionism is a particularly relevant personality characteristic that is relevant to medical students. Faultless performance, meticulous attention to detail and high levels of competency generally represent desirable traits of medical students and physicians, yet students with excessively high standards may have difficulty completing assignments and may experience extra self-imposed pressure (Humphris & Kaney, 1998). A strong association is observed between socially prescribed perfectionism (the perception that others expect oneself to be perfect) and current psychological stress in medical students, which affects their performance (Henning, Ey, & Shaw, 1998). Stress can also lead to anxiety, which may affect students' emotional balance, attentiveness, motivation, and energy to study (Guthrie, Black, Shaw, Hamilton, Creed, Tomenson, 1995).

Lack of professionalism.

Attitudinal issues, which include a variety of behavioral manifestations including professionalism deficits among medical students, can be disruptive to the overall learning environment (Bennett, Roman, Arnold, Kay, Goldenhar, 2005). These behaviors are ambiguous, irritating, and, in extreme cases, indefensible to faculty: argumentative that hinders student-teacher communication and thus the quality of the learning experience; lack of personal motivation and responsibility; and the arrogance of students who have high estimation of their ability (Hendrickson & Kleffner, 2002). Defensiveness and lack of motivation can be the behavioral manifestations of underlying learning deficiencies or medical problems. These appear to be intertwined with the student's sense of safety

within the academic environment. Students who are not punctual and take personal responsibility for completing assignments often find themselves failing examinations.

Intervention Education**: situating remediation in medical education**

Remediation is defined as "a class or activity intended to meet the needs of students who initially do not have the skills, experience or orientation necessary to perform at a level that the institutions or instructors recognize as 'regular' for those students" (Grubb and associates, 1999, p. 174). The human and financial costs of academic failure amongst medical students are extremely high. Often remedial support is infrequently available or is available only for students failing their final examinations. Students who are referred to a remedial class or activity in medical schools include those presented to an academic progress committee who have not met expectations in a course or clerkship rotation, students who meet some but not all requirements of a clinical evaluation, as well as students with characteristics such as poor interpersonal skills, excessive shyness, poor integration of skills, and lack of personal responsibility (Tonesk & Buchanan, 1987, Cleveland, Arnold, & Chesser, 2005). In many medical schools, the complex patterns of assessment and requirements for promotion based on average passing grade rather than on requirement to pass all subjects, results in weak students continuing their courses with little guidance or specific educational intervention. For some students their learning problems remain unaddressed and their learning environment unaltered, leading to repetition of failure (Tooth, Tonge, McManus, 1989). Traditionally, students with academic difficulties were identified by a personal tutor or equivalent, often serving a combined academic and counseling role. Now, across higher education sector, personal tutorial systems and counseling care are under strain from

increased student numbers (Rourke, 2006, Sullivan, 2008; AAMC, 2008) and demands on faculty time for clinical service, research, and administrative responsibilities (Schwartzstein, Huang, & Coughlin, 2008). Furthermore, recent initiatives to promote increased access and diversity in medical education (Lakhan, 2003; Spencer, Young, Williams, Yan, & Horsfall, 2005; LCME: Diversity policies, 2008) have raised requirements for educational, welfare and counseling support. These factors have compromised educational diagnosis of each individual student prior to initiating remedial educational intervention, individualized support systems for students, and slowed down the identification of struggling or challenging students and their quick referral for remediation. The importance of student support to the educational progress has been recognized by the AFMC and LCME, both of which include provision of student support and guidance in their reviews of educational standards (LCME, 2008). Based on a literature review on remediation in higher education, adult learning, and medical schools, there are certain ingredients central for designing successful interventions for underprepared students. These ingredients are:

1. Establishment of a good relationship between tutors and student, where the tutor is expected to take initiative in contacting remedial students.
2. Tutor taking the responsibility to arrange a follow-up meeting.
3. Tutor devoting significant time helping remedial students building skills within a real-world context as opposed to abstract approach.
4. Tutor is approachable.

5. Tutor creating a positive learning environment to develop students' inquiry (Levin & Koski, 1998; Malik, 2000; Poorman, Webb, & Mastorovich, 2002; Bloom, 2005).

Student Centered Learning: learning contract in remediation

The use of a learning contract is an integral component of student-centered learning; as a pedagogical tool it is sufficiently flexible enough to accommodate different learners and learning experiences (Knowles, 1986). A Learning contract is defined "as a written agreement between teacher and student which makes explicit what a learner will do to achieve specified learning outcomes" (Richardson, 1987, p.102). A learning contract has 5 components:

1. Learning objectives.
2. Learning resources and activities/strategies.
3. Target dates to meet the objectives.
4. Types and sources of evidence for learning.
5. Criteria for evaluating evidence of learning (Knowles, 1986; McAllister, 1996; Schoolcraft, 2000).

Sometimes, establishing a passing grade is seen as an additional requirement of the learning contract (Richardson, 1987; Watson, 2002). Traditionally, learning contracts have been used in nursing and other clinically based health professions, with exemplary or senior-level students engaged in a one-on-one relationship with the preceptors (Chan & Wai-tong, 2000; Mazhindu, 1990; Timmins, 2002). However, there is no published article indicating that they have been incorporated into remediating preclinical medical students with deficits in basic science knowledge. In a student-centered remediation

process, the learning contract is adapted to numerous learning contexts, styles, and objectives, permitting application across many disciplines. The use of learning contracts also supports a step-wise approach to developing remedial learning plans that provide additional supportive strategies, such as tutoring, academic advising, and counseling, to struggling students (Knowles, 1986). In remediation, the learning contract makes the expectations of the learning experience explicit and identifies performance concerns, corrective actions, timelines, and consequences (Schoolcraft, 2000). It is also anticipated in the learning contract that there be opportunities for student involvement and collaboration during the remediation process. The responsibility of the struggling student with sufficient insight into their learning needs may include preparing the written learning contract, outlining the objectives, and identifying learning resources and strategies. Students will also specify timelines and initiate a week-by-week schedule for learning activities. Although the faculty would retain the right and duty to evaluate student progress and provide immediate feedback, they may become more of a resource for students, reviewing students' work and suggesting learning resources (Knowles, 1986).

Measuring the 'Capacity to Change': what is 'capacity to change' performance and its implication for remediation?

Remediation strategies are based on the intention that during the remediation process, struggling students should acquire knowledge and skills to recognize their strengths and weaknesses, be able to self-direct their learning, and be motivated to change, in order to improve their performance (Hendricson & Kleffner 2002). However, it is difficult to demonstrate a capacity for self-directed learning and to change

performance in practice, even where short-term changes in knowledge occur (Beaudry, 1989; Davis, Thompson, Oxman, & Haynes, 1995). Most struggling students appear to be unaware of what are often substantial gaps in their knowledge and skills, leading to poor performances (Cleland, Arnold, & Chesser, 2005; Langendyk, 2006). Students in this group are difficult to remediate. This finding raises the question of how can we measure the "capacity to change" for students. The nature of 'capacity to change' is critically related to change in performance, which is relevant to remediation of an individual. The "capacity to change performance" involves interrelated concepts of different constructs such as insight, motivation, professional and social network, learning behavior, personality and locus of control. This set of interrelated constructs that explain and predict the behavior of a person to improve performance constitutes the theory of the capacity to change (Hays, Jolly, Caldon, McCorrie, McAvoy, McManus, & Rethans, 2002). Therefore, assessment of the "capacity to change performance" requires measures of the different constructs. Ideally, all such measures would require data from both the struggling student against external indicators of a particular measure. Some of these measures can be addressed with existing tests and rating scales, while others may require new assessment methods to be developed.

Insight.

Having the capacity to change performance implies that an individual has insight into his or her performance, and that these insights are correct (perhaps against agreed professional bench marks). For example, students with insight into deficits of basic science knowledge are aware of gaps in this knowledge. "There may be a range of levels of insight in different individuals. At some point this may reach a level which is

inadequate for effective self-regulation" (Hays et al., 2002, p.965). Insight and performance may be critically related, and there are instances where increasing insight in the presence of decreasing performance can also cause difficulties. This indicates that insight alone is not enough to significantly affect performance, but other constructs such as motivation are necessary to bring about a change in performance (Andrewes, Hordern, & Kaye, 1998; Francis & Penn, 2001). However, insight is an important component of this, but this is not well defined in the context of medical performance. The literature on insight is vast and complex. In psychological theory, insight was a term first coined by Kohler to describe the behavior of apes solving puzzles (Gould & Gould, 1994). The psychoanalytic movement uses the term to refer to the capacity to understand the psychological functioning of the self and others, and sees it as an advanced psychological trait or capacity (Amador & Kronengold, 1998). It has also been used in psychological medicine as a fundamental concept in the etiology and susceptibility to treatment of schizophrenia (Andrewes, Hordern, & Kay, 1998). Some authors also use the term 'insight' to describe the capacity of professionals (or any individual) to achieve some measure into the thoughts and feelings of others (Ickes, Marangoni, & Garcia, 1997), and insight has been defined as a contributor to expertise (Sternberg & Horvath, 1998). Although the concept of the reflective individual has been much used in medicine, it is distinguishable from insight; the notion of the reflective practitioner is developed from individuals who are motivated towards and successful at professional or task improvement (Schon, 1983; Borduass, Gagnon, Lacoursiere, & Laprise, 2001). It could be argued, and is consistent with the concept presented here, that for failing students to be successfully remediated, they should be able to have insight into their learning, by having

the ability to recognize their skills or knowledge deficit and strengths, and performance of others, before they can self-reflect accurately on their performance. In some literature, insight and self-awareness are seen as synonymous (Longhurst, 1988). In this context, insight may comprise a combination of the three constructs:

1. Conscious and knowledgeable of one's own performance (where the frame of reference is of one's own construction and format over a period of time).
2. Aware and knowledgeable of the performance of others (where the one makes reference to an externally defined or accreditation standard, or acceptable performance).
3. Ability and commitment to reflect on both of the above measures to make an acceptable judgment (Beckett & Hager, 2002).

These constructs can also be intertwined with performance to create different categories of struggling students with respect to multidimensional capacity for insight and motivation to change performance. For example, if a struggling student has low insight and low motivation to change, he or she is likely to perform poorly. Such an unconsciously incompetent student may be the most difficult to remediate. However, this is not the only category of potential concern. A struggling student with high insight and low motivation to change might also cause concern because he or she is clearly poorly motivated to improve, perhaps because of stress or personal distraction, despite the fact that they have the ability to improve. A struggling student with low insight but high motivation to change (unconsciously competent) may also be difficult to remediate because he or she may not engage in effective study habits even if there is eagerness on his or her part to do so. Such a student might not easily adapt to a new way of studying

or learning. Some struggling students may have 'typical' insight and 'typical' motivation to change. Such consciously competent students are not difficult to remediate because they have the ability and willingness to change their performance. However, those with lack of insight irrespective of their motivation to change/improve may be irremediable even if regularly exposed to their deficiencies. This then raises the question as to why we should bother to attempt to remediate them. They may be beyond the capacity to change. Before making decisions on whether an individual should remediate, measuring the 'capacity to change performance' for that individual assumes more importance.

Insight can be measured by methods that compare self and external performance broadly from several perspectives (Rethans, Westin, & Hays, 1996). For example, a semi-structured interview may be useful as it might further explore the differences between self and external evaluations about targeted behaviors (Sayer et al., 2002). Failure of the struggling student to demonstrate awareness of his/her deficits could demonstrate the absence of insight. Another method that may be useful to demonstrate a student's awareness of his or her own deficiencies is the critical incident analysis (originally called significant insight moment analysis). In this analysis, focus should not be on the incident or poor performance itself, but rather on the meaning of the incident to the individual who experienced it (Flanagan, 1954).

Additional assessment of the capacity to change performance involves measures of other constructs, such as professional and social network (professional isolation versus integration, sociability; studying alone, internet use, networking with other good students, and self-reliant) (Brown, 1983; Martenson, 1986); learning behavior and learning disabilities (cognition and meta-cognitive processes, self-directed, deep and surface

learning, acceptance of feedback, self-concept of developmental learning, reflection, difficulties in the acquisition and use of listening, speaking, reading, writing, and reasoning or mathematical skills) (Gall, 1970, Blackman & Goldstein, 1982; Bordage, 1994; Rosebraugh, 2000; Hendricson & Kleffner, 2002); motivation (stress, depression, life events, openness to new ideas, financial, and acknowledgement as measured by general health questionnaire burnt out scale) (Humphris & Kaney, 1998; Ross, Cleland, & Macleod, 2006); and Personality and locus of control (conscientiousness, intro/extroversion, and neuroticism, and perfectionism, good impulse control, both concrete and abstract) (Frost, Marten, Lahart, & Rosenblate, 1990; Costa & McCrae, 1992).

Current Approaches to Remediation

Certain skills areas or deficits in knowledge may be particularly challenging to remediate. A growing body of evidence suggests that remediating non-cognitive problems, such as lack of professionalism, is more challenging than remediating cognitive problems (Hunt, Carline, Tonesk, Yergan, Siever, & Loebel, 1989; Murden, Way, Hudson, Westman, 2004)**.** All remediation strategies published to date for medical students and residents are designed for those failing any part of the comprehensive clinical skills assessments (White, Ross, & Gruppen, 2009; Saxena, O'Sullivan, Teherani, Irby, Hauer, 2009**;** Ratan, Pica, & Berkowitz, 2008; Hauer et al., 2008; Rosenblatt & Abrams, 2002; Sayer et al., 2002). These strategies are also similar to those adopted for nursing students failing clinical assessments (Gallant, MacDonald, Higuschi, 2006; Zuzelo, 2000). Comprehensive remediation strategies for basic science knowledge deficits are yet to be published. Based on the remediation strategies referenced above

and a thematic review of the literature on remediation and the learning sciences, essential elements of successful remediation programs for clinical skills that would enhance existing efforts involve a 4-step process (Hauer, Ciccone, Henzel, Katsufrakis, Miller, Norcross, Papadakis, and Irby, 2009) (Figure 1): (1) Screening (verification of results and referral), (2) Diagnosis (identifying skills, clinical knowledge, or non-cognitive deficits), (3) Prescribed Activity (generation of a negotiated management plan, learning contract, or study exercises), and (4) Retesting and Evaluation (supplemental examination, consequences, record-keeping and feedback):

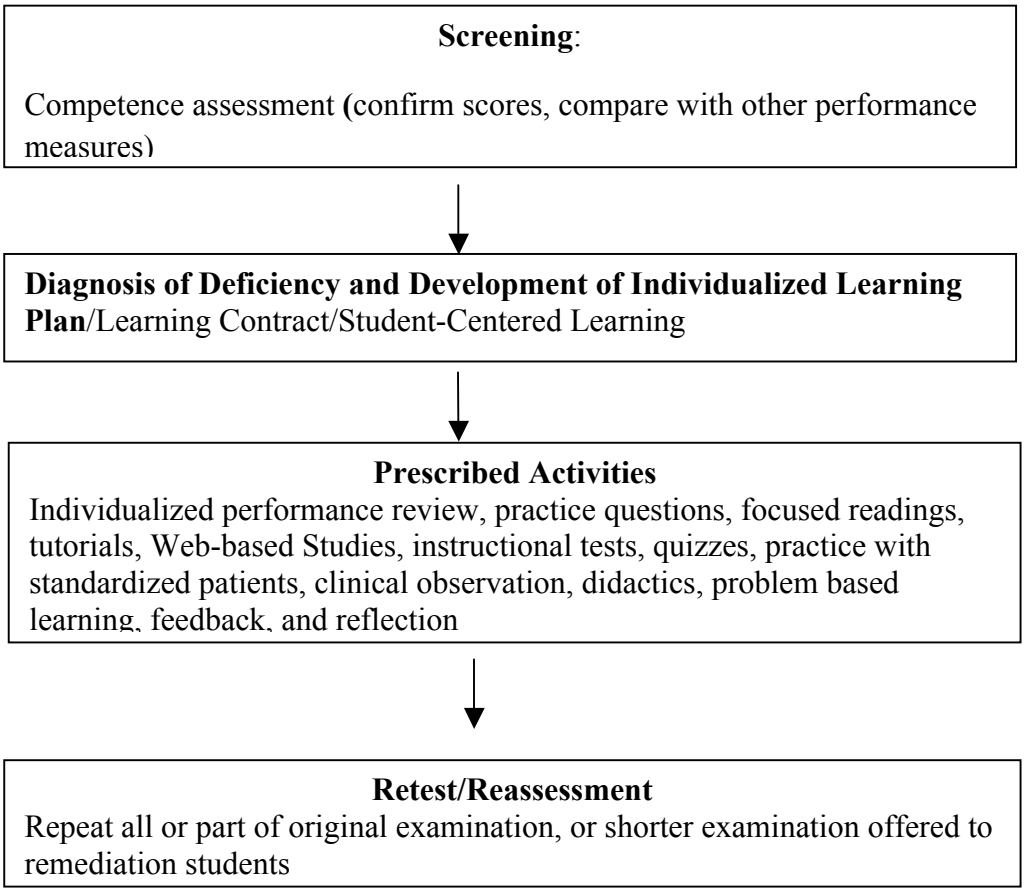

Figure 1. Model for Remediation of Clinical Skills Deficits: Adapted from Hauer et al. (2009, p. 107).

Screening.

Remediation begins with the identification of failing students and verification of their assessment scores, most commonly by reviewing examination score reports, watching all or a portion of the failing student's examination video, or meeting with the failing student. This is usually carried out by a member of the progress committee or promotions committee. After the verification is completed, the student is referred by letter to a director of remediation, dean, or member of an examination or academic oversight committee, who will be responsible for diagnosing failing student's needed area(s) of remediation and developing remediation plans.

Diagnosing.

In most medical schools, emphasis is placed upon voluntary participation. Students with medical or learning disability are referred to clinical specialists, psychologists or learning disability services, before being allowed to participate in the academic component of the remedial program. Each student attends an initial meeting with one or more faculty tutors. The diagnosis involves identification of individual causes of academic failure and negotiation of a prescribed remedial activity/management plan/learning contract. Remedial tutors take written notes during the meeting. Students are given the option of video or audio-taping the sessions For consistency and respondent validation, review of notes take place between tutors and students before formal documentation takes place. In these sessions, students are encouraged to talk freely about problems with courses and their own perceived reasons for their academic failure. Remedial tutors will then direct the conversation towards their learning style (Tooth, Tonge, & McManus, 1989) and examination preparation techniques. Finally, a semi-

structured interview will be held. This allows for certain questions to address factors known to be associated with poor academic performance (Powis, Waring, Bristow, & O'Connell, 1992).

Prescribed activities.

Particular areas of academic deficiency and specific social needs are highlighted in the form of a problem list, which faculty tutor and a student will have planned together. The issues generated are categorized into academic and personal issues that could be either addressed within the remediation program or for which external referral is sought. A suitable action plan will be made, thus completing and recording the educational diagnosis. A learning contract, in effect, is negotiated as follows: Faculty tutors will offer weekly tutorials, practice with standardized patients, clinical observations and feedback, independent work, directed focused-reading, web-based modules, or practice in interpreting diagnostic test results. Other activities could include workshops or discussion sessions focusing on clinical reasoning and referral to a counselor or psychiatrist to address communication problems or professionalism issues. During the diagnostic phase and agreed management plan action, students could be motivated and empowered with responsibility for their own learning, thus promoting self-sufficiency and autonomy.

Retesting.

After completing the prescribed remedial activity, students are expected to repeat all or part of the original examination (supplemental examination), followed by a formal appraisal of their remediation. This appraisal will examine their preparation, participation, attitudes to the remediation process and its tutors, knowledge, skills and

interpersonal relationships with reference to their initial problem list. Records and reports relating to the remediation program are confidential and regularly updated throughout the year. Paper-based records are kept for access by faculty tutors and students. Senior tutors receive a formal report on their students' initial evaluations and subsequent progress. Students should be aware of this communication, which is designed to enable long-term monitoring of the student's progress in greater detail by senior tutors after the remediation is completed. The efficacy of remediation is determined by recording success of students in their retests or supplemental examinations. In addition, an anonymous postal/electronically administered survey is delivered to participating students. This survey addresses their views about the program, its usefulness and its impact on their studies. It also allows for renewal of the remediation program (Hauer et al., 2009). The remediation steps may not be prevalent in most medical schools. Medical schools vary in the intensity and scope of remediation offered to students who performed poorly on clinical skills and cognitive assessments. Although many schools invest in significant resources in remediation, the effect of these efforts on students' subsequent performance is unknown.

Chapter III: Research Design

Applying Program Theory to a Remediation Program

The research questions pertaining to this thesis are addressed by applying a mixed method data collection approach, utilizing document review, survey questionnaires and interviews, organized under the theoretical framework of program theory to a pre-clerkship remediation program; a case study. Specifically, a conceptual framework defining the resources, activities, and how these lead to attaining the expect effects of the remediation program, will be described. The program theory approach is utilized for the collection and organization of the data from students, faculty, and review of faculty documents. In addition, the theoretical framework of the logic model "*if -then*" statements will be applied for the discussion of the data.

Ideas about how material and human resources, and time, are invested to design and implement procedures or activities of a program and how these cause changes or benefits to clients/a target population are often referred to as program theory (Lipsey, 1993; Freddollino, 1999; Schmitz & Parsons, 1999; Sidani & Sechrest, 1999; McLaughlin & Jordan, 2004). Program theory can be thought of as underlying beliefs about how a program works. Implicit in these assumptions is that *if* the appropriate resources are organized into relevant sequence of activities*, then* these will bring about changes and how these activities are linked to outcomes of the program are expected to address a specific problem (McLaughlin & Jordan, 2004). The most important aspect of program theory is to clearly describe the series of processes that determines how a program works and what drives its outcomes (Chen, 1990; Cook, 1993; Lipsey, 1993;

Freddollino, 1999; Schmitz & Parsons, 1999; Sidani & Sechrest, 1999). Therefore program theory embraces aspects of formative evaluation (sometimes referred to as program improvement/informative evaluation) and summative program evaluation which focuses on whether a program works or not (Wholey, Hatry, & Newcomer, 1994; Patton, 1997; Jenkins, Ellwein, Boswell, 2009). The inputs, processes, and outputs are often referred to as the elements of the program theory (Wholey, 1983, 1987; Lipsey, 1993; Sidani & Sechrest, 1999). Some have also included as elements, the target population/clients and the appropriate extraneous factors (McLaughlin & Jordan, 1991). The elements of the program theory are categorized into six groups (Lipsey, 1993):

1. *Problem definition "*specifies what condition is treatable, for which populations, and under what circumstances, that is, statement of boundaries that distinguish relevant from irrelevant situations" (Lipsey, 1993, p. 11) for a particular program**.** A clear definition of the presenting problem is essential for designing the program and for identifying the target population.
2. *Critical inputs* describe what is needed and should be done to produce the intended activities and desired outcomes of a program. They specify the services to be offered, the activities to be performed, or the procedures to be followed for delivering the program as intended. They "provide the basis for judging the magnitude or strengths of inputs" (Lipsey, 1993, p. 11).
3. *Mediating processes* are the "intervening or mediating variables on which the process is contingent, and the crucial interactions with individual differences, timing, mode of delivery, or other relevant circumstances" (Lipsey, 1993, p. 11). They are the activities that constitute a program, and are necessary steps leading to

the program's outcomes. The mediating process can also be viewed as the series of changes that occur after receiving the program services and that, in turn, produce the desired outcomes.

4. *Expected outcomes* represent the effects or outcomes anticipated as a result of the program. They are the changes or benefits resulting from activities and outputs. The expected outputs are described by the ultimate outcomes and can be divided into short-term, intermediate, and long-term outcomes. (Chen, 1990; Lipsey, 1993).
5. *Extraneous factors* "include contextual or environmental factors that will significantly affect treatment processes" (Lipsey, 1993, p. 11). These factors include facilities, training of personnel, social conditions, organization factors, and characteristics of clients prior to entry into the program. These factors are broadly divided into antecedent and mediating variables. "Antecedent variables are those the program starts with, such as client characteristics, geographical variables and economic status. Where as mediating variables are the influences that arise as the program unfolds, such as staff turnover, new policies, and new competing programs" (McLaughlin & Jordan, 2004, p. 10).
6. *Implementation issues "*are aspects of the treatment delivery system relevant to its function of providing the specified treatment" (Lipsey, 1993, p. 11); they refer to the resources needed for carrying out the program services (activities and procedures)" The resources normally include material supplies and human skills that enhance the delivery of the program as intended. The materials needed can be classroom, written and reference materials, objectives, standardized patients,

tutorial sessions, and electronic resources. The human skills describe the expertise of the moderators or personnel providing the activities/procedures, including their knowledge, teaching and communication skills.

I have constructed a conceptual framework for operationalizing program theory (Figure 2), which has been adapted from Sidani & Sechrest (1999, p. 232).

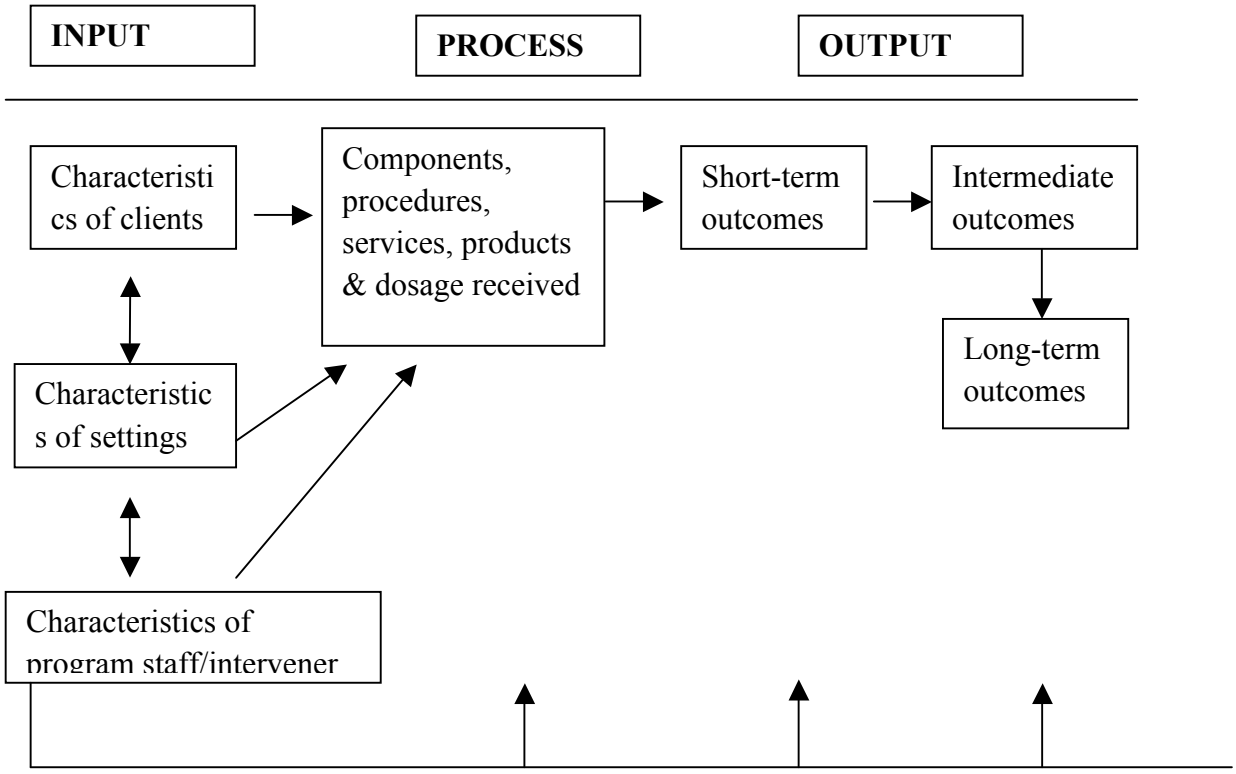

Figure 2. Conceptual Framework for Operationalizing a Program Theory: adapted from Sidani & Sechrest, 1999.

Sidani & Sechrest (1999) organized the elements as variables into an operational framework of three categories based on modification of the context-input-process product

(CIPP) model for evaluating educational programs (Stufflebeam, 1996; Stufflebeam & Shinkfield 1985):

1. *Input* "incorporates variables that reflect the problem definition, exogenous factors, and some implementation issues" (Sidani & Sechrest 1999, p. 233). It includes resources, participants' characteristics, settings, and program staff/interveners. These variables determine the delivery of the program services and/or effectiveness of the program in producing the anticipated outcomes.
2. *Process* includes variables that reflect the activities, procedures, and participation of the program. "Process operationalizes the following of a program theory: critical inputs, mediating processes, and some implementation issues" (Sidani & Sechrest 1999, p. 233). It includes activities and procedures believed responsible for leading to the expected outcomes of a program. The process represents series of activities that involves the delivery of the program.
3. *Output* reflects the expected outcomes (short, intermediate, and long-term outcomes) of a program theory (Sidani & Sechrest 1999). They represent the reasons for which the program is given and are often used as criteria for assessing the effectiveness or success of the program.

Logic Model

A logic model is a plan of a program. It is a useful tool for describing the relationships between the elements of the program theory (McLaughlin & Jordan, 2004). It can be thought of as a systematic way to present and share understanding of how the program will work and factors that make it work under certain conditions to solve identified problems (Bickman, 1987). It can also be the basis of understanding the relationships

among the resources to operate a program, the activities planned, and the changes or results to achieve. Furthermore, it is useful for providing stakeholders with a road map describing the sequence of activities connecting the needs for the program with its expected results. A logic model could bring program concepts and aspirations into reality (McLaughlin & Jordan, 2004). Therefore I will utilize the following components of the preceding conceptual framework to establish the "*If"* statements of a logic model.

IF:

1. The characteristics of the participants, program staff, and setting influence the mediating and outcome variables directly and indirectly.
2. The program component and dosage influence the short-term and/or intermediate outcomes.
3. The intermediate outcomes influence the ultimate outcomes (Sidani & Sechrest, 1999).

This will be followed by "*Then"* statements that will present and discuss the results. The *then* statement will explain how our remediation program works and then tests it against best practices through a comparison to the literature. It is essential that relevant information related to these components is collected from multiple sources, including program documents and policy statements, discussions with stakeholders, site visits and observations, interviews, surveys, and literature (Schmitz & Parsons, 1999; Freddolino, 1999; Sedani & Sechrest, 1999; McLaughlin & Jordan, 2004*)*.

Why this methodology?

Currently, we have no model or conceptual framework to describe our remediation program to share with faculty and students. Applying the "*if-then*"

statements of the logic model in a narrative style to describe our remediation program might provide remedial tutors, course directors, and other stakeholders with a clear description of the sequence of events connecting the needs of our program with its desired outcomes. This description could serve as a planning tool for us to develop program strategy and enhance program concepts and approaches to stakeholders. It could form the basis for a focused management and governance plan that helps identify data needed to monitor and improve our remediation programming. It also could also provide program information and progress toward goals in ways that inform faculty and students with a common shared understanding of remediation, and advocate for a particular activity or approach that has found to be effective in achieving the intended program outcomes. Effective evaluation and program success rely on the fundamentals of clear assumptions and expectations about how and why a program will solve a particular problem, generate new possibilities, and make the most of valuable assets; this approach could help us achieve this in our remediation program. Further, it could help create a shared understanding of and focus on our program goals and methodology, relating our planned activities to projected outcomes.

Research Objectives

Undergraduate medical curricula emphasize that for pre-clerkship students to prepare for clerkship training, residency and clinical practice, they must achieve competency in basic science knowledge. However, students may complete their preclinical studies without mastering defined basic science competency, and weak performers may never receive adequate feedback on biomedical knowledge that needs improvement. This problem may be widely encountered across the continuum from medical school to

practice (Hauer, et al., 2009) Therefore, medical schools need to identify and remediate students who have not achieved competency in basic science knowledge. Although medical schools have individualized remediation programs designed to help pre-clerkship students improve and overcome their deficits in biomedical knowledge, these are not standardized and have yet to be described in the literature. Currently, little is known about remediation plans used to remedy students' basic science knowledge deficits and their effectiveness. To address these problems, the objectives of this study are to:

1. Utilize the program theory approach as a theoretical framework to collect and present data on an existing remediation program at a Canadian Medical School.
2. Apply the "*if-then*" statements of a logic model to the pre-clerkship remediation to describe its strengths and weaknesses.
3. Propose a framework for systematic remediation of basic science knowledge deficits based on analysis of the existing program.

Research Questions

In order to address the research objectives, the following questions will be explored. The questions have been organized around the elements identified in program theory (Sidani & Sechrest, 1999):

1. Input/Resources
    a. What are the characteristics of struggling students?
    b. What are the characteristics of the setting?
    c. Who provides remedial activities?
    d. What material resources are provided?

2. Process/Activities
    a. How are students knowledge deficits identified?
    b. What learning plans are developed to address those deficits?
    c. What are the prescribed remedial activities/procedures of the learning plans?
    d. What theories of best practices of learning (e.g. student-centered learning, intervention education, and capacity to change performance) are the activities based on, if any?
3. Outputs/outcomes
    a. What are the consequences for retesting of students after our remediation?
    b. Does our remediation have lasting effect on student performance?
    c. What is the confidence and satisfaction in our remediation plan? For example, what are the views of students, remedial tutors, and program directors of the effectiveness, strengths, and weaknesses of our remediation process?

Setting and Participants

This study was carried out in a Canadian medical school. The subjects in this study were basic science faculty involved with the pre-clerkship program and pre-clerkship students (students in their first two years of study). The researcher of this study was also the Director of Remediation and Chair Committee of Evaluation Medicine I. He interacted extensively with both pre-clerkship students and faculty, in fulfilling his administrative and teaching duties. These duties came with a position of power and

authority in making decisions. As a result, pre-clerkship students and faculty may feel compelled, or under duress, to participate in this study if they were directly contacted and recruited by the researcher. Therefore, to address this situation, the researcher requested that a third party, the Students' Affairs Office, Faculty of Medicine, recruit the subjects by sending them invitations to participate in this study, followed by signing the Letter of Consent Forms. This office sent out the student survey questionnaires to all pre-clerkship students (approximately 206 students). Of these students, seventy-eight of 206 (38%) responded. Forty-seven of 107 were first year students compared to thirty one of 99 second year students. The faculty survey questionnaires were sent to 36 basic science faculty (who have accepted the invitations and signed the consent forms) involved with remediation in the pre-clerkship program, The Students' Affairs Office also sent invitations to basic science faculty in the pre-clerkship program to participate in the telephone interview after completing the surveys. Faculty and pre-clerkship students received up to 2 reminders to complete the questionnaires. This study was reviewed and approved by the Research Ethics Board.

Instruments and Measures

Survey questionnaire delivery.

Some of the survey items have been previously piloted, tested, and used in the design and development of remediation programs for medical students and residents after comprehensive skills examinations (Saxena et al., 2009; Hauer, et. al., 2008). The final survey instrument for faculty (Appendix A) and pre-clerkship students (Appendix B) contains questions on our remediation steps or activities, confidence in the remediation process, different learning activities, aspects of intervention education, measuring

constructs for the 'capacity to change' performance, and student-centered learning. The survey instrument was distributed via survey monkey. After an initial e-mail contact with the participants by the Students Affairs Office, non-responders were sent up to 2 follow-up e-mails.

Structured telephone interview.

Faculty participants, who had completed the surveys, were invited to complete a structured telephone interview (Appendix C) lasting approximately one hour with the researcher. This structured interview protocol ensured that all participants were asked identical questions. The interview protocol also included further probes or additional questions depending on where the interviewee was headed. This protocol included open-ended questions about strategies used to identify students needing remediation and verification of their scores, list of the types of difficulties encountered by struggling students, action plan for the identified difficulties, citation of evidence supporting the action plan, remediation outcomes, retest requirements, academic consequences of failing the retests, and comments on the strengths and weaknesses (satisfaction) of the remediation process. Non-responders were sent up to 2-follow-up telephone calls. No incentives were provided to participants for completing the interview.

Data analysis

Survey questionnaires.

The survey data was analyzed and reported to determine how much consensus or common themes emerged among the participants. Descriptive statistics (frequencies) using SPSS software version 15.0 for Windows (SPSS Inc, Chicago, Illinois) has been used to determine consensus among clinical remediation programs (Saxena et al., 2009;

Hauer, et. al., 2008). In this study, descriptive statistics of frequencies were computed for all responses of the survey items, (for example the number of faculty and students that responded, the number/percentage of faculty that verified a failing student's assessment scores before remediation, the percentage of respondents identifying web-based learning as a remediating activity, or the percentage of respondents that expressed confidence at the 'agree'/ 'strongly disagree' level in remediating the item domains) to determine common themes.

Structured telephone interview.

Telephone interview data on strategies used to identify students needing remediation and verification of their scores, list of the types of difficulties encountered by struggling students, action plan for the identified difficulties, citation of evidence supporting the action plan, remediation outcomes, retest requirements, and academic consequences of failing the retests, were recorded and transcribed verbatim. The transcripts were coded using the open and axial coding methods, as described (Saxena et al., 2009; Hauer et al., 2008). Coding was performed as transcripts became available. The ATLAS.T1 Version 5.0 Software (Scientific Software Development GmbH, Berlin, Germany; http://www.atlasti.de) was used to organize and retrieve coded data. It allows for the connection of visually selected passages, memos, and codes to identify common themes.

Review of faculty documents relating to evaluation and remediation

Meeting agendas, templates of letters sent out to remedial students, procedures and process documents on evaluation and remediation were all analyzed by reviewing for information pertinent to the plan and implementation of the remediation program. Poorly

defined information was further clarified by interviewing administrative and program staff. The documents were revisited regularly and rechecked to make sure that changes in the remediation program operations and process were taken into consideration.

Coding into elements of the program theory framework

The consensus data for the surveys, common themes from the transcribed-telephone interviews, and information gathered from faculty documents were then categorized into the elements of the program theory (Wholey, 1987; Lipsey, 1993; Sidani & Sechrest, 1999). Interviewee perceptions about the satisfaction, efficacy or rigor, of our remediation program, and the factors that influenced design and functioning, and the strengths and weaknesses of our program were also presented as elements of the program theory.

Chapter IV: Presentation and Analysis of Data

Using Program Theory as Theoretical Framework to Collect, Organize, and Analyze Data

A mixed methods approach was used to collect the data for this study; the benefit of a mixed method approach is that it can be used to triangulate data derived from smaller population, and that one data collection form supplies strengths to offset the weaknesses of the other form to understand a research problem (Creswell, 2005, p. 514). Data for this thesis was derived from the Undergraduate Medical Education (UGME) Progress Committee's documents, faculty and pre-clerkship students' surveys, and structured interviews with faculty. The program theory framework, where data is coded into input, process, and output (Lipsey, 1993; Freddollino, 1999; Schmitz & Parsons, 1999; Sidani & Sechrest, 1999; McLaughlin & Jordan, 2004), was utilized to collect the results. The data is then discussed using the narrative approach of a logic model (McLaughlin & Jordan, 2004). A logic model of a program after implementation helps explains the relationships between the elements of the program theory as they are observed (Leeuw, 2003). In this approach, the reader will see an "*if*" statement that introduces each component followed by a "*then"* statement that will present and discuss the results. The "*then*" statement will explain how our remediation program works and then test it against best practices through a comparison to the literature.

Results and Discussion of Input

Input is the first step in the program theory framework; it includes resources and other variables that affect the delivery of the program activities and services. I have incorporated factors that reflect the governance, policy and procedure, clear problem

definition, verification of scores, characteristics of remedial students and faculty tutors, resources and extraneous factors, required for the delivery of the remediation program.

IF: The characteristics of the participants, program staff, and setting influence the mediating and outcome variables directly and indirectly.

THEN:

Governance, policy and procedure.

Our remediation documents indicate that, the policy and regulations of the remediation program are developed by the UGME Progress Committee, and administered by the Office of Evaluation under the leadership of the Director for Remediation. The director reports to the UGME Progress Committee. This progress committee meets regularly to discuss the performance of all undergraduate students (pre-clerkship & clerkship) students. Two of the more important functions of this committee are a) to identify students who are having difficulties with their examinations; and b) to recommend formal remediation or other forms of assistance to those students who require it. The purpose is to preempt further difficulties, and to provide additional support and resources to enhance the potential of our students to address their learning deficiencies. To this end, students may be placed on 'probationary status' or 'monitored status' based on their performance. Although part of the role of the UGME Progress Committee and Evaluation staff is to build awareness of our remediation program among students and faculty, most of the participants (90%) expressed unfamiliarity with the remediation process. Only a very small number, mostly course directors and senior administrators, were familiar with the program. One participant, a faculty tutor, explained: "I don't know what the expectations of remediation are. My knowledge of remediation is very, very,

poor; they don't tell us anything about it." Another participant, a pre-clerkship student, commented: "It is confidential."

All the course directors expressed their concerns during the structured telephone interview that they are waiting for a better understanding of the expectations for the remediation process before expanding communication about the process to faculty tutors. A majority of the participants (94%) in this study suggested that there is lack of awareness and clarity about the remediation program.

Faculty respondents expressed the need for the remediation program to be centrally organized and mandated with common objectives and prescribed academic plans rather than left to individual course directors to arrange scheduling and implementation. This sentiment was clearly expressed by one faculty participant who commented: "The remediation program is not well organized centrally. It is left to course directors to organize. It should be centrally organized with specific structure."

Responses from student participants indicated that most (85%) felt that the administration of remediation was secretive and confidential, lots of rumors that create fear into students. However, students who self-indentified as having remediation (4 students) indicated that they did receive detailed information about the remediation, and had a positive experience.

Most students and faculty respondents (96%) expressed their concerns that:

1. All students are not provided with detailed information about the remediation program at the beginning of the academic year, including objectives.
2. There is lack of information about the resources available for remediation and how to access them.

3. The faculty website or handbook does not have information to communicate to students the policy, governance and process for remediation.
4. There is inflexibility in the remediation schedule

A review of faculty documents, UGME Progress Committee meeting agendas, and formal correspondences sent to remedial students from the Office of Evaluation, indicated that the UGME Progress Committee has been established to implement the rules and delivery of the remediation program, although there was no evidence of policy statements on remediation. This is consistent with the view that appropriate governance committee, notification, and documentation are all critical elements of implementing any effective remediation program (Goulet, Jacques, & Gagnon, 2005; Ratan, Pica, & Berkowitz, 2008). The rules and governance directly affects the information provided to faculty and pre-clerkship students about evaluation and remediation. The UGME Progress Committee is moving forward on drafting policy statements and stipulating the expectations of the remedial program.

Clear problem definition.

Despite wide spread endorsement (88.9%) from all respondents (faculty and students participants) for remediation of students who fail their block cognitive examinations, most, that is, 94.3% of those respondents felt that the main purpose of remediation is to reduce academic failure in pre-clerkship. One respondent commented: "I don't know what mechanism for accountability exists for the remediation process. I suspect the prevailing ideology at this medical school is to move people through pre-clerkship because it is not considered the most important part of the educational process."

Another respondent stated: “Remediation is meant to give you another chance to pass the supplemental examination.”

Interestingly, a small number of respondents (7.3% of total respondents) were of the opinion that remediation of failing students was unnecessary, and that they (failing students) should be made to repeat the year after failing a block. The sentiment from those respondents is reflected by one respondent who explained:

“I would like to recommend that students who fail exams repeat the block. This would be a normal standard of conduct in the working adult world. I find that there is an expectation among medical students that as long as they don’t exhibit pathological misconduct, they are entitled to graduate. When I read about medical schools in England where the lowest performers are weeded out every year, I think: that is really nasty, but it’s not all wrong.”

Although the faculty and pre-clerkship students viewed remediation as providing help for failing students to pass the supplemental examinations, however, the UGME Progress Committee has clearly stated (in correspondence documents to remedial students) that, the purpose of remediation is to provide additional support and resources to enhance the potential of failing students to address their learning deficiencies. The UGME Progress Committee’s view of remediation is consistent with that in the literature (Grubb et al, 1999; Hauer et al, 2009).

Common themes emerged from the faculty structured interviews and comments from the survey questionnaires. One of these themes: awareness and understanding of the remediation program revealed that both faculty and student participants suggested that clear, detailed information, and transparent communication, including objectives, would

address some of the anxiety and uncertainty surrounding remediation (Appendix D, 1). This theme is consistent with studies that have identified that clarification of expectations and procedure for remediation is a helpful intervention to foster successful student performance (Poorman, Webb, & Mastorovich, 2002). Therefore, this university should provide clear and transparent information on its remediation program.

Verification of scores.

A review of minutes from monthly meetings of the UGME Progress Committee indicates that steps are taken to ascertain that students with final over all grades of < 60% actually performed poorly and needed remediation. Verification is first performed by the Academic Lead, Evaluation. This consists of reviewing score reports and manual inspection of the answer sheets of the failing students to make absolutely sure that there is no machine error, or that answer options were clearly marked. Second, the Director of Evaluation also performs another manual inspection of the scores for the failing students and cross checks with the answer key. This is to avoid human and machine errors. After the release of results to all students, they are allowed to review their exam performance to verify their scores. This has the added effect of ensuring that a flawed checklist design or answer key from the Evaluation Office cannot artificially lower students' scores. The director of remediation also views the checklist of answers for the examination scores for students who would like a second look at their scores to ensure accuracy.

Characteristics of remedial students: motivation to change, insight into their learning problems, and capacity to change their performance in examinations.

In brief, a student is placed on probationary status when he/she fails a single block cognitive examination (score > 59.5%), and therefore is mandated to remediate.

Monitored status is reserved for students whose block cognitive examination performance is border line (61-63%). The descriptions of Probationary or Monitored Status are not meant to be punitive; the sole purpose is to identify students early who may have some difficulty (and who therefore may be at risk for future difficulty), so that timely and appropriate intervention can be provided. Students with other deficiencies (learning disability, medical and psychological problems) are referred to the Student Learning Centre and counseling services.

A review of faculty documents showed that most of the remedial students were identified as a result of poor performance in medicine II (second year of the pre-clerkship program), specifically due to failure in the block V and VI examinations. However, it is rare to find remedial students in medicine I

Faculty tutors were asked how often they assessed remedial students for some measures of the "capacity to change performance," such as insight, neuroticism, and anxiety (Appendix E)**.** The results showed that faculty tutors:

1. Never assessed self-reflection, neuroticism, acceptance of feedback, depression, social networking with other students, and openness to new ideas, and setting priorities and time to finish assigned tasks.
2. Assessed (less than half of the time) motivation to change, obsessively concerned with grades that hinders performance, anxiety, and taking responsibility for problems.

The remediation process should involve assessing students for their "capacity to change performance." because measuring the "capacity to change performance (extent of the knowledge and skills to recognize strengths and weaknesses, motivation to change,

neuroticism, depression, and anxiety) of failing students has been shown to be important for determining whether or not they could benefit from remediation (Hays et al, 2002; Cleland, Arnold, & Chesser, 2005), or corrective action actions taken (Langendyk, 2006). This is even more so, since a majority of students and faculty respondents (96%) expressed their concerns that remedial students have not acquired the necessary skills to address their learning deficiencies.

Characteristics of faculty tutors.

Eleven of 36 (30.5%) faculty, directly involved with the pre-clerkship program as instructors, responded to the survey. Of the 11 faculty survey respondents, 6 were course directors (4 of the course directors consented and participated in the structured telephone interview). On average, the faculty survey respondents had been in their role for at least 3 years; the 4 course directors who participated in the structured telephone interview had been remediating students for the past 5 years. None of the survey or telephone interview respondents withdrew from the study.

A theme emerged from the faculty structured telephone interview, which indicated the lack of expertise in remediation practices*:* The lack of faculty's knowledge on the use and application of best practices of intervention remediation, and how to use different educational tools to diagnose specific learners' deficits should be addressed through faculty development program. As one faculty member, a course director, commented: "I have been very active. However, we need a methodology that enables me to engage students"

Therefore, this university should provide professional development in remediation for faculty tutors to develop expertise in diagnosis of learning deficits, and acquire best

practices in intervention education and learning theories. In support of this action, several studies have shown that, one of the critical factors to support student academic enhancement for addressing their learning deficiencies is interaction with supportive expert tutors (Ericsson, Krampe, Tesch-Römer, 1993; Sosniak, 2006; Tsui, 2009).

Faculty respondents were asked how often they utilized the following best practices of intervention education in the remediation program: taking initiative to contact students and responsibility to arrange a follow-up meeting, devoting significant time to remediation, helping students build their cognitive learning skills, being approachable, and creating a positive learning environment to develop students' inquiry. The responses from faculty shown in Appendix F showed that most of the time, faculty tutors:

- Took the first initiative to contact students for scheduled and follow-up meetings.
- Devoted significant time to remediation.
- Were approachable.
- Created a positive learning environment to develop students' inquiry.

Certain ingredients are central for designing successful interventions for underprepared students, such as establishment of a good relationship between tutor and student, tutor taking the initiative to contact students or "expecting", tutor taking the responsibility to arrange a follow-up meeting, tutor devoting significant time, building skills within a real-world context as opposed to abstract approach, tutor is approachable, and tutor created a positive learning environment to develop students' inquiry (Levin & Kiosk, 1998; Malik, 2000; Bloom, 2005). Some of these ingredients have been incorporated into our remediation program, as noted above. For example, faculty tutors

contacted remedial students for follow-up meetings, provided support and a positive learning environment, and were approachable. In addition, failing students were formally informed by the UGME Progress Committee to discuss any concerns about remediation they would like addressed with the director of remediation.

However, in contrast, faculty tutors did not provide enough guidance to remedial students to build cognitive learning skills. Faculty tutors felt that their clinical responsibilities, research commitment, and other departmental services, prevented them from full participation in the remediation process, especially at time of planning for their summer holidays.

Resources.

Remedial students could also be referred by the Assistant Dean, Student Affairs to the following resources: The Learning Assistant Centre, Disability Services, Student Counseling Services, and Clinical Skills Centre, and Office of the Associate Dean, Professionalism. These resources are essential because learning deficiencies in some failing students can occur for several non-academic/cognitive reasons including stress due to financial, social relationships (Sayer et al, 20020, learning disabilities (Walter & Croen, 1993), underlying medical and psychological conditions (Rosal et al, 1997), and lack of motivation (Ross, Cleland, & Macleod, 2006). Indeed, the referral provided by the Assistant Dean Student Affairs addresses this issue, of non-cognitive learning deficiencies in our medical school.

Further, most students and faculty respondents (96%) expressed their concerns that additional resources, such as financial reward were required for recruiting remedial tutors to support individualized remediation, writing up instructional tests questions for

formative question banks that could be used to identify struggling students earlier in the courses. Also, faculty tutors concluded that they are reluctant to engage their colleagues for assistance with remediation, until the relevant resources are available as it is unlikely to gain support when they are away on summer holidays, the period for remediation. This opinion expressed in the faculty survey is consistent with one of the themes that emerged from the structured telephone interview: insufficient resources and unprotected time, which indicated that faculty felt that their clinical responsibilities, research commitment, and other departmental services, prevented them from full participation in the remediation process, especially at time of planning for their summer holidays (Appendix D, 3). Other resources, such as financial reward for recruiting remedial tutors were required.

Extraneous factors.

Most of the student respondents (95%) expressed the following concerns that could hinder their participation in the remediation:

1. Social stigma and shame that comes with failure.
2. Enrolment in other programs during summer, such as the B.Sc medicine, and clinical exposure in rural areas.
3. Rearrangement of travel plans.
4. If it is mandatory.
5. Financial hardship as summer jobs will have to take second place to remediation. Consistent with this view, one student participant commented: “It is definitely something to be dreaded, though mostly because it takes up free time in the summer.”

Most faculty (10 of 11 faculty tutors) expressed that their effective participation in the remediation was hindered by the following:

1. Lack of clarity about the remediation process.
2. Lack of transparency about the policy and governance of the remediation.
3. Expectations of the methodology that will enable faculty to effectively engage students.

On the other hand, most of the faculty thought that their participation was enhanced by the following:

1. Scheduling of remedial sessions.
2. Remediation activities organized for groups of remedial students rather than individualized remediation.
3. Use of electronically managed learning activities.

Results and Discussion of Process

The next step in the program theory framework is process; it encompasses the steps taken to produce the program outcomes. Process should also take into account the series of changes that take place after receiving the program services and that lead to the desired program effects. Process puts into operation the following activities: Performance review and identification of learners' deficits, development of academic plan and learning contract, and development of learning activities, and use of learning activities with deliberate practice, timely feedback and reflection.

*IF***:** The program component and dosage influence the short and/or intermediate Outcomes,

THEN:

Performance review and identification of learners' deficits.

A total of 10 of 11 faculty respondents did not conduct any individualized performance review session, in which a failing student met with the faculty tutor or a designated faculty member to discuss the examination results. For example, which questions were answered incorrectly or correctly, and at what level of learning? Such sessions explore reasons for the poor examination score through probing and semi-structured interview questions. With the exception of the one faculty member who conducted individualized performance review and diagnostic activity sessions with failing students, invariably faculty tutors reviewed the performance on their own in the absence of failing students. They also came to a general diagnostic conclusion for all failing students' difficulties without specifically pointing out their individual deficiencies. As one of the faculty respondent explained: "I don't have the time with my busy clinic to schedule appointments for each student on remediation. I think generally they lack knowledge and need to study harder, and attend all lectures and tutorials."

The faculty tutors that did performance reviews without involving the students also took the responsibility of addressing the deficits for the failing students. The students were not given the opportunity to provide, at least, their perception for their deficits. There were no attempts made to ascertain whether the failing students were ready for the remediation, no analysis of their deficits, or recommendation for how to address their specific deficits. Furthermore, the failing students were grouped to attend remedial meetings with faculty without individualized attention This difficulty in finding qualified faculty tutors and securing the faculty time needed to offer individual attention to failing students, were commonly cited weaknesses of the remediation process. One faculty

respondent complained: “As clinical faculty, I have very little time to spend with students, and this causes me not to be rigorous with the remediation process.” Remedial education has been shown to have the greatest impact on the learner when it is individualized, highly interactive, and delivered in a meaningful context (Johnson, 2004), therefore our remediation process should not involve group remediation of failing students, and lack of students input into their remediation.

Development of an academic plan and learning contract.

Only one of the 11 faculty respondents has required that failing students develop their own learning plans. However, even this respondent did not require any commitment from those students to a learning contract. The majority of faculty (10 tutors) never expected or encouraged students to generate their own academic plans, or to sign a learning contract. The students (98%) also indicated they have never engaged in developing an academic plan or signed a learning contract. The lack of active participation of students in their remediation is contrary to the evidence of best practices in remediation. For example, several studies have demonstrated that student-centered learning is important for effective remediation, which makes explicit what a learner will do to achieve specified learning outcomes: signing a learning contract, outline learning objectives, identify learning resources and activities, specify time lines to complete assigned tasks, and develop schedule for learning activities (Knowles,1986; Richardson, 1987; Schoolcraft, 2000). In this regard, therefore our remedial students should sign a learning contract, identify their learning deficits, develop their individualized plan and learning activities, rather than faculty solely prescribing learning activities for them.

Development of learning activities.

Faculty tutors were asked how often they used different learning activities with remedial students. The result (see Appendix G) showed that faculty respondents (11 tutors) employed a uniform approach for all failing students irrespective of their specific deficits. The learning activities (more than half of the time) prescribed were:

1. Self-directed/independent study.
2. Practice questions for self assessment.
3. Faculty tutoring for groups of failing students.

Almost all of the student respondents (93.7%) expected faculty tutors to provide them with a list of learning strategies if they had to remediate.

Our remediation program should be tailored to the learner's specific learning deficits, rather than faculty tutors prescribing the same academic plan for all remedial students because several studies have shown that the development of cognitive expertise is domain and task specific, and needs to be scaffold in terms of the learning stage/difficulty level (Qian & Alverman, 1995; Ge & Hadré, 2009),

Use of learning activities with deliberate practice, timely feedback, and reflection.

All 11 faculty respondents indicated, as shown in Appendix H that, they did not monitor or assessed the following learning activities for remedial students:

1. Deliberate practice overtime of learning activities.
2. Sought additional experience and learning opportunities in other settings.
3. Provided timely feedback on the learning activities to students.
4. Reflection on learning activities.

Our remedial students should be guided by faculty to monitor their own performance accurately in light of external standards, coaching in self-reflection, and getting timely feedback from faculty, since evidence shows that deliberate and conscious practice, and self reflection under the guidance of experienced mentors who can offer specific and timely feedback are important features for improvement and success in remediation (Hauer et al, 2009). In addition, as development of learners' cognitive expertise (gaining knowledge and learning skills) requires deliberate practice (conscious and focused) to make improvement in performance (Pangaro, 1999; Hendricson & Kleffner, 2002; Ericsson, 2004), the remedial students should be monitored and given opportunity to practice overtime, in contrast to the four weeks of remediation period imposed by the UGME Progress Committee.

Results and Discussion of Output

Output is the last step in the program theory framework; it represents the effects or outcomes anticipated as a result of the activities of a program. They constitute the reasons for which the program is given and are used as indicators for the effectiveness of a program. The following measures constitute the output: Retesting, rigorous retesting, confidence and satisfaction of the remediation program.

IF: The short and intermediate outcomes influence the ultimate outcomes**,**

THEN:

Retesting.

Retesting of all failing students is a requirement for them to progress to the next stage. After remediation, students are expected to complete the supplemental examination and obtain the passing grade of 59.5% (the same level of performance required for the

final block examination). The supplemental examinations are supposed to be at the same level of difficulty and modalities as the final block examinations. This is to ensure that acceptable levels of performance have been achieved. It is assumed with the supplemental examination that remediation efforts have succeeded and that the failing students are deemed competent enough to have addressed their particular deficiency. Analysis of data on the performance of failing students in the supplemental examinations from 2005-2009 showed that over 99% of those students were successful to progress to the next level, as shown in Table 1:

Table 1

Distribution of Students' Performance Status: 2005-2009*

Pre-clerkship Year	Number of students on Monitored Status (struggling students): Probationary Status (Failing students): Passed supplemental Examination: total number of students sitting to the examinations (*n*)				
	2005	2006	2007	2008	2009
Medicine I: First Year	5:0:0:98	3:0:0:100	4:1:1:107	2:1:1:106	4:0:0:107
Medicine II: Second Year	8:6:6:97	6:7:7:98	5:6:6:99	7:9:9:101	5:8:8:104

***** *Excludes the number of students who were on deferral and on Monitored Status (scored 60-63%) or failed (< 59.5%, on Probationary Status) for the Medicine I Formative Objective Structured Clinical Examination (OSCE) and Medicine II Summative OSCE.*

In fact, so far only one student has been recorded to have failed the supplemental examination after remediation because that student did not appear for the supplemental examination due to personal problems. Incidentally, that student was granted another chance to rewrite the supplemental examination, and was successful. Nevertheless, all

the faculty respondents (11 tutors) did not feel that the supplemental examinations addressed particular students' deficiencies since there is no evidence or data to support this assumption, although virtually all students normally pass the supplemental examination as noted above. As one respondent suggested:

"Passing the supplemental examination does not necessarily mean overcoming the academic problem, because students can still fail the same subject discipline as before and compensate for this failure by achieving higher grades in other subject disciplines (that they were already successful in attaining high grades); show me the evidence." Another respondent lamented that:

"Those students will still keep on having academic difficulty even after remediation because the supplemental examinations appear to be less difficult since we don't really generate enough new questions for this examination. There is a significant amount of overlap between the final and supplemental examinations."

Rigorous retesting.

A majority of students and faculty respondents (96%) expressed their concerns that:

1. Remediation is not rigorous enough
2. Students focused just on passing supplemental examination

Faculty respondents lamented that they could not know whether students did obtain pass marks in subject discipline that they had failed previously in the final examination prior to the supplemental examination. One faculty respondent commented that: "Is it my responsibility to help them pass the supplemental examination or is the goal to make sure that they have the knowledge base to apply to clinical problems?"

All Faculty respondents raised serious concerns about the lack of rigorous outcome data regarding our supplemental examinations. This concern is consistent with a theme that emerged from the faculty structured telephone interview: uncertainty about the performance data of remedial students and the consequences of failing the supplemental examination. This indicated that faculty struggled to understand the details of the performance measures in specific subject disciplines that caused the students to remediate. The lack of institutional research capacity to analyze the performance data before and after the supplemental examinations hampered the ability of faculty to understand whether remediation was having the desired effects (Appendix D, 2). One faculty participant acknowledged that: "students focus on passing the next examination. We need to refocus them on bigger skills. Students disengage."

Although, our assumption about our remediation is that failing students' deficits are addressed, this has never been ascertained by any empirical data. Our assumption that our remediation efforts have succeeded because failing students have achieved a pass mark needs to be reexamined in the absence of any data showing that failing students who passed the supplemental examination overall have also successfully made significant improvement in the subject discipline that they had failed in the first place. That is, they have corrected their deficiencies.

Confidence and satisfaction.

The confidence and satisfaction data of the remediation program from the faculty survey responses is summarized as shown in Table 2:

Table 2

Summary of Faculty Survey Data on Confidence and Satisfaction in the Remediation Program

Confidence statements:	Mean value*
I am confident in our supplemental examination scores.	3.0
I am confident that our school's remediation program is effective.	1.0
I am confident in our ability to remediate knowledge deficits.	2.1
Satisfaction statement: I am satisfied that our remediation program is properly administered.	2.3

**Mean value is derived from 5-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree (neutral), 4 = agree, and 5 = strongly agree. n = 11(number of faculty respondents).*

Faculty respondents were confident with the comprehensive assessment supplemental examination scores. However, faculty's confidence in remediating knowledge deficits and effectiveness of the remediation program itself was below the "agree" level. Similarly, the level of faculty's satisfaction with the remediation program overall was below the "agree" level.

This university could instill confidence in students and faculty about the remediation program by restructuring the supplemental examinations to test only the areas of learning deficits in specific disciplines or subjects, and require a passing grade in

those areas, rather than an overall passing grade, because a customized assessment methods addressing selected areas of deficits are required for remediation to achieve desired effects (Hauer, et al. 2007; Hauer et al., 2009). In addition, outcomes-based research results could be utilized to demonstrate a change in performance of remedial students, since outcomes-based research have been shown to ensure acceptable level of performance (Hauer etl al. 2007; Hauer, et al., 2009).

Chapter V: Conclusion

Summary of Results

The participants described a remediation process that was administered and monitored by the UGME Progress Committee, and included verification of scores. However, participants suggested that there was lack of clarity and transparency about communication of the expectations of the remediation program. Faculty participants raised concerns about insufficient resources and unprotected time to fully engage in the remediation process. This remediation process did not involve diagnosis of specific learner's deficits and students were not encouraged to actively engage in their own remediation. Consequently, there was no development of an academic plan, prescribed learning, or learning contract to encourage student centered learning. Faculty expressed lack of knowledge on the use and application of best practices of learning theories, intervention education, and how to use different educational tools to diagnose specific learner's deficits. A majority of participants admitted uncertainty about the efficacy of the remediation process and outcomes. The absence of rigorous supplemental examinations to test whether or not students have addressed their specific learning deficits may reflect decisions to allocate limited resources to instructional activities coupled with lack of outcomes-based research.

Recommendations

Based on my analysis and review of the literature on selected topics in the learning theories on intervention remediation, I suggest the following are changes that could be incorporated into our remediation program to enhance existing efforts:

Input.

1. The lack of awareness and clarity about the expectations of remediation for both faculty tutors and failing students should not be surprising. A clear and transparent communication about the expectation of remediation would allay some of the uncertainty and anxiety surrounding the effort and help build support for it.
2. Significant resources should be invested to recruit faculty and facilitate faculty development in remediation practices to produce qualified remedial faculty tutors.
3. Before failing students engage in prescribed learning activities, they should be assessed or counseled for their 'capacity to change performance'
4. If faculty expects that remedial students should have the capacity to change, then, likewise this requires change in faculty to meet students' needs. Specifically, the attitude of clinical faculty of being "too busy" with their clinics to devote significant time to remediation has to change. The change in faculty will require a significant shift in the culture of teaching in medicine. Clinical faculty have to remember that expert modeling and scaffolding is important for change in students (Ge & Hadré, 2009)**.**

Process.

5. Failing students should be supervised by faculty tutors to be active participants in their remediation through student-centered learning practices (e.g. learning contract) so that they can diagnose their learning deficits and develop their individualized learning plan, and learning activities. The emphasis on individualized learning deficits and plans was supported by most students. As one participant, a student

commented: “I don’t know enough to give recommendations. One on one instruction and flexibility would be important to me.”

6. Failing students should be monitored to engage in those learning activities with deliberate practice, immediate feedback, and reflection.

Output.

7. In the absence of any rigorous data to support our assumption that our remediation program has succeeded and that failing students are deemed competent in basic science knowledge, we need to take appropriate action if remediation does not achieve the desired results. This could mean that, our remediation efforts must be coupled with outcomes-based research to demonstrate a significant change not just in the overall performance but also in the subject discipline failure that led to the remediation.
8. The culture of “perfectionism” in medicine (Enns, Cox, Sareen, & Freeman, 2001), which means that medical students are hardly subjected to failure, has to be reexamined in light of the fact that individuals with poor performance may be beyond the capacity to change (Hays et al., 2002). One participant, a faculty tutor directly involved with remediation, commented: “We need to allow student failure.”

Proposed Framework for a Remediation Program

Medical educators and accrediting organizations like the AFMC and LCME (2009) have mandated that pre-clerkship students must achieve competency in the basic sciences to prepare for clerkship rotations, residency training and eventually clinical practice. Therefore, medical schools need to identify and remediate students who have not achieved basic science knowledge competency. When deficits go undetected or

unaddressed, physician performance and patient safety are jeopardized. For example, performance problems in the domains of basic and clinical science knowledge have been linked to subsequent disciplinary action by state medical boards (Papadakis, Teherani, & Banach, et al, 2005; Papadakis, Arnold, Blank, Holmboe, & Lipner, 2008). Therefore, it would seem important to have effective remediation strategies to address a lack of competence in basic science knowledge for pre-clerkship students before advancing to clerkship. However, a review of the literature on remediation of the deficiencies in basic science knowledge in UGME yielded surprisingly only one study that described performance improvement after a tutorial intervention for pre-clerkship students who fail an in course cognitive examination (Schwartz & Loten, 1998). This paucity of studies on remediation interventions of basic science knowledge deficits is concerning, and it highlights the need for medical schools to perform more large-scale, outcome- based remediation programs and to share the results of those programs. To address the concern of the lack of remediation strategies for preclinical basic science knowledge deficits, the purpose of this study was to describe our own basic science remediation program through applying the concepts of logic model (Lipsey, 1993; Freddollino, 1999; Schmitz & Parsons, 1999; Sidani & Sechrest, 1999), and to determine whether our remediation program is supported by best practices of the learning theories including intervention education (Malik, 2000; Poorman, Webb, & Mastorovich, 2002), student-centered learning (McAllister, 1996), and the 'capacity to change performance' (Hays, Jolly, Caldon, McCorrie, McAvoy, McManus, & Rethans, 2002). Specifically, we sought to identify strengths and weaknesses in our remediation program, and propose recommendations by replacing weaknesses with the best practices of the learning

theories, leading to an improved remediation program. Efforts at enhancing remediation are most likely to occur at the UGME, where there is centralized oversight of the learners and where assessment is a routine part of the educational environment. However, there is surprisingly little evidence to guide “systematic remediation” in UGME. It is better to develop a logic model before a remediation program is designed and implemented. The logic model narrative approach to remediation of basic science knowledge deficits in this study point to a remediation framework that includes: the need for clarity about expectations for remediation, active student participation for identifying deficiencies, individualized instruction, and deliberate practice followed by feedback, reflection, and outcomes-based research reassessment. Application of a logic model approach to remediation could provide conceptual framework from which other medical schools could develop and implement a similar system of remediation process into their programs. Consequently, medical educators using a logic model approach to their remediation could adjust approaches and change courses, systematize program activities, progress toward goals in ways that inform, advocate for program resources, and inform policy decisions. Establishing an effective approach to remediation requires collaborative efforts and an understanding of the scholarship on models of remediation. In this way, if one remedial approach is more effective than another, it could become a valuable tool to be incorporated into remediation schemes for failing students. A remediation framework based on a logic model is proposed, as shown in figure 3.

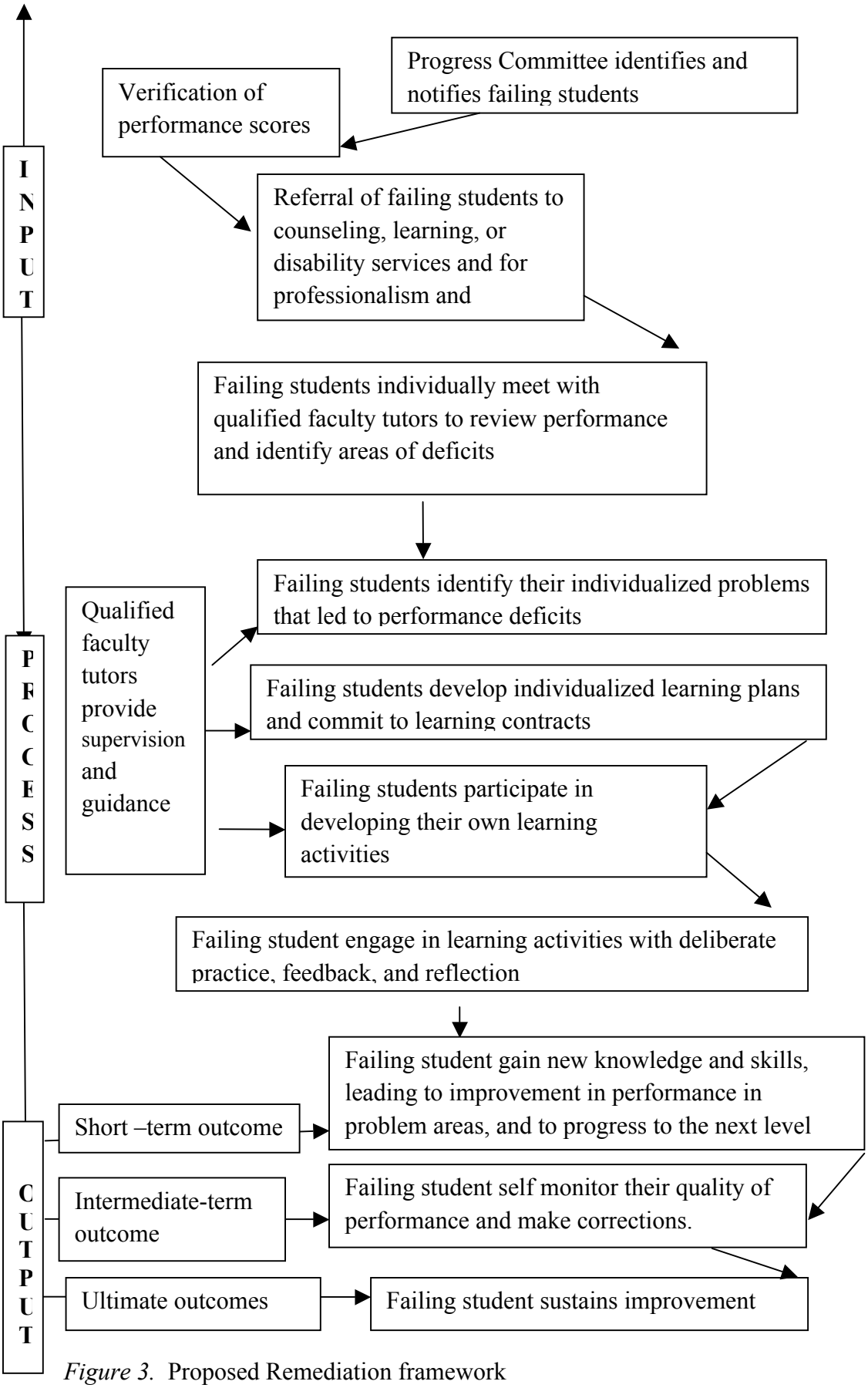

Figure 3. Proposed Remediation framework

Scope of the Study

This study is limited in several circumstances. Although the framework in figure 3 is representative of information gathered from data solicited from the participants, it would have been very reassuring if several rounds of discussion took place with the stakeholders to get their perspectives on the assumptions underlying the framework. As this was not possible due to time limitation, the credibility of this study cannot be absolutely ascertained because the participants are they only ones who can legitimately judge the credibility of the results. However, their perspectives and experiences were clearly represented in this study by including several direct quotations from them in the text. These quotations lend some credibility to this study. In addition, data from which this framework was developed is dependable because there was no rejection or retraction of survey or interview responses by the participants, nor was there any change in the setting and context of the remediation program. Although the sample response rate for this study was significant for a mixed method study, it should be emphasized that perceptions of faculty and student respondents might be differ from those of other faculty and students at this medical school.

Although the remedial framework only addresses deficits in basic science knowledge after a comprehensive cognitive examination, certain attributes of the learning theories and intervention education useful for remediation that were included in the framework, such as deliberate practice, timely feedback, reflection, and student centered learning can also be applied to remediation for deficits in skills in gross anatomy/practical courses, or to problem-based or team-based learning, where other learning behaviors apart from content knowledge are examined. Therefore, the type of

basic science knowledge under consideration is not a limiting factor. This broadens the transferability of the model. Duration for which the students receive the remedial program will be crucial in determining its rigor and efficacy in different contexts.

Consistent with previous reports in the literature, the preparation of the addendum and learning contract and follow-up meetings and documentation of students completing prescribed academic activities are time consuming for faculty (Hauer et al., 2007; White et al., 2009; Gallant, MacDonald, & Higuchi, 2006). The remediation process must be assessed for fit with existing academic regulations and policies before implementation. The potential exists for a failing student to appeal the process and/or it outcome if any step in the remediation process conflicts with current regulations. Before implementation, it is advisable to consider the potential positive and negative outcomes of the process and have policies in place that mitigate these outcomes. For example, a failing student's voluntary withdrawal or leave of absence from a preclinical course or year before remediation is initiated or before a final grade is assigned, thereby avoiding the potential of a failing grade on his/her academic record. In addition, the coding of the transcribed verbatim interview data (Appendix I) may have not been saturated with the emerging themes. So, some useful themes are potentially missing. It is noteworthy that no system of remediation, irrespective of how effective it is, can alleviate medical students' stress entirely, nor will any remediation system meet the demands of all students completely; the framework that is proposed from this study is no exception to these rules.

Appendix A: faculty survey

I would appreciate your assistance with my research: Systematic Approach to Remediation in Basic Science Knowledge for Pre-clerkship Medical Students: a case study. You are being invited to complete this survey after signing the Letter of Consent Form (Appendix J). The survey will take approximately 30 minutes. I would like to gain an understanding of the program strengths, weaknesses, and potential areas of improvement by reviewing faculty and students' experiences, expectations, and suggestions for change. Information collected through this survey will not identify any individual respondent. Survey data will be reviewed by me and potentially identifying information will be removed before response transcripts are recorded, analyzed, and published. The results will be disseminated as aggregate data only.

Using the following 1-5 scale, please indicate, by circling the most correct response, the degree to which you utilized the following activities with remedial students: 1: Never 2: Less than half the time; 3: about half the time; 4: more than half the time; 5: always

1. Process/Activities: Use of learning Activities

1 2 3 4 5 a. self-directed/Independent study

1 2 3 4 5 b. Directed-focused readings

1 2 3 4 5 c. Directed web-based reviews

1 2 3 4 5 d. Faculty tutoring for groups of failing students

1 2 3 4 5 e. Practice questions for self assessment

1 2 3 4 5 f. Seminars on examination preparation skills

1 2 3 4 5 g. Problem-based learning sessions

1 2 3 4 5 h. Review of instructional tests

1 2 3 4 5 i. Concept mapping study skills

1 2 3 4 5 j. Revision sessions

1 2 3 4 5 k. Other activities (list and score for other activity/ies)

2. Inputs/Resources: Practices of Intervention Education

Based on literature in higher education, there are some ingredients central for designing a successful intervention for underprepared students (Levin & Koski, 1998; Malik, 2000; Poorman, Webb, & Mastorovich, 2002; Bloom, 2005). Using the same scale, please assess how often you utilized these as a tutor.

1 2 3 4 5 a. Taking initiative to contact students

1 2 3 4 5 b. Taking the responsibility to arrange a follow-up meeting

1 2 3 4 5 c. Devotes significant time to remediation

1 2 3 4 5 d. Help student to build cognitive learning skills

1 2 3 4 5 e. Approachable

1 2 3 4 5 f. Create a positive learning environment to develop students' inquiry

3. Inputs/Resources: Measuring Capacity to Change Performance

Some students who perform poorly, or are struggling, need to acquire new knowledge and skills to change their performance. In this context, remediation implies that those students have the capacity to change performance. Determination of the capacity to change includes measures of some constructs, such as: insight, motivation, professional and social network, learning behavior and personality, which may trigger or contribute towards change in performance (Hays et al., 2002; Eisen, et al., 2001; Amador & Kronengold, 1998; Andrewes, Hordern, & Kay, 1998). Using the same scale, please

assess how often do you measure or assess to see if your remedial students exhibit these characteristics:

1 2 3 4 5 a. Insight/awareness of weaknesses and strengths

1 2 3 4 5 b. Self-reflection

1 2 3 4 5 c. Motivation/desire to change

1 2 3 4 5 d. Obsessively concerned with grades that hinders learning

1 2 3 4 5 e. Neuroticism/negative thoughts about self confidence

1 2 3 4 5 f. Anxiety/stress

1 2 3 4 5 g. Setting priorities and time to finish assigned tasks

1 2 3 4 5 h. Openness to new idea

1 2 3 4 5 i. Acceptance of feedback

1 2 3 4 5 J. Depression

1 2 3 4 5 k. Taking responsibility for problems

1 2 3 4 5 l. Social networking with other students

1 2 3 4 5 m. Others (list and score other constructs not mentioned above.

3. Process/Activities: Different learning activities promoting student centered or active learning

Traditional medical curriculum concentrated on teaching rather than learning and facts rather than concepts. A more modern view places emphasis on adult learning theory, learning contracts (McAllister, 1996), or problem solving skills (Newman & Peile, 2002; Chan & Wai-tong, 2000). These learning activities have been incorporated into remedial programs (Gallant, MacDonald, Higuchi, 2006), and shown to improve

students' performance (Lutz, Wilkinson, & Sainsbury, 2003; Cleland, Arnold, & Alistair, 2005). Using the same scale, please assess how often your students have:

1 2 3 4 5 a. Developed or generated their learning objectives

1 2 3 4 5 b. Contributed to finding additional learning resources and activities

1 2 3 4 5 c. Being well prepared and completed their learning objectives on time

1 2 3 4 5 d. Provided feedback on the types and sources of evidence for learning

1 2 3 4 5 e. Provided criteria for evaluating evidence on their learning objectives

1 2 3 4 5 f. Appraised their own performance and that of an external criteria

1 2 3 4 5 g. Reflected on academic progress

1 2 3 4 5 h. Sought additional experience and learning opportunities in other settings

1 2 3 4 5 i. Others (list and score other activities not mentioned above)

5. Output/outcomes: Confidence and Satisfaction

Please indicate your confidence level for the following items with 1 being the least confident and 5 being the most confident:

1 2 3 4 5 a. I am confident in our supplemental examination scores

1 2 3 4 5 b. I am confident that our school's remediation program is effective

1 2 3 4 5 c. I am confident in our ability to diagnose knowledge deficits

1 2 3 4 5 d. I am satisfied that our remediation program is properly administered.

6. Output: outcomes

Please take a few moments to provide your perspectives on the remediation program and its outcomes by filling in the comment boxes below:

Please type your comments in the boxes below:

a. What do you feel is important for me to know about the remediation program?

b. What would be your suggestions for change?

c. What factors enabled or hindered your participation in the remediation program?

Appendix B: pre-clerkship students' survey

I would appreciate your assistance with my research: Systematic Approach to Remediation in Basic Science Knowledge for Pre-clerkship Medical Students: a case study. You are being invited to complete this survey after signing the Letter of Consent Form (Appendix J). I would like to gain an understanding of program strengths, weaknesses, and potential areas of improvement by discussing with faculty and students their experiences, expectations, and suggestions for change. The survey will last approximately 30 minutes. Information collected through this survey will not identify any individual respondent. Survey data will be reviewed by me and potentially identifying information will be removed before responses are organized into data themes and analyzed. Results will be disseminated as aggregate data.

Please type your responses in the boxes below each question:

1. Inputs/Resources**:** What is your understanding of the remediation process in the pre-clerkship program?
2. Output: What are your expectations of the remediation process?
3. Input: Please comment on how you feel about the environment created in the faculty around the issue of remediation.
4. Output: What do you think are the weaknesses of the remediation program policies and regulations?
5. Output: What do you think are strengths of the remediation program policies and regulations?
6. Input**:** What do you think would hinder your participation in the remediation program?

7. Input**:** Would you feel confident to seek remediation, and if so why?

8. What would you like to recommend in the remediation program?

Appendix C: faculty structured telephone interview

I appreciate your willingness to be interviewed today. As it was indicated to you earlier, the purpose of this interview is to assist with my research: Systematic Approach to Remediation in Basic Science Knowledge for Pre-clerkship Medical Students: a case study. You are being invited to participate in this interview. I would like to gain an understanding of program strengths, weaknesses, and potential areas of improvement by discussing with faculty and students their experiences, expectations, and suggestions for change. The interview will last from 40-60 minutes. Before we start, I will describe the nature of my interview questions. Please, also be aware that depending on how you answer the questions, further probing questions may follow.

I will record the interview using a digital recorder and take field notes at the same time. Please feel free to ask me to turn off the recorder at any time. An informal copy of the summary report will be made available to all interviewees. Please contact me if you would like the copy. Your participation in this interview will be taken to indicate your consent to participate in this study.

1. Input**:** Verification and Diagnosis

   a. How do you identify student's performance deficits in the basic sciences?

   b. Why do you think the students have the types of learning difficulties encountered?

   c. what are the strategies you develop to address the underlying difficulties?

2. Inputs/Process/Output**:** Structure and Administration

   a. What are your expectations of the remediation program?

   b. Do you use learning contracts in remediating students? If so, please describe the

   c. Could you please comment on the supplemental examinations?

3. Input/Process/Output

   a. How do you assess if a particular student's cognitive deficit is effectively addressed?

   b. Do you provide feedback to students on their learning activities?

   c. What do think about students' participation in the remediation process?

   d. What do you think are the strengths and weaknesses of the remediation process?

4. Input**:** Plans for remediation

   a. Please tell me about the support and resources you are provided for remediation.

   b. How could the remediation process be improved?

   c. What do you think about the need for external evaluation of the remediation program?

   d. How would you feel about professional development in remediation?

***Appendix D*: common themes that emerged from the faculty structured-interview** (n = 4), **and comments from the faculty (n = 11) and students' survey (n = 78), that affected implementation of the remediation program**:

1. Awareness and understanding of the remediation program

   Faculty suggested that clear, detailed information, and transparent communication, including objectives, would address some of the anxiety and uncertainty surrounding remediation.

2. Uncertainty about the performance data of remedial students and the consequences of failing the supplemental examination.

   Faculty struggled to understand the details of the performance measures in specific subject disciplines that caused the students to remediate. The lack of institutional research capacity to analyze the performance data before and after the supplemental examinations hampered the ability of faculty to understand whether remediation was having the desired effect.

3. Insufficient resources and unprotected time

   Faculty felt that their clinical responsibilities, research commitment, and other departmental services, prevented them from full participation in the remediation process, especially at time of planning for their summerholidays. Other resources, such as financial reward for recruiting remedial tutors were required.

4. Lack of expertise in remediation practices

The lack of faculty's knowledge on the use and application of best practices of intervention remediation, and how to use different educational tools to diagnose specific learners' deficits should be taught through faculty development program.

5. Requirement for central organization and delivery of remediation

The remediation program needs to be centrally organized and mandated with common objectives and prescribed academic plans rather than left to individual course directors to arrange scheduling and implementation**.**

Appendix E: measurements of the capacity to change performance: characteristics of remedial students

The characteristics of remedial students were assessed to different degrees (expressed as mean scores) by asking faculty tutors how often they assessed those characteristics. The mean score was derived (n = 11) using the following 1-5 Likert scale: 1: Never 2: Less than half the time; 3: about half the time; 4: more than half the time; 5: always or almost always

- Insight/awareness of weaknesses and strengths (2.0)
- Self-reflection (1.3)
- Motivation to change (2.0)
- Obsessively concerned with grades that hinders learning (2.4)
- Neuroticism/negative thoughts about self confidence (1.3).
- Anxiety/stress (2.0).
- Setting priorities and time to finish assigned tasks (1.0).
- Openness to new idea (1.0).
- Acceptance of feedback (1.3).
- Depression (1.0).
- Taking responsibility for problems (2.3).
- Social networking with other students (1.0).

Appendix F: practices of intervention education

Faculty respondents indicated doing the following intervention education practices to different degrees (expressed as mean scores); the mean score was derived (n = 11) using the same 1- 5-point Likert scale.

- Took initiative to contact students (4.0).
- Took responsibility to arrange a follow up meeting (3.3).
- Devotes significant time to remediation (3.3).
- Help students to build cognitive learning skills (2.0).
- Approachable (4.0).
- Create a positive learning environment to develop students' inquiry (3.3).

Appendix G: development of learning activities

Faculty tutors (n = 11) were asked how often they used different learning activities to different degrees (expressed as mean scores) with remedial students. The mean score was derived using the same 1-5 point Likert scale.

- Self-directed/independent study (4.03).
- Practice questions for self assessment (3.54).
- Faculty tutoring for groups of failing students (2.21).
- Seminars on examination preparation skills (1.0).
- Problem-based learning sessions (1.2).
- Review of instructional tests (1.0).
- Concept mapping study skills (1.0).

Appendix H: use of learning activities with deliberate practice, timely feedback, and reflection

Faculty tutors (n = 11) were asked how often they monitored or assessed to different degrees (expressed as mean scores) the use of learning activities with deliberate practice, timely feedback and reflection. The mean score was derived using the same 1-5 point Likert scale.

- Deliberate practice of learning activities (1.3)
- Sought additional experience and learning opportunities in other settings (1.0)
- Provided feedback on the learning activities to students (1.4)
- Reflected on learning activities (1.0)

Appendix I: sample of verbatim transcribed structured telephone interview

I have never identified or took part in assessing students' performance problems, you know. We just get informed that students will be approaching us for remediation. The administrators send us email informing us, usually 2 weeks after the exams, that some students will need remediation. I guess those students are the failures in their classes. What really bothers me is that we don't receive any guidance as to what is expected of remediation. The remediation program is not well organized centrally. It is left to course directors to organize. It should be centrally organized with specific structure. (What do you mean by specific structure?). I think. It will be much less stressful, if I know how many hours of remedial sessions are required and what the objectives are for the sessions. I am a very busy clinician and with less time to devote to remediation. I have done my share of teaching these kids; some of them come to lectures and a majority doesn't come to tutorials where the topics and concepts are reinforced. To ask me to do more teaching is summer so that those students can pass is too much to ask of me. Left to me alone, they should be allowed to repeat the year. They just need to study harder. They remediation is really loose right now……. (Pause). (So what do you think are the learning deficiencies for the failing students?)

I don't really know what their learning problems are due to before the examinations. I can only guess, you know, that they don't understand the concepts and need to read more on their own. In any case, I don't even know their grades in my subject area. I just know those who fail the block score below 60%. ……. (Pause). (Don't you think some of the students have other problems apart from studying harder?). Sure, I am hearing these days that our students are being counseled for learning

disabilities and given extra time. I don't know much about the deficits to make comments, but some students have expressed to me that they are stress due to some family problems. I don't know whether to believe them or not. Hey, (laughter) some may give all types of excuses to impress upon me to help them pass the supplemental exams. I think some students have genuine reasons for their failures. I don't know those reasons. The UGME office should be compiling data on those reasons.

My strategies for remediation are very simple. I usually meet with all the students in my office and review some areas of the course materials and answer practice questions. I ask them to do practice questions and do self-study. I don't have the time and patience for individual remediation for every failing student. I also have to plan for my summer holidays. I really believe the students that fail are those who should not be in our medical school. We should just weed them out. This idea of individual remediation is not possible here. If the students don't know their problems, how can I help them? We give them what they want but not hold them accountable for their own learning problems. When last did we fail a student? I expect that we should clearly try to distinguish those who are just lazy and those who truly have a learning problem. Some of the students, you know, will keep on having academic difficulties because they are not capable of handling the work load in medicine. Those with learning problems, we may have to advice them to seek another profession. Do we have the expertise in this university to clearly recognize those students with learning disabilities? I am not aware of such expertise in the medical school. I really think that "we should allow failure in this medical school. This will send a strong message to other students about the seriousness they have to take their studies.

What are you talking about learning contracts? I don't have a clear knowledge of what you mean by learning contract. I have never used it, or be informed that we are to use it for remediation. Have we used it here? I believe the remediation is optional. I see some of the students come and go during my revision sessions. I don't really keep attendance for their participation in the remedial sessions. I don't believe my colleagues do so. I think, if we contact students to come for remediation, we don't have any policy to my knowledge of the expectations for students to participate in remediation. I have never received any notification or memorandum on students' objectives for remediation. I don't even know when the supplemental examination is scheduled. I don't really receive any information on the students after the supplemental examinations. So, I don't have any idea how the students performed on the supplemental examination, particularly in my discipline. So, I can't ascertain if I was able to help them address their learning problems effectively. I have been here long enough to know that all students graduate in medicine. So, I guess it doesn't really matter whether their learning deficiencies are addressed or not. I am not qualified in the techniques to assess students' learning deficiencies. It will be nice to attend some workshops for faculty development in remediation if I have my time protected to do so. I am always busy with my clinical responsibilities.

I actively contact remedial students to see if they require further sessions after our initial meeting. If the have questions, I am available to respond. I don't give timely feedback because I don't have the time to see what every student is doing to prepare for the supplemental exams. They students don't show me what learning strategies they are using to correct their problems, so I can't really guide them in their studies, or make

suggestions to them to improve the quality of their learning. I guess most of them study by revising their notes.

I don't receive any support what so ever for my remediation efforts in summer. I have not been asked to see what support and resources I would require to effectively provide remedial sessions. It would be nice if I am provided with financial assistance to recruit remedial tutors. We have some residents who can do a very good job at teaching the students. We should remunerate residents who do teaching in summer to remediate students. Some of them would like to teach. They are a good human resource pool to engage. They are several weaknesses of the remediation program they way I see it: Detailed information about failing students, including their grades in every discipline should be provided to faculty tutors; their attendance in tutorials or courses, their previous performance records, and clearly outlined objectives for the remediation program for both should be provided to all stakeholders. We should also try and identify some of those failing students earlier on before the examinations through instructional tests. We need to be access resources needed beyond our normal responsibility to provide the extra remedial tutorials. I don't mind if there is an external evaluation of our program to have some specific guidelines recommended to follow in order to deliver an effective remediation to students. There is a danger that some of those students will graduate with serious learning deficits that could put patients at risk. It is in our interest to bring rigor to the remediation program. We need to know if the students are actually improving their performance, and how significant is the improvement. Also, we have to make sure that there is an improvement in the specific discipline subject they failed. There is the need for policy on remediation. I understand that there is now a progress committee that

monitors the performance of all students through out the undergraduate medical education continuum. This committee in my opinion is central to developing a policy. So far, the committee seems to be identifying more students needing remediation than before. The remediation could not be improved without providing the necessary resources and protecting our time commitment because we also have our patients to look after. It is high time that students themselves begin to be accountable for their own learning and remediation, we are always tasking faculty to help students pass the exams but not being firm with students, especially those who believe they have the right to graduate irrespective of their performance.

Appendix J: sample letters of informed consent

Letter of Informed Consent for Faculty:

Principal Researcher: [redacted]

[redacted]

[redacted]

Winnipeg, Manitoba R3E 0J9 Canada

[redacted]amara@cc.umanitoba.ca

Sponsor: [redacted]

[redacted]

University Teaching Services

[redacted]

[redacted]Cheryl_Kristjanson@cc.umanitoba.ca

Dear Faculty:

A copy of this consent form, which is only part of the process of free and informed consent throughout your participation in this study, will be for your own records and reference. It should explain to you the general information on the research and your role. If you are in doubt as to the nature of the research, or would like clarification of any item mentioned here, or information in this form, you are free to ask or contact me anytime. Read carefully all the details provided in this form and understand any attached information. If you require additional information, please do not hesitate to contact me [redacted] or my thesis advisor [redacted]. My name is [redacted] [redacted] Faculty of Medicine. In addition to my administrative duties, as mentioned above, I am a Graduate Student in the Faculty of Education. You are being invited to participate in this research study, which is

in partial fulfillment for requirements of my M. Ed degree (post-secondary). The purpose of this study is to carry out formative evaluation of the pre-clerkship remediation program in the Faculty of Medicine, by discussing with faculty their experiences and suggestions for change. I would like to gain an understanding of the program strengths and potential areas of improvement, with a view of formulating a model for remediation that is based on the principles of student-centered learning, intervention education, and the capacity to change performance.

The study will consist of a faculty telephone interview and separate electronically administered survey questionnaires for faculty and pre-clerkship students. You will be asked to participate in both the telephone interview and to complete the survey questionnaire. The telephone interview session is anticipated to last about 60 minutes. I will act as facilitator and take notes during our digitally recorded interview discussion. A structured question guide, which will be forwarded to you prior to the interview, will be used to facilitate discussion around topics important for remediation. You will be asked various questions about your perspectives on the remediation program and its implementation. The audio-taped interviews and supplemented notes will be transcribed. Common themes from the transcripts will be developed and typed into a summary report. If you are interested in receiving the report please contact me at amara@cc.umanitoba.ca The survey questionnaires will be anonymously sent to participants, and it might take about 30 minutes to complete it. The survey data will be analyzed using descriptive statistics. The aggregate data from this analysis will be summarized into a report. An informal copy of the report will be made available for all participants who wish to see it. The findings from this study will be important for medical education. Consequently, the

results may be presented at conferences, in posters, and published as abstracts or peer review journal articles.

Your participation in any part of this study and expression of your opinions are strictly voluntary. Anonymity and confidentiality will be respected and protected. After interviews have been transcribed, interviewees' names will be replaced by unique coding system. Interview notes and transcribed data will be stored in a locked-coded safety cabinet in a secured room. The legends containing the names and coding system will be separately secured from the data as another layer of added confidentiality precaution. The digitally recorded audio-tapes will be stored on my computer and protected by a cryptic password. The survey questionnaires hardcopies will be secured in a safety coded cabinet in a locked room. No names will be used in the summary and final report. Data will be presented as aggregate data and where individual quotes are used, all descriptors will be removed. The researcher will use the data from this study as secondary data for future improvements to the remediation program. All data and materials, including the digitally recorded interview data, will be destroyed by shredding and incineration after the required length of time for the study.

There are no anticipated risks and/or discomfort involved in this study. Your participation or non participation will not affect your involvement in the remediation program or your professional standing in the Undergraduate Medical Program. The potential benefit from this study is that, the information provided from this study will be important to the development and implementation of the remediation program, and help inform policy decisions on its resources, activities and effectiveness. You will receive no compensation for your participation in the study. The only cost to you is the time it will

take to complete the survey, and/or telephone interview. Your participation is crucial to this study, as it will facilitate my goal of reaching a target group size. I hope you will choose to participate and offer your opinions and insights into the remediation program. I look forward to talking to you and/ or receiving your completed survey. This research has been approved by the Education and Nursing Research Ethics Board. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Secretariat at [redacted] A copy of this consent form has been given to you to keep for your records and reference. *Remember**:** If you volunteer to take part in this research project, you may withdraw at any time without consequences of any kind. Further, the researcher will discuss with you the possibility for you to withdraw from the project in your best interest, as below*:

SIGNED AGGREEMENT:

By signing this form, it is implied that you have understood to your satisfaction all the information provided and your role in the research project. It is understood that you have freely and willingly agree to participate as a subject. This agreement affects neither your legal rights nor takes away the legal and professional responsibilities of the researchers, sponsors, or supporting institution. You have the right to freely withdraw from the study at anytime, and/or decide not to answer any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent. Please feel free to ask for explanation or new information for the duration of your participation.

I understand that:

i. My signature indicates that I voluntarily and freely agree to be part of this research study.

ii. By signing this form, I do not waive any legal rights.

iii. I will receive a copy of this form.

Signature of Subject……Date……

I believe that the subject fully understands my explanation and has freely given me informed consent.

Signature of Investigator……Date……

Letter of Informed Consent for Students:

Dear Pre-clerkship student:

A copy of this consent form, which is only part of the process of free and informed consent throughout your participation in this study, will be for your own records and reference. It should explain to you the general information on the research and your role. If you are in doubt as to the nature of the research, or would like clarification of any item mentioned here, or information in this form, you are free to ask or contact me anytime. Read carefully all the details provided in this form and understand any attached information. If you require additional information, please do not hesitate to contact me [redacted], or my thesis advisor [redacted].

My name is [redacted], Faculty of Medicine. In addition to my administrative duties, as mentioned above, I am a Graduate Student in the Faculty of Education. You are being invited to participate in this research study, which is in partial fulfillment for

requirements of my M. Ed degree (post-secondary). The purpose of this study is to carry out formative evaluation of the pre-clerkship remediation program in the Faculty of Medicine, by discussing with faculty and students, their experiences and suggestions for change. I would like to gain an understanding of the program strengths and potential areas of improvement, with a view of formulating a model for remediation that is based on the principles of student-centered learning, intervention education, and the capacity to change performance.

The study will consist of a faculty telephone interview, and separate electronically administered survey questionnaires for faculty and pre-clerkship students. You will be asked to participate in completing the students' survey questionnaires only. The survey questionnaires will be anonymously sent to participants, and it might take about 30 minutes to complete it. The survey data will be analyzed using descriptive statistics. The aggregate data from this analysis will be summarized into a report. An informal copy of the report will be made available for all participants who wish to see it. The findings from this study will be important for medical education. Consequently, the results may be presented at conferences, in posters, and published as abstracts or peer review journal articles.

Your participation in any part of this study and expression of your opinions are strictly voluntary. Anonymity and confidentiality will be respected and protected. Hardcopies of the survey questionnaires will be secured in a safety coded cabinet in a locked room. No names will be used in the summary and final report. Data will be presented as aggregate data and where individual quotes are used, all descriptors will be removed. The researcher will use the data from this study as secondary data for future

improvements to the remediation program. All data and materials, including memorandum notes, will be destroyed by shredding and incineration after the required length of time for the study.

There are no anticipated risks and/or discomfort involved in this study. Your participation or non participation will not affect your involvement in the remediation program or your standing in the M.D degree program. The potential benefit from this study is that, the information provided from this study will be important to the development and implementation of the remediation program, and help inform policy decisions on its resources, activities and effectiveness. You will receive no compensation for your participation in the study. The only cost to you is the time it will take to complete the survey.

Your participation is crucial to this study, as it will facilitate my goal of reaching a target group size. I hope you will choose to participate and offer your opinions and insights into the remediation program. I look forward to receiving your completed survey.

This research has been approved by the Education and Nursing Research Ethics Board. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Secretariat at [redacted] Margaret_bowman@umanitoba.ca. A copy of this consent form has been given to you to keep for your records and reference.

*Remember**:** If you volunteer to take part in this research project, you may withdraw at any time without consequences of any kind. Further, the researcher will discuss with you the possibility for you to withdraw from the project in your best interest, as below*:

SIGNED AGGREEMENT:

By signing this form, it is implied that you have understood to your satisfaction all the information provided and your role in the research project. It is understood that you have freely and willingly agree to participate as a subject. This agreement affects neither your legal rights nor takes away the legal and professional responsibilities of the researchers, sponsors, or supporting institution. You have the right to freely withdraw from the study at anytime, and/or decide not to answer any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent. Please feel free to ask for explanation or new information for the duration of your participation.

I understand that:

i. My signature indicates that I voluntarily and freely agree to be part of this research study.

ii. By signing this form, I do not waive any legal rights.

iii. I will receive a copy of this form.

Signature of Subject……Date……

I believe that the subject fully understands my explanation and has freely given me informed consent.

Signature of Investigator……Date……

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