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WEB PAPER

Motivation as an independent and a dependent variable in medical education: A review of the literature

R. A. KUSURKAR[1,2], TH. J. TEN CATE[1], M. VAN ASPEREN[1] & G. CROISET[2]

[1]University Medical Center Utrecht, The Netherlands, [2]VU University Medical Center, The Netherlands

Abstract

Background: Motivation in learning behaviour and education is well-researched in general education, but less in medical education.

Aim: To answer two research questions, 'How has the literature studied motivation as either an independent or dependent variable? How is motivation useful in predicting and understanding processes and outcomes in medical education?' in the light of the Self-determination Theory (SDT) of motivation.

Methods: A literature search performed using the PubMed, PsycINFO and ERIC databases resulted in 460 articles. The inclusion criteria were empirical research, specific measurement of motivation and qualitative research studies which had well-designed methodology. Only studies related to medical students/school were included.

Results: Findings of 56 articles were included in the review. Motivation as an independent variable appears to affect learning and study behaviour, academic performance, choice of medicine and specialty within medicine and intention to continue medical study. Motivation as a dependent variable appears to be affected by age, gender, ethnicity, socioeconomic status, personality, year of medical curriculum and teacher and peer support, all of which cannot be manipulated by medical educators. Motivation is also affected by factors that can be influenced, among which are, autonomy, competence and relatedness, which have been described as the basic psychological needs important for intrinsic motivation according to SDT.

Conclusion: Motivation is an independent variable in medical education influencing important outcomes and is also a dependent variable influenced by autonomy, competence and relatedness. This review finds some evidence in support of the validity of SDT in medical education.

Introduction

The importance of motivation in learning behaviour and education is well-researched and proven in general education, but much less in medical education. White and Gruppen (2007) highlight that research relevant to motivation needs to become a greater focus in medical education. The interest of medical educators in motivation is on the rise, especially in the last decade. Three major viewpoints (Mann 1999; Williams et al. 1999; Misch 2002) bring to light the issues that form the starting point for the current review: To what extent are medical students intrinsically or extrinsically motivated? Why do we need to know? Which type of motivation is useful in medical education?

Research in medical education can derive a lot from the wealth of literature in general education, where motivation has been shown to be a predictor for learning, academic success, persistence or continuation in a study and well-being (Vansteenkiste et al. 2004, 2005b; Hustinx et al. 2009). There are several reasons why motivation of medical students could be different from general education students. Medical education is not typical for higher education because of the intertwining with clinical work. Unlike general education, where students have a wide variety of choices to do different things and create unique profiles for themselves, medical education works towards one restricted and clearly defined profession. The environment within which teaching and learning occur is highly specific. Also, medical students are considered highly motivated from the outset having gone

Practice points

- Motivation can be viewed as both, an independent and a dependent variable in medical education.
- Motivation as an independent variable influences learning and study behaviour, academic performance, choice of medicine as a career, choice of specialty and the intention to continue medical study.
- Research on motivation as a dependent variable in medical education is scarce, though the existing research seems to suggest that the learning environment plays an important role in enhancing motivation. A need for more research in this area is identified.

Correspondence: R.A. Kusurkar, Center for Research and Development of Education, University Medical Center Utrecht, P.O. Box 85500, 3508 GA Utrecht, The Netherlands. Tel: 31 88 7556819; fax: +31 88 7553409; email: R.Kusurkar@umcutrecht.nl; rashmi.kusurkar@gmail.com

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through a considerable effort to enter medical school. These arguments underlie the rationale for studying motivation, particularly in medical students.

Looking into the basic foundation of motivation research, there are many different theories of motivation, the major ones being Hierarchy of needs theory (Maslow 1970), Need to Achieve Theory (Murray, cited by Franken 1988), Expectancy-value Theory (Atkinson 1966), Attribution Theory (Weiner 1974), Social Cognitive Theory (SCT) (Bandura 1986, 1989), Goal Theory (Pintrich 2000) and Self-determination theory (SDT) (Deci & Ryan 1985).

Most of the above-mentioned theories explain issues on the basis of the level of motivation. SDT explains issues based on the quality of motivation. It argues that even if the level of motivation in an individual is high, different qualities of motivation will result in very different outcomes (Williams & Deci 1999). SDT is a general motivation theory which holds true for different aspects of motivation in an individual's life, including education and learning.

SDT postulates that human beings have a natural tendency to develop towards self-determination (Deci and Ryan 1985). Motivation is a continuum (Figure 1) with intrinsic motivation at one end of the spectrum and amotivation (lack or absence of motivation) at the other. Intrinsic motivation makes a person pursue an activity for personal interest or enjoyment. It is the most autonomous/self-determined form of motivation. Extrinsic motivation makes a person pursue an activity for a separable outcome, i.e. to obtain a reward or to avoid a loss. Extrinsic motivation has different levels of self-determination, hence is composed of four different stages: external regulation, introjected regulation, identified regulation and integrated regulation. 'External regulation', in the case of education, means studying because of pressure or expectation of others, without interest in the study. 'Introjected regulation' means there is realization of the importance of the study but the causation is perceived as external. 'Identified regulation' means that the importance of study is valued, has been identified with and the regulatory process has been accepted. 'Integrated regulation' means that the acceptance of the importance ascribed to the study has been fully integrated into the individual's coherent sense of self; the locus of causation is now internal. Self-determination, the regulation type that fits with intrinsic motivation, means that one determines one's own motivation; the motivation is self-generated and autonomous. External regulation is the least and integrated regulation is the most self-determined regulation of extrinsic motivation.

Many studies have combined intrinsic motivation, integrated and identified regulation as autonomous motivation and introjected and external regulation as controlled motivation (Ryan & Deci 2000b). Amotivation signifies the state in which a person lacks the intention to act (Deci et al. 1991; Ryan & Deci 2000a,b). Intrinsic motivation is built on the inherent needs for 'autonomy', 'competence' and 'relatedness'. The need for autonomy or self-determination is related to the feeling of volition in one's actions. The need for competence is related to one's feelings of capability in achieving the target. The need for relatedness concerns the desire to relate to the significant others in one's life through work and achievement. Significant others could be parents, teachers, colleagues, peers or others; in medical education and practice, it could even mean patients. Fulfilment of these three basic psychological needs makes a person intrinsically motivated for a particular activity. SDT puts forth autonomous motivation as the desired type of motivation leading to more deep learning (Grolnick & Ryan 1987; Vansteenkiste et al. 2005a & b), less superficial information processing (Vansteenkiste et al. 2004), higher achievement (Boggiano et al. 1993; Soenens & Vansteenkiste 2005), decreased drop-out intention and behaviour (Vallerand et al. 1997; Hardre & Reeve 2003), greater creativity (Koestner et al. 1984) and enhanced well-being or adjustment (Black & Deci 2000; Levesque et al. 2004). SDT also postulates that motivation can change from extrinsic to intrinsic and vice versa depending on the feelings of autonomy, competence and relatedness a student experiences in his or her study (Deci 1975). Williams et al. (1999) describe how SDT is important in medical education.

According to the general education literature, motivation influences learning and outcomes of learning, for example performance (Vansteenkiste et al. 2004, 2005b; Hustinx et al. 2009). Motivation therefore is an independent variable influencing variables like learning, academic success (Vansteenkiste et al. 2004, 2005b; Hustinx et al. 2009), etc. which become the dependent variables. Changes in the quality of motivation into more or less self-determined forms, depending on the learning experience (SDT), and level of motivation altering, depending on the feelings of self-efficacy (SCT), attributions of successes and failures (Attribution Theory), expectation of success or failure and incentive value of success or failure (Expectancy-value Theory), suggests that motivation is also a dependent variable. Thus, there are independent variables that influence the dependent variable 'motivation'.

This review was performed to answer these research questions: (a) How has the literature studied motivation as either an independent or a dependent variable? (b) How is motivation useful in predicting and understanding processes and outcomes in medical education?

With the increasing awareness that findings in medical education research should draw on relevant educational

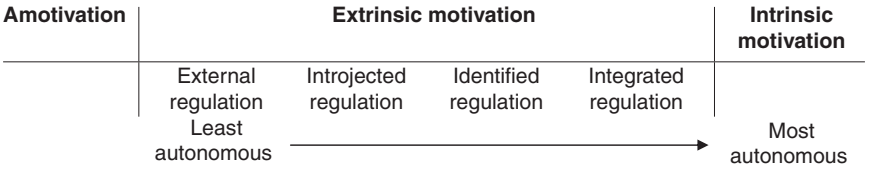

Figure 1. The self-determination continuum (Ryan & Deci 2000a).

Table 1. Inclusion and exclusion criteria for studies to be included in the review.

Inclusion criteria	Exclusion criteria
1. Studies/reviews on motivation which report empirical research on pre-medical, undergraduate, graduate and post-graduate medical students	1. Studies which were not empirical in nature like viewpoints
2. Studies identifying motivation for medical school/medicine/branches of medicine	2. Studies on populations other than on pre-medical, undergraduate, graduate and post-graduate medical students
3. Quantitative research studies with well-formulated definitions and operationalization of concepts, analysis of data, specific measurement of motivation	3. Studies which did not measure motivation with a valid method
4. Qualitative research studies with well-defined concepts, reliable methods (2–3 coders and consensus reached), well-reasoned conclusions and analysis	4. Studies which measured motivation for very specific aspects like reading, etc.
	5. Quantitative studies which did not have complete statistical analyses

theory (Bligh 2003), we have tried to understand how these variables influence motivation in the light of SDT as applied to medical education.

Methods

A literature search was designed by RAK, TJC and GC with the aim of identifying outcome variables that result from high motivation and variables that affect the quality and strength of motivation. In the first case, motivation is the independent variable and in the second case, the dependent variable. The inclusion and exclusion criteria were formulated by RAK, TJC and GC as described in Table 1.

The first literature search on motivational aspects in medical education was conducted by RAK in April 2009, but it was recently updated to include all papers from 2009 up to September 2010. This search was performed using the PubMed, PsycINFO and ERIC databases, which we expected would cover all relevant articles, and searching for the keywords 'motivation', 'motivate', 'motivator', 'motive', 'drive', 'incentive', 'purpose', 'goal', 'medical students', 'medical school', 'intern', 'resident', 'clerk', 'registrar' and 'postgraduate training' (Figure 2), and using the 'explode' function for relevant terms included under these terms. Additional limits set were 'items pertaining to humans', 'in English' and '1979–2010'. Papers published in journals as well as presented at conferences were included. In the first step, RAK and MVA read the titles and abstracts, and excluded the studies which were not actually about motivation (202). In step two, since the aim was to look specifically at papers which studied factors affecting motivation and outcomes of motivation, RAK and MVA separately made further selection of papers according to the inclusion and exclusion criteria in Table 1. Any differences of opinion were debated and consensus was reached on which papers to include/exclude. A thematic analysis of the papers which were to be included was conducted. RAK and MVA coded the papers separately according to the different themes and reached consensus on the inclusion of papers under relevant themes. All authors agreed on the themes described in the results. After the thematic analysis, a higher level analysis was performed by all authors to combine the themes that describe the findings in the light of SDT.

Results

The total number of papers found initially was 460; 271 from PubMed, 88 from PsycINFO and 101 from ERIC (Figure 2). Out of these 460 articles, 202 were excluded because they were not studying motivation. After removing duplicates (22) from different databases, 236 articles remained for review.

Studies were excluded because they deviated from the focus of the review in the following respects: not empirical/motivation was not measured (12) (e.g. Misch 2002 – viewpoint article), focused on motivation for very specific issues (84) (e.g. Bobo et al. 2009 – motivation for rural practice), did not focus on students (61) (e.g. Cvek et al. 2009 – on medical faculty), weak or inadequately described methodology or analyses or reasoning (5) (e.g. Wormwald et al. 2009 – conclusions not based on findings and not well-reasoned), focused on instrument construction/validation (3) (e.g. Lonka et al. 2008), full text not available (15) (e.g. Odusanya et al. 2000).

Thus, a total of 56 articles were finally included in the review. Papers have been described in the results section that employed motivation as an independent variable and those that used it as a dependent variable.

Motivation as an independent variable

Motivation not only controls action being taken, but also how well it is taken. This supposes a relationship with success in achieving the target. Here motivation is the controlling variable, i.e. it behaves as an independent variable and influences other variables. Studies have been conducted in medical education to determine the possible outcomes of strength and quality of motivation and type of goal contents. Goal contents according to SDT are of two types: intrinsic, e.g. community contribution, personal growth, health, affiliation, because they provide inherent satisfaction of the basic psychological needs; and extrinsic, e.g. fame, status, money, because they provide external manifestations of self-worth (Vansteenkiste et al. 2006). These outcomes can be subsumed in five categories

Learning and study behaviour. Motivation has been reported to influence study behaviour and learning in medical students. An achieving motive and strategy and having motivation for a career in medicine were found to correlate with greater time investment in study (Wilkinson et al. 2007a). Autonomous motivation was found to be positively correlated with deep approach and reflection in learning and also the intention to continue studies, whereas it was negatively correlated with superficial approach (Sobral 2004). Amotivation was found to be correlated negatively with reflection in learning and deep approach and positively with superficial approach (Sobral 2004). Motivation was reported to directly influence a tutorial group's cognitive processes (Dolmans et al. 1998).On the one hand, having higher

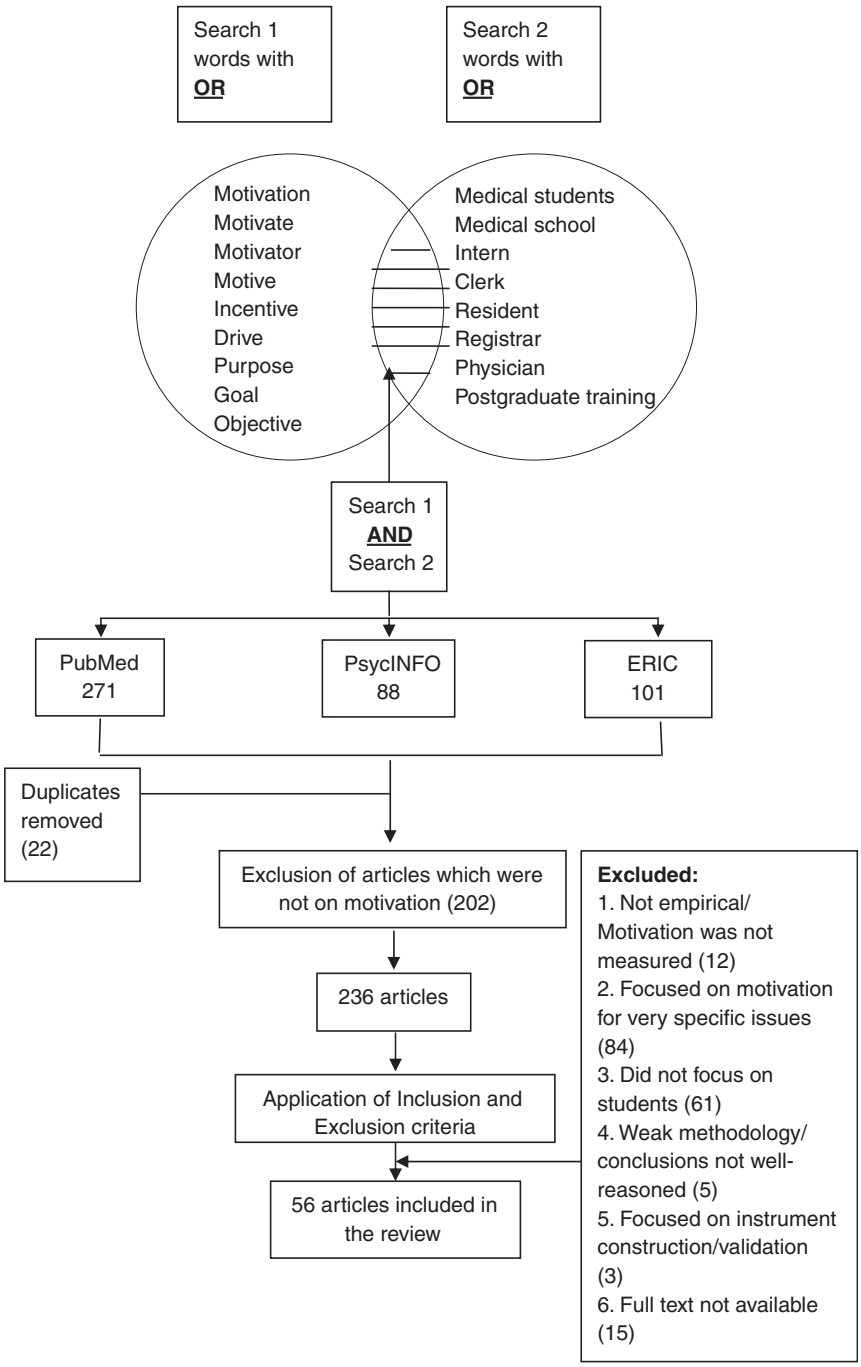

Figure 2. Scheme of literature search and results.

motivation enhances learning; on the other hand, it was also found that in small group teaching the lack of motivation in a group member is perceived as inhibiting the learning process of other students in the group (de Grave et al. 2002). A study in UK found that motivation to be a good doctor and avoid harm to patients is related to a vocational approach to study in medical students (Mattick & Knight 2009). This means that students are stimulated to gain knowledge that will help them in their practice of medicine. This study also reported that different intrinsic motivations, namely interest in medicine and learning, achievement and workplace utility, and extrinsic motivations, namely social competition or pressure and assessment, stimulate learning in medical students (Mattick & Knight 2009).

Concerning study-related behaviour intrinsically motivated medical students tended to take more optional credit courses and peer-tutoring activities (Sobral 2008). Apart from academic activities, motivation was also positively correlated with health-related extracurricular activities like working in an old-age home (Hulsman et al. 2007).

Academic success/performance. Studies on strength or quality of motivation as a predictor of academic success have found both conclusive and inconclusive evidence.

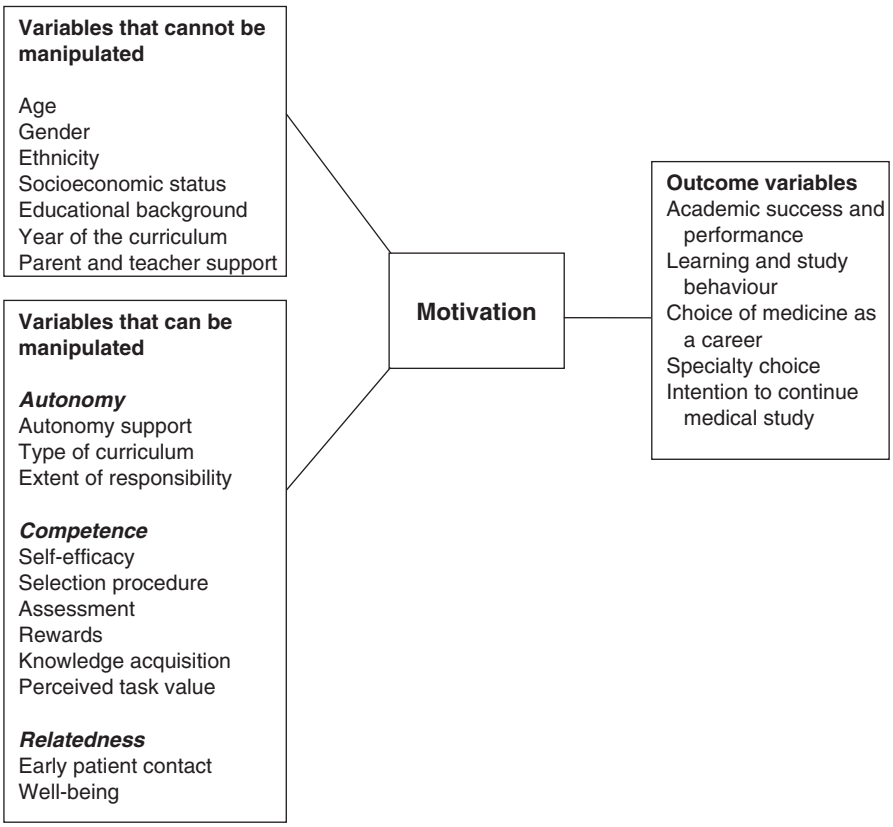

Figure 3. Diagrammatic representation of empirically found variables that affect motivation or that are affected by motivation.

Higher motivation (Moulaert et al. 2004) and also specifically higher intrinsic motivation (Sobral 2004) have been found to correlate with higher academic grades in both pre-clinical (Sobral 2004) and clinical years. Motivation was found to predict performance in only one school in a US-based study, performed in two medical schools (Webb et al. 1997). Strength of motivation to study medicine was found to be predictive of GPA in the third year, but not the first 2 years of medical study, in another study (Hoschl & Kozeny 1997). Tutorial group productivity was found to be significantly higher in the groups having students with higher motivation as compared to those with lower motivation (Dolmans et al. 1998; Carlo et al. 2003). Students entering medicine with intellectual challenge (SDT intrinsic goal content) as the most important motive were found to have higher GPAs (Price et al. 1994). Academic performance other than grades/GPAs has also been studied. Strength of achievement motivation was found to be a better predictor of professional attainment in males than females (Lorber & Ecker 1983). Defining academic success as how far a student had progressed in his/her doctoral thesis in the final year of medical school, having higher extrinsic career motivation (striving for promotion, income, prestige, etc.) was found to predict greater advancement in the thesis (Buddeberg-Fischer et al. 2003).

There were other studies that failed to find significant correlations. A Netherlands-based study found no significant correlation between motivation and academic success (Hulsman et al. 2007). Neither extrinsic nor intrinsic motivation was significantly correlated with academic performance in a UK study (Popovic 2010). On analysing admission interviews data of academically at-risk medical students, there was no significant difference in motivation of successful and unsuccessful students (Elam et al. 1999). No significant difference was found in performance between students with high and low motivation (conditions created by using external motivators) and controls when tested on clinical case processing and recall of differential diagnosis (de Bruin et al. 2005). Intrinsic motivation, which was measured by only one item, was found to be significantly negatively correlated ($r = -0.17$) with academic success (Tan & Thanaraj 1993).

Choice of medicine as a career. Studies have been conducted to understand what kind of motivation or motives drive students to enter medical school. Four major underlying dimensions appeared, as found using the Medical Situations Questionnaire in the UK: helping people, being respected, being indispensable and becoming a scientist (McManus et al. 2006). Similar motives (Karalliedde & Premadasa 1988) and intellectual content were found in other studies on pre-medical and medical students (Kutner & Brogan 1980; Harth et al. 1990; Todisco et al. 1995; Vaglum et al. 1999; Lovecchio & Dundes 2002; Wierenga et al. 2003; Rolfe et al. 2004; Khater-Menassa & Major 2005). The ability to help people appears to be the strongest motive (Kutner & Brogan 1980; Price et al. 1994; Todisco et al. 1995; Vaglum et al. 1999; Rolfe et al. 2004; Millan et al. 2005). Women over 30 chose medicine to find intellectual motivation, develop competence and feel achievement (Kaplan 1981). Medical students, who had a background in nursing education, chose medicine mainly out of the desire for

increased patient care responsibility, medical knowledge, personal challenge and status (Gussman 1982).

Choice of a specialty within medicine. Motivation also influences the choice of a specialty. Students choosing primary care (Rogers et al. 1990; Kassler et al. 1991; Vaglum et al. 1999) and psychiatry (Vaglum et al. 1999) were driven by a people-oriented motive or diversity in diagnosis and treatment (Khater-Menassa & Major 2005) as compared to students choosing high technology or non-primary care specialties, who were driven by science-oriented motive (Vaglum et al. 1999) or working with new technology (Khater-Menassa & Major 2005). Other motives for choosing non-primary care specialties were better lifestyle, monetary rewards and prestige (Rogers et al. 1990). Strong career motivation (Buddeberg-Fisher et al. 2006) or higher intrinsic career motivation (Buddeberg-Fischer et al. 2003) were found to be independent predictors of choice of speciality. Students not considering any primary care specialties showed significantly higher achievement and power motives (Buddeberg-Fisher et al. 2006).

Intention to continue medical studies. Autonomous motivation was found to correlate significantly positively with intention to continue studies, i.e. not dropping out of medical school, and amotivation was negatively correlated with intention to continue studies (Sobral 2004).

Our belief that motivation is an independent variable in medical education was confirmed by the findings of this review. This sets the foundation for the merits of studying motivation as a dependent variable because if motivation is an important determining variable of learning and academic and professional success, and if it can be manipulated by arrangements in the curriculum and by teachers' actions, then it is of great importance that we map such variables.

Motivation as a dependent variable

Motivation for medical study may be influenced by a variety of factors in the individual student and the learning environment and curriculum. McLelland and Steele (1973) found that factors like race, religion, environment and child-rearing practices had direct influence on achievement motivation and factors like family structure, slavery, occupational status and climate had indirect influence. The hierarchical model of motivation by Vallerand and Ratelle (2004) has proposed and empirical evidence has been gathered to support the view that motivation can change and be manipulated, hence is a dependent variable. Within such factors in medical education, we made a distinction between factors that cannot be manipulated and factors that can be manipulated.

Variables that cannot be manipulated. Some variables influencing motivation for medical study were found which cannot be manipulated.

Age. This influences motivation for medical study. In an Australian study, differences in motivations for choosing medicine were found between mature-age (approximately 41 years) and normal-age entrants (approximately 34 years). Most mature-age entrants cited intellectual satisfaction as their main reason followed by working with people and desire to help others. Most normal-age entrants cited desire to help others followed by enjoyment through working with people and intellectual satisfaction (Harth et al. 1990).

Gender. Studies which look into gender differences in motivation for medicine were found. Males report interest in science (Robbins et al. 1983; Vaglum et al. 1999; McManus et al. 2006), being indispensable (McManus et al. 2006), helping people (Vaglum et al. 1999) and having a career (Robbins et al. 1983) as the most important reasons motivating them for medicine. Females report helping people (Wierenga et al. 2003) and having a career as the most important reasons (Robbins et al. 1983; Vaglum et al. 1999). Other studies found that ranking of motives like opportunity to help people (Kutner & Brogan 1980), scientific nature of medicine and intellectual challenge, in that order, by males and females was similar (Kutner & Brogan 1980; Price et al. 1994; Todisco et al. 1995); however, more females than males were oriented towards altruistic motives and more males than females were oriented towards financial security (Kutner & Brogan 1980; Price et al. 1994) or prestige/status (Wierenga et al. 2003). Others found that female medical students scored higher on the person-oriented motive (Vaglum et al. 1999; McManus et al. 2006), lower on natural science motive (McManus et al. 2006) and opportunity for higher income (Vaglum et al. 1999) and equal to male medical students on status-oriented motive (Vaglum et al. 1999). Apart from gender differences in goal contents for medicine, gender differences in generalized motivation have also been studied. Males were found to have higher extrinsic career motivation than females (Buddeberg-Fischer et al. 2003). Female medical students have been found to be significantly more achievement oriented as compared to male medical students (Loucks et al. 1979). Among tutorial groups, motivation of female students was also found to be significantly higher than male students (Carlo et al. 2003).

Ethnicity. This plays a role in motivational orientation. In a study carried out in the US with high school students who were considering medicine as a career option, white students were predominantly motivated by the 'challenge of the medical profession', whereas black students by the 'chance to help people' (Wagoner & Bridwell 1989). Black students rated 'monetary benefits' of the profession and status significantly higher than white students (Wagoner & Bridwell 1989). This was in contrast with a UK-based study which found that non-white students score significantly higher on 'Science' and significantly lower on 'Helping people' as compared to white students (McManus et al. 2006).

Socioeconomic status. This, rather than ethnicity or gender, was found to play a definitive role in the perceptions of high school students about medical school and their motivation to apply, in a study in the UK (Greenhalgh et al. 2006). Students from higher socioeconomic status tended to focus on intrinsic factors like challenge, achievement and fulfilment in medicine, whereas students of lower socioeconomic status tended to

focus on the extrinsic rewards like expected income (Greenhalgh et al. 2006).

Personality traits. The temperament dimension of persistence and the character dimensions of self-directedness and self-transcendence (which are expected to enhance the learning process) are associated with intrinsic academic motivation in medical students (Tanaka et al. 2009).

Educational background. A study in Finland found that non-graduate entry students had higher achievement motivation as compared to graduate entry students (Kronqvist et al. 2007).

Year of medical curriculum. This was also found to influence motivation for joining and continuing medical study. Contrary to common beliefs and other studies mentioned above, a UK-based study found that first-year medical students were more oriented towards prestige, money and success, whereas final year students were more oriented towards relief of suffering and importance for mankind (Powell et al. 1987). Another study, based on the US, found that first-year medical students had higher achievement orientation than students after their third year. This finding was attributed to a shift in the motivational structure from achievement to self-gratification needs (Burstein et al. 1980).

Teacher and parent support. A qualitative study in the UK among first- and second-year medical students to identify factors influencing students' motivation to apply to medical school showed that parent support and encouragement had a positive effect and lack of teacher support had a negative effect (McHarg et al. 2007).

These are variables which cannot be manipulated by medical educators.

Variables that can be potentially manipulated. Other independent variables influence motivation and can potentially be manipulated. We have classified these variables under the three basic psychological needs for intrinsic motivation, namely autonomy, competence and relatedness.

Autonomy. Autonomy support for learning is like a cornerstone for developing intrinsic motivation for learning according to SDT. Autonomy in learning means that the students can plan their educational activities of their own volition, within the boundaries of defined limits. We found evidence of this in a few studies in medical education. The different themes that can be ascribed to this particular variable are as follows.

Autonomy support. A study done on US medical students found that autonomy support by instructors during clerkships enhanced students' motivation to select a residency in that particular field of medicine (Williams et al. 1997). The choice of internal medicine ($r=0.29$) and surgery ($r=0.34$) clerkships in this study were significantly correlated with the students' perceptions of autonomy support on these corresponding clerkships. Autonomy support by teachers was a significant predictor for both, students' autonomous motivation and competence for a study course in another study (Williams & Deci 1996). Intrinsic motivation for a course was positively correlated with autonomy in learning ($r=0.354$) in a study in France (Pelaccia et al. 2009). Students in a problem-based learning (PBL) curriculum found themselves to be intrinsically motivated because of autonomy in their learning, as opposed to students in a traditional curriculum who found themselves to be extrinsically motivated because of a controlling learning environment (White 2007).

Curriculum. A PBL curriculum was found to motivate students to learn for learning's sake, i.e. intrinsic motivation, because of autonomy in their learning. Traditional curriculum motivated students towards obtaining high grades, i.e. extrinsic motivation. These students' perceived a controlling learning environment (White 2007). A German study found that students' motivation is higher in blended PBL as compared to traditional PBL, both through quantitative and qualitative data (Woltering et al. 2009). Blended learning carefully complements face-to-face classes with e-learning modules and when incorporated into a PBL curriculum gives higher autonomy to students in their learning.

Patient responsibility. Interns perceived greater responsibility for patient care in a general practice learning environment and this was responsible for their greater motivation for learning (Cantillon & MacDermott 2008). Greater responsibility also means more autonomy in patient handling and treatment.

Competence. Feeling competent in learning stimulates intrinsic motivation for it. We found studies on medical students which substantiated this claim.

Self-efficacy. Intrinsic motivation was found to be positively correlated with perceived self-efficacy or competence ($r=0.419$) (Pelaccia et al. 2009).

Selection procedure. Students entering medicine through a selection procedure were found to have significantly higher strength of motivation and lower certificate orientation (extrinsic goal content) than students entering through either weighted lottery or outstanding high school GPA (Hulsman et al. 2007). Awareness of having been chosen through a demanding selection procedure might have a positive effect on students' self-efficacy beliefs and identity formation, inspiring them to develop a strong level of commitment to medical study and health care. Though this selection procedure did not necessarily make students achieve higher grades than the others, they engaged more in health-related extracurricular activities (Hulsman et al. 2007), which appears to be intrinsic goal content and the motivation appears to be autonomous.

Type of assessment. Standards-based assessment system was found to be associated with beneficial effects on deep motive and deep strategy for learning and professional identity (Wilkinson et al. 2007b). Thus, students were motivated to use deep approach to learning when evaluated against pre-set

standards as opposed to when evaluated against each other. Comparison with pre-set standards and meeting those standards could stimulate feelings of competence in learning as opposed to comparison with peers which could result in feelings of personal failure and incompetence.

Rewards. It was found that nearing the end of the medical study, the percentage of students agreeing that a degree with honours was a motivator for learning and not a demotivator was significantly lower than students in the beginning of the study. An honours system does not necessarily motivate students and may demotivate a significant number of them over the time course of the study (O'Neill et al. 1999). An honours system could work in a negative way for students who know that they are not likely to get honours, by making them feel incompetent in learning.

Knowledge acquisition. A study on small group learning found that increase in knowledge and understanding of subject matter increases students' motivation for the study and interest in the course content (Draskovic et al. 2004). This means that the students were more motivated for learning when their feelings of competence in their learning were strong.

Task value. Intrinsic motivation was found to be positively correlated with perceived task value of training ($r = 0.546$) in a study in France (Pelaccia et al. 2009). Similarly, in a study from UK, students in PBL groups felt motivated for group working as they perceived that it was responsible for delivering their learning (Willis et al. 2002). So, the perceived task value of training periods in the former study and PBL group working in the latter study was high and led to feelings of competence in learning.

Relatedness. This could have a special significance in medical education. Significant others could not only be parents, teachers, peers, but could also be patients. Contact with patients could help students relate to their identity as future doctors and strengthen their beliefs about why they are in medical education in the first place. Evidence for this was found in some studies in medical education.

Early patient/clinical contact. Early contact with patients stimulates students' motivation for biomedical and further study by connecting theory to clinical practice (Diemers et al. 2008; Von Below et al. 2008). Thus, students were inspired towards their future work as doctors.

Well-being. Well-being was found to affect motivation in daily work and overall career; lower well-being lead to feelings of ambiguity in career choice and higher well-being lead to greater zeal towards purpose in medicine and intrinsic passion for work (Ratanawongsa et al. 2008). Well-being in this study was defined as 'a balance among multiple parts of residents' personal and professional lives, including professional, family, social, physical, mental, spiritual and financial domains'. This could be thought of as a doctor who has strong feelings of relatedness with his family and colleagues would have higher motivation. Autonomous motivation has been found to lead to enhanced well-being in general education studies (Black & Deci 2000; Levesque et al. 2004).

Summary of findings

The summary of the findings of this review is portrayed in Tables 2 & 3 and Figure 3.

Discussion

Motivation is correlated with learning through approach to study and study behaviour. Most studies in medical education have found evidence in favour of 'Motivation correlates with academic performance'. The other studies did not find significant correlations, two of which have small sample size, hence may have lacked the power to find significant differences (Elam et al. 1999; de Bruin et al. 2005). Tan and Thanaraj (1993) found significantly negative correlation, but in this study intrinsic motivation was measured with only one item in the questionnaire. We were not always able to confirm the reliability of the outcome measures, so these findings should be interpreted with caution. The relationship between motivation and learning success has been well-substantiated in general education (Dickinson 1995; Vansteenkiste et al. 2004, 2005b; Hustinx et al. 2009).

Altruistic motives, intellectual content and interest in the study are all intrinsic goal contents (SDT) that drive students towards medical study and profession and the motivation that such students exhibit in their choice of medicine is autonomous. Parental pressure, status, income and prestige are extrinsic goal contents (SDT) and the motivation exhibited by such students in their choice of medicine is controlled. Thus, we can conclude that most medical students enter medical study and profession for intrinsic goal contents and thus exhibit autonomous motivation in their choice of medicine (Vansteenkiste et al. 2006).

Overall, students choosing primary care specialities seem to be driven by intrinsic goal contents and hence autonomous motivation, whereas students choosing non-primary care specialities seem to be driven partly by intrinsic goal contents, i.e. science-oriented motive/working with new technology, and partly by extrinsic goal contents, i.e. lifestyle, money, prestige. The dominant motivation, i.e. autonomous or controlled, in these students may vary from individual to individual.

Autonomous motivation being correlated with decreased dropout intentions among medical students is consistent with the finding in general education research (Vallerand et al. 1997; Hardre & Reeve 2003). However, there was only one study in medical education with this finding, so it has limited generalizability.

There was only one study that found that age influences motivation. Though this finding has been observed in general education research by McLelland and Steele (1973) in school

Table 2. Summary of findings – motivation as an independent variable.

Serial number	Motivation as an independent variable influences	Total number of papers (Reference numbers of papers included as per the table in the appendix)	Major findings
1.	Learning and study behaviour	7, size of correlations some small and some moderate (papers 7, 9, 16, 26, 40, 41, 51)	– Autonomous motivation was positively correlated with deep approach to study, reflection in learning and intention to continue studies – Motivation influenced learning in small groups – Motivation to be a good doctor stimulated vocational approach to learning – Motivation correlated positively with peer tutoring, extracurricular activities, academic and others
2.	Academic success/ performance	14, small size of correlations (papers 1, 5, 6, 9, 11, 15, 16, 23, 30, 33, 35, 41, 42, 48)	– Nine studies found positive relation between higher motivation and academic performance – The other studies either did not find significant correlations or one found significantly negative correlation, but in this study intrinsic motivation was measured with only one item in the questionnaire
3.	Choice of medicine as a career	14 (papers 13, 14, 17, 18, 20, 22, 25, 29, 28, 35, 39, 44, 45, 50)	– Motives – helping people, being respected, being indispensable and becoming a scientist – Helping people is the strongest motive – Women over 30 and nurses join medicine for personal challenge
4.	Choice of specialty within medicine	6 (papers 1, 2, 19, 20, 38, 45)	– Primary care specialities are chosen for people-oriented motive – High technology specialities are chosen for science oriented motive
5.	Intention to continue medical studies	1, moderate size of correlations (paper 41)	– Autonomous motivation positively correlated with intention to continue studies and amotivation correlated negatively

children, in this study this difference was found between entrants who were 35 vs. 45 years of age. In most countries, the average age at entry into medical study is around 17 years, except in the US and Australia where it is around 23 years. In the light of this, the study by Harth et al. (1990) seems irrelevant to most of the medical student population and the findings do not have any explanation of confirmation in theoretical background.

Concerning gender differences in motivation, there is considerable evidence that female medical students seem to have higher strength and better quality of motivation than male medical students.

Ethnicity and socioeconomic status also have not been explored in enough detail and because of contradictory findings have limited generalizability. Similarly, variables like educational background, personality traits, year of curriculum, teacher and parent support have too little number of studies to be generalizable. Further research needs to be done on these variables because the findings can have an impact on the selection procedures for admission to medical schools.

Variables which can be used to manipulate motivation and have been uncovered in this review have a strong theoretical background in SDT though the absolute number of studies is not too high. But these findings are easily substantiated by the literature in general education (Vallerand & Ratelle 2004). Satisfaction of the basic needs of autonomy (Dickinson 1995; Hardre & Reeve 2003; Levesque et al. 2004; Soenens & Vansteenkiste 2005), competence (Guay et al. 2001; Soenens & Vansteenkiste 2005) and relatedness (a more distal relation, Deci & Ryan 2000) has been found to enhance intrinsic motivation in general education students.

The merits in viewing motivation from the point of view of a dependent and an independent variable in medical education were supported by this review. Having support that motivation is an independent variable, influencing important outcomes like learning and academic performance, is important in order to look at motivation as a dependent variable and explore variables influencing it. There seems to be a fair amount of research on motivation as an independent variable, but research on motivation as a dependent variable is scarce. This review identifies a gap in the literature on this particular issue, especially because identifying factors influencing motivation could help medical educators incorporate them into design of a curriculum or development of their institute's teaching culture and learning environment. There is one major flaw in the research designs of most of the studies included in the review, which is that motivation should ideally be studied using a longitudinal study design as it is expected to be dynamic. But most studies employ a cross-sectional design probably for ease in carrying out the research.

This review also leads us to some research questions. *Motivation as an independent variable* – If motivation does influence performance, then what are the mechanisms that cause this relationship? *Motivation as a dependent variable* – Do the strength and quality of motivation change over the course of medical study (in a longitudinally designed study)?

Table 3. Summary of findings – motivation as a dependent variable.

Serial number	Motivation as a dependent variable is influenced by	Total number of papers(Reference numbers of papers included as per the table in the appendix)	Major findings
Cannot be manipulated			
1.	Age	1 (paper 14)	– Mature-age and normal-age entrants had differences in motivations for choosing medicine
2.	Gender	10 (papers 1, 5, 22, 24, 28, 35, 37, 44, 45, 50)	– Males and females had different type of motives for joining medicine, also some similarities – Females were found to have higher strength of motivation and males were found to have higher extrinsic motivation
3.	Ethnicity	2 (papers 28, 41)	– Predominant motives of black and white students for joining medicine were different and the findings of the two studies were contradictory
4.	Socioeconomic status	1 (paper 12)	– Higher socioeconomic status students were found to focus on intrinsic factors for choosing medical study whereas lower socioeconomic status students chose medical study for extrinsic rewards
5.	Personality traits	1 (paper 43)	– The temperament dimension of persistence and the character dimensions of self-directedness and self-transcendence are associated with intrinsic academic motivation in medical students
6.	Educational background	1 (paper 21)	– Non-graduate entry students had higher achievement motivation as compared to graduate entry students
7.	Year of medical curriculum	2 (papers 3, 34)	– In one study, first-year students were more oriented towards extrinsic rewards of the medical profession, whereas final-year students were more oriented towards helping mankind – In the other study, first-year students had higher achievement motivation than third-year students
8.	Teacher and parent support	1 (paper 27)	– Having parent support and not having teacher support play a positive and negative role, respectively, in students choosing for medical study
Can be manipulated			
9	Autonomy		
	Autonomy support	4 (papers 32, 49, 54, 55)	– Autonomy support in medical study was found to stimulate choice of a particular specialty and intrinsic motivation for learning
	Curriculum	2 (papers 49, 56)	– PBL curriculum was found to stimulate intrinsic motivation and traditional curriculum was found to stimulate extrinsic motivation – Blended PBL increases students' motivation as compared to traditional PBL
	Greater patient responsibility	1 (paper 4)	– Greater patient responsibility was responsible for greater motivation for learning
10.	Competence		
	Self-efficacy	1 (paper 32)	– Intrinsic motivation was positively correlated with self-efficacy
	Selection procedure	1 (paper 16)	– Students entering through medical entrance exam have higher motivation
	Assessment	1 (paper 52)	– Type of assessment influences type of motivation for study
	Rewards	1 (paper 31)	– Rewards may demotivate significant number of students
	Knowledge acquisition	1 (paper 10)	– Perception of increased knowledge increases motivation
	Perceived task value	2 (papers 32, 55)	– Intrinsic motivation was found to be positively correlated with perceived task value – Perceived task value of PBL groups increased the motivation for group working
11.	Relatedness		
	Early patient/clinical contact	2 (papers 8, 46)	– Early patient contact stimulates student motivation
	Well-being	1 (paper 36)	– Feeling of well-being enhances motivation

To our knowledge, this has not been previously reported. If there are changes, what are the causes for these changes? Are these causes related to curriculum structure or learning environment? Can they be influenced or manipulated? If and whenever these questions are answered, we would have concrete means of enhancing motivation of our students.

Further implications

The SDT is a general theory of motivation which can be a good foundation for medical educational curricular reforms, structuring of the medical learning environment, continuing medical education and lifelong learning. Curricular reforms need to take into account the effects on student motivation produced by these changes, short term and long term. Designing of curricula could benefit from keeping in mind that motivation of students can be enhanced by incorporating teaching methods like PBL, small group working, etc. Learning environments inculcating autonomy-supportive behaviours by teachers, supporting students' feelings of competence through regular and constructive feedback and enhancing feelings of relatedness through mentoring support, positive role models, small group working and early contact with patients, can go a long way in stimulating students' autonomous motivation. Autonomously motivated students' would experience greater satisfaction with the profession, leading to lowering of stress and burnout possibilities. Integration of values of the medical profession into the culture of medical institutions could also help in shifting extrinsic goal contents to intrinsic goal contents, changing the focus from money, status and power to community service. SDT applied to medical education could perhaps be the answer to medical educators' dreams of intrinsically motivated students and doctors.

This review has a few limitations. In spite of the well-designed search strategy, it is possible that we missed a few papers where motivation was not the main variable under investigation, but was an incidental finding. We expect this to have happened for qualitative studies, not quantitative, as we had strict criteria for reliable measurement of motivation and we expect that any studies with these inclusions would be classified under the category of motivation in the different databases. We expected to find a few studies on 'assessments drive learning', but found only one, which was excluded for poor quality. The reason for this could be that in such studies motivation is not measured *per se*, but is an incidental finding. The inaccessibility to full-text versions of 15 papers (some were only dissertational abstracts not full papers, some authors did not respond even after contacting them through their information from the internet, other authors could not be found on the internet to contact and there was no external library access to these papers) is also a potential limitation of this review.

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Notes on contributors

R. A. KUSURKAR, MD, is a Researcher in the Center for Research and Development of Education, UMC Utrecht, and is especially interested in research on motivation of medical students.

Th. J. TEN CATE, PhD, is a Professor of Medical Education and Director of the Center for Research and Development of Education, UMC Utrecht.

M. van ASPEREN, MD, is a Junior Medical Teacher in the Center for Research and Development of Education, UMC Utrecht.

G. CROISET, MD, PhD, is a Professor and Director of Medical Education, VU University, Amsterdam.

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Appendix

Table A1. Research papers included in the review.

No.	Study reference	Country setting, *N*	Research objectives	Findings relevant to the review	Type of study
1	Buddeberg-Fischer et al. (2003)	Switzerland, 719 medical graduates	How do gender and personality traits contribute to their academic achievement and further career planning?	Women plan their career more purposefully than men. Gender, personality traits and career motivation play an important role in academic achievement and career planning	Questionnaire-based, Quantitative
2	Buddeberg-Fisher et al. (2006)	Switzerland, 522 residents	To investigate the influence of gender, personality traits, career motivation and life goal aspirations on the choice of medical speciality	Gender, career motivation and life goals are predictors for speciality choice	Quantitative

(*continued*)

Table A1. Continued.

No.	Study reference	Country setting, *N*	Research objectives	Findings relevant to the review	Type of study
3	Burstein et al. (1980)	USA, 246 medical students	To study the characteristics of medical students as a product of professional maturation and personality as opposed to sampling errors	A shift in the motivational structure from achievement to self-gratification needs was found from year 1 to 3	Questionnaire-based, Quantitative
4	Cantillon and MacDermott (2008)	Ireland, 4 interns, 4 staff involved in the programme	To determine the factors that contribute to most motivating effective learning in a general practice setting	Interns perceived greater responsibility for patient care in a general practice learning environment and this was responsible for their greater motivation for learning	Qualitative. This study had a very low sample size, i.e. 4 interns, though the quality of the study and interpretations were sound
5	Carlo et al. (2003)	Canada, 115 first-year medical students	To explore student perceptions and gender differences in perception about effect of motivation, cohesion, sponging, withdrawal, interaction and elaboration on group productivity	Tutorial groups were found to be more productive if the students in the group had higher motivation as compared to those with lower motivation. Female students had significantly higher motivation than male students	Questionnaire-based, Quantitative
6	de Bruin et al. (2005)	The Netherlands, 24 fourth-year medical students and 24 expert doctors	To determine the possible influence of motivation on clinical case processing and recall	There were no differences between the control, low and high motivation conditions in diagnostic accuracy, number of summaries in recall and study time on the cases. These conditions were produced by using external motivators	Quantitative
7	de Grave et al. (2002)	The Netherlands, 200 medical students from year 1 to 4	To explore students' perceptions of incidents in tutorial groups and of the tutor's role in these incidents. Students perceive that lack of motivation in a group member in small group teaching inhibits the learning process of others	Motivational influences have a particularly strong impact on tutorial group function	Questionnaire-based, Quantitative
8	Diemers et al. (2008)	The Netherlands, 24 third-year medical students	To explore what effects early patient contacts have with regards to knowledge construction and development of clinical reasoning skills	Early patient contacts motivate students for medical study	Qualitative
9	Dolmans et al. (1998)	The Netherlands, 39 tutorial groups of students	To expand understanding of cognitive and motivational influences on tutorial group processes	Tutorial group productivity is significantly higher in groups with higher motivation. Motivation also influences cognitive processes in the group significantly	Questionnaire-based, Quantitative
10	Draskovic et al. (2004)	The Netherlands, 89 first-year medical students	To explore the relations between the variables comprising learning mechanisms in small groups	If students feel that the group sessions have brought about a positive change in their knowledge and understanding of subject matter, their motivation for the study and interest in the course content will increase	Questionnaire-based, Quantitative
11	Elam et al. (1999)	USA, 51 at-risk medical students	To determine retrospectively the predictive values of cognitive and non-cognitive variables collected during admissions	There was no significant difference between motivations of academically successful and unsuccessful students on *t*-test	Mixed methods research, Qualitative data quantitatively scored and analysed

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Table A1. Continued.

No.	Study reference	Country setting, *N*	Research objectives	Findings relevant to the review	Type of study
12	Greenhalgh et al. (2006)	UK, 68 high school students	To investigate what going to medical school means to academically able 14–16 year olds from different ethnic and socioeconomic backgrounds	Pupils from higher socioeconomic groups viewed medicine as having high intrinsic rewards like personal fulfilment and achievement and those from lower socioeconomic groups thought more about the extrinsic (financial) rewards of medicine	Focus group study, Qualitative
13	Gussman (1982)	USA, 33 medical students with nursing background	To find out why medical students, who have completed nursing education, choose to enter medical study	Motivations for entering medical study were increased patient care responsibility, medical knowledge, personal challenge and status	Questionnaire-based, Quantitative
14	Harth et al. (1990)	Australia, 121 mature-age and 270 normal-age medical entrants	To compare motivation to study medicine between mature-age and normal-age medical entrants	Most mature-age entrants cited intellectual satisfaction as their main reason followed by working with people and desire to help others. Most normal-age entrants cited desire to help others followed by enjoyment through working with people and intellectual satisfaction	Questionnaire-based, Quantitative
15	Hoschl and Kozeny (1997)	Czech Republic, 92 medical students	To identify variables like pre-medical education grades, admission procedure and personality structure domains with predictive validity for academic success over 3 years of study	Motivation to study medicine is predictive of GPA in the third year, but not the first 2 years of medical study, though the explained variance in GPA was small, i.e. 6%	Partly questionnaire-based and admission interview committee reports, Quantitative
16	Hulsman et al. (2007)	The Netherlands, 418 first- and second-year medical students	To establish how Selection procedure students compared with Random Selection and Direct Access students on motivation, academic achievement, study behaviour and extra-curricular activities	Selection procedure students were significantly more highly motivated but this was not reflected in academic achievement, though motivation did affect study behaviour and health care-related extracurricular activities. No significant correlation was found between motivation and academic success	Quantitative
17	Kaplan (1981)	USA, 37 medical students, who were women over 30 years	To study motivations of medical students, who were women over 30, decide to study medicine	Motivations for studying medicine were intellectual stimulation, developing competence and to feel achievement	Questionnaire-based, Quantitative
18	Karalliedde and Premadasa (1988)	Sri Lanka, 154 medical students	To obtain information on the socioeconomic background and aspirations of medical graduates on entry to the medical schools in Sri Lanka	Attraction of medicine as a science and caring for the sick were the prime factors for choosing a career in medicine	Questionnaire-based, Quantitative
19	Kassler et al. (1991)	USA, 293 fourth-year medical students	To determine what factors distinguish medical students who choose primary care careers	Primary care specialty was chosen for direct and continuity of patient care and psychosocial aspects. High technology specialties were chosen for higher income, prestige, research opportunities and better quality of life	Questionnaire-based, Quantitative

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Table A1. Continued.

No.	Study reference	Country setting, *N*	Research objectives	Findings relevant to the review	Type of study
20	Khater-Menassa and Major (2005)	Lebanon, 127 graduating medical students	To highlight factors considered by medical students while making a career choice and to compare these between primary care and non-primary care candidates	Intellectual content and helping people appeared to be among the top motivations for medicine and diversity in diagnosis and therapy vs. working with new technology were the reasons for choosing primary vs. non-primary care specialties	Questionnaire-based, Quantitative
21	Kronqvist et al. (2007)	Finland, 25 graduate entry and 120 non-graduate entry medical students	To look at the study performance of students with different educational backgrounds with special emphasis on graduate entry students	Non-graduate entry students had higher achievement motivation as compared to graduate entry students. This finding cannot be generalized as the sample size of graduate entry students ($N = 25$) was very small	Questionnaire-based, Quantitative
22	Kutner and Brogan (1980)	USA, 338 medical students	To explore the relevance of certain factors to the decision to enter medicine for women medical students	Similar motives were found between males and females for entering medicine, namely interest in people, help others and independence in work	Mixed methods research
23	Lorber and Ecker (1983)	USA, 400 physicians with data from medical school	To analyse effects of achievement motivation, performance in medical school, peer evaluation, prestige of internship and family responsibilities on professional attainment	Achievement motivation was a better predictor of professional attainment in men than in women	Questionnaire-based, Quantitative
24	Loucks et al. (1979)	USA, 246 medical students	To explore whether there are differences between personality traits of female and male medical students	Female medical students were significantly more achievement oriented as compared to male medical students	Questionnaire-based, Quantitative
25	Lovecchio and Dundes (2002)	USA, 97 pre-medical students	To study why students either persevere in their pre-medical studies or seek alternative careers	Pre-medical students were attracted to medicine by scientific interest, intellectual challenge and the power to help others	Questionnaire-based, Quantitative
26	Mattick and Knight (2009)	UK, 15 second- and 13 third-year medical students (follow-up study)	To capture the full range of intentions and motivations for learning that exist within populations of medical students	Motivation to be a good doctor and avoid harm to patients stimulates a vocational approach to study in medical students. Different intrinsic motivations, namely interest in medicine and learning, achievement and workplace utility and extrinsic motivations, namely social competition or pressure and assessment, stimulate learning in medical students	Qualitative study
27	McHarg et al. (2007)	UK, 15 second-year medical students	To identify the influences contributing to students' decisions to study medicine	Parent support and encouragement had a positive effect and lack of teacher support had a negative effect on students' motivation to apply to medical school. The results of this study cannot be generalized owing the fact that the sample size is low ($N = 15$) and it is a highly selected sample	Interview-based, Qualitative

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Table A1. Continued.

No.	Study reference	Country setting, *N*	Research objectives	Findings relevant to the review	Type of study
28	McManus et al. (2006)	UK, 2867 prospective medical students	To explore the nature of the generic motivations for studying medicine in those considering medical careers, and to examine how those motivations differed between different types of individual in terms of demography and personality	Four major underlying dimensions for choice of medicine as a career appear: helping people, being respected, being indispensable and becoming a scientist. Differences were found according to gender and ethnic origin. Males report interest in science and being indispensable as the most important reasons motivating them for medicine non-white students score significantly higher on 'Science' and significantly lower on 'Helping people' as compared to white students	Questionnaire based, Quantitative, Sizes of correlations between gender and motivations for joining medicine are small ($r < 0.2$, though statistically significant)
29	Millan et al. (2005)	Brazil, 60 first-year medical students	To determine the reasons for choosing the medical profession and investigate their socioeconomic and psychological profiles and gender differences	Most students had chosen medicine out of altruistic or person-oriented motives followed by intellectual curiosity	Interview-based, Qualitative data assessed quantitatively
30	Moulaert et al. (2004)	The Netherlands, 777 years 1–6 medical students	To investigate the relationship between several aspects of deliberate practice like planning, study style, motivation and self-reflection and study achievements among undergraduate students	Motivation significantly correlated ($r = 0.3$) with academic performance	Questionnaire-based, Quantitative
31	O'Neill et al. (1999)	UK, 1290 medical students	To look at students' perceptions and effects of awarding degree with honours	More students from the earlier years agreed that a degree with honours was a motivator for learning and the number decreased as they approached final year. An honours system does not necessarily motivate students and may demotivate a significant number of them over time-course of the study	Mixed-methods study
32	Pelaccia et al. (2009)	France, 302 medical and nursing students with a ratio of 1:2	To assess the impact of training periods in the emergency department on the motivation of health care students to learn in the field of emergency medicine	Experiential learning without negative outcome events increases intrinsic motivation for a course. Intrinsic motivation is positively correlated with high perceived task value ($r = 0.546$), self-efficacy ($r = 0.419$) and autonomy in learning ($r = 0.354$)	Questionnaire-based, Quantitative
33	Popovic (2010)	UK, 436 first-year medical students	To identify any connection between students' ethnicity, affluence and academic performance	Neither intrinsic nor extrinsic motivation was significantly correlated with academic performance	Questionnaire-based, Quantitative
34	Powell et al. (1987)	UK, 30 first-, third- and final- year medical students	To study medical students' perceptions of medicine and its specialties	First-year students are more oriented towards prestige, money and success, but final-year students are more oriented towards relief of suffering and importance for mankind. Though this study was of good quality, the findings have limited generalizability as the sample size was very small ($N = 30$)	Questionnaire-based, Quantitative

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Table A1. Continued.

No.	Study reference	Country setting, *N*	Research objectives	Findings relevant to the review	Type of study
35	Price et al. (1994)	Australia, 399 first-year medical students	To correlate motivational and demographic factors with performance in medical study and its completion	Altruistic reasons were the most important for most males and females, though more females were oriented towards them than men and more men than females were oriented towards financial security. Students entering medicine with intellectual challenge as the most important motive were found to have higher GPAs, though the variance in GPA explained was low, i.e. around 5% ($r = 0.05$)	Questionnaire-based, Quantitative
36	Ratanawongsa et al. (2008)	USA, 26 residents	To explore residents' concept of well-being and how it affects their work	Well-being affects motivation in daily work and overall career; lower motivation leading to feelings of ambiguity in career choice and higher well-being leading to greater zeal towards purpose in medicine and intrinsic passion for work	Qualitative
37	Robbins et al. (1983)	USA, 144 third-year and 74 fourth-year medical students	To assess similarities and differences between male and female medical students with respect to fear of success, interests and attitudes towards medical school	Males found interest in science, helping people and having a career, most important motivations to join medicine; whereas women ranked helping people first	Questionnaire-based, Quantitative data assessed quantitatively
38	Rogers et al. (1990)	USA, 266 medical students	To seek factors that influence medical students to choose primary care or non-primary care specialties	Motives for choosing primary care specialties were longitudinal patient care opportunities, whereas motives for choosing non-primary care specialties were better lifestyle, monetary rewards and prestige	Questionnaire-based, Quantitative
39	Rolfe et al. (2004)	Australia, 608 medical students and graduates	To compare the medical school experiences, research and academic achievements and practice outcomes of graduates who entered medical study with high school background vs. tertiary background	Working with people, intellectual satisfaction and helping others and were the most important motives for joining medicine for both high school and tertiary entrants. Significantly more tertiary entrants entered for professional independence than high school entrants and more high school than tertiary entered because of parental pressure. Also significantly more high school entrants had doubts about wanting to be a doctor as compared to tertiary entrants	Questionnaire-based, Quantitative
40	Sobral (2008)	Brazil, 247 first-year medical students	To study the scope of student-selected components in a medical programme and analyse their relationships with achievement and motivation	Higher intrinsic motivation was related to more optional course credits and peer-tutoring activities	Quantitative study

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Table A1. Continued.

No.	Study reference	Country setting, *N*	Research objectives	Findings relevant to the review	Type of study
41	Sobral (2004)	Brazil, 297 first-year medical students	To describe the patterns of medical students' motivation early in the undergraduate programme and to examine their relationships with learning features and motivational outcomes	Medical students portray distinct patterns of autonomous and controlled motivation that seem to relate to the learners' frame of mind towards learning as well as the educational environment. (GPA in pre-clinical years and motivation correlation $r = 0.14$).	Quantitative
42	Tan and Thanaraj (1993)	Malaysia, 128 second-year medical students	To explore interactions between study orientations and preferences for different kinds of learning environments	Intrinsic motivation was significantly negatively correlated with academic grades, but it was measured with only one item in the questionnaire	Quantitative
43	Tanaka et al. (2009)	Japan, 112 second-year medical students	To examine the relationships between personality traits and intrinsic academic motivation	The temperament dimension of persistence ($r = 0.237$) and the character dimensions of self-directedness ($r = 0.369$) and self-transcendence ($r = 0.223$), which are expected to enhance the learning process, are associated with intrinsic academic motivation in medical students	Questionnaire-based, Quantitative
44	Todisco et al. (1995)	Australia, 645 first-year medical students	To investigate gender differences in motivations of students at entry into medical school	Both male and female medical students ranked desire to help others as the most important motivation, followed by scientific nature and intellectual challenge of the profession	Ranking-based, Quantitative
45	Vaglum et al. (1999)	Norway, 379 first-year medical students	To study motivation of students for going to medical school	Most important motives influencing the decision to study medicine are helping people, desire for challenge and interest in human biology. Female medical students scored higher on the person-oriented motive, lower on natural science motive and equal to male medical students on status-oriented motive. Differences were also found in motives for choosing specialties	Questionnaire-based, Quantitative
46	Von Below (2008)	The Netherlands, 60 students, 15 facilitators	To assess and analyse students' and clinical facilitators' experiences of the Early Professional Contact course	'Early Professional Course' increased student motivation for biomedical and further study. Students were inspired for their future work as doctors	Questionnaire-based, Quantitative
47	Wagoner and Bridwell (1989)	USA, 180 high school students	To assess general motivational factors for choosing a career and to explore if there are ethnic differences	Differences were found between white and black medical students motivations to choose a medical career. Black students gave significantly higher ratings to earning potential, job security and status of a physician than white students	Questionnaire-based, Quantitative

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Table A1. Continued.

No.	Study reference	Country setting, *N*	Research objectives	Findings relevant to the review	Type of study
48	Webb et al. (1997)	USA, 206 first-year medical students	To examine relationship between medical school performance and non-academic variables like leadership, expected difficulty in medical school and motivation	Non-academic variables like leadership, motivation and expected difficulty level predicted about 11% variance in academic performance in only one school and the size of correlation of motivation and performance was small ($r = 0.22$) and not significant	Questionnaire-based, Quantitative
49	White et al. (2007)	USA, 36 medical students	To explore links between medical students' use of self-regulated learning as it relates to motivation, autonomy and control by comparing PBL and traditional curricula	PBL curriculum motivated students to learn for learning's sake, i.e. intrinsic motivation. This could be because of the autonomy they find in their learning. These students were able to channelize their motivation for effective transition from the classroom to the clerkship. Traditional curriculum motivated students towards obtaining high grades, i.e. extrinsic motivation. This could be because of a controlling environment by the faculty. The transition from classroom to clerkship for these students was more difficult	Interview-based, Qualitative
50	Wierenga et al. (2003)	West Indies, 193 medical students	To study motivation for and concerns about studying medicine and future career plans of students	Main motivations were joining medicine were people oriented, interest in human biology and defined profession. Males had significantly higher orientation than females towards prestige/status, whereas women had higher orientation towards working with people	Questionnaire-based, Quantitative
51	Wilkinson et al. (2007a)	New Zealand, 173 fourth-and fifth-year medical students	To determine how time in study relates to motivation and study approaches	Higher achievement motivation, certainty of career choice and lack of confidence are associated with greater time investment in study	Quantitative
52	Wilkinson et al. (2007b)	New Zealand, 1258 medical students	To evaluate the impact of standards-based assessments on medical student learning	Standards-based assessment system was found to be associated with beneficial effects on deep motive, deep strategy and professional identity	Questionnaire-based, Quantitative
53	Williams et al. (1997)	USA, 207 fourth-year medical students	To determine whether autonomy support by instructors during Internal medicine and surgery clerkships could predict that those students would choose that particular specialty	Choice of internal medicine ($r = 0.29$) and surgery ($r = 0.34$) clerkships were significantly correlated with the students' perceptions of autonomy support on their corresponding clerkships. The correlations, though significant, were small in size. Autonomy support enhances students' motivation to select a residency in that particular field of medicine	Questionnaire-based, Quantitative

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Table A1. Continued.

No.	Study reference	Country setting, *N*	Research objectives	Findings relevant to the review	Type of study
54	Williams and Deci (1996)	USA, 56 second-year medical students with follow-up data after 2 years	To test whether instructors who are perceived as more autonomy supportive will facilitate students becoming more autonomous in their learning	Autonomy support by teachers was a significant predictor for both, students' autonomous motivation and competence for a study course	Quantitative
55	Willis et al. (2002)	UK, 16 second- and third-year medical students	To focus on producing a qualitative description of the cognitive and motivational influences on group processes and how they contribute to a successful PBL group	Students in PBL groups felt motivated for group working as they perceived that it was responsible for delivering their learning	Qualitative study
56	Woltering et al. (2009)	Germany, 97 and 88 third-year medical students in blended PBL and traditional PBL, respectively.	To determine whether blended PBL increases students' motivation and supports their learning process	Students' motivation is higher in blended PBL as compared to traditional PBL, both through quantitative and qualitative data	Mixed-methods study