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# Examining the link between burnout and medical error: A checklist approach

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ABSTRACT

*Background:* The aim of this cross-sectional study was to develop an evidence-based systematic Medical Error Checklist (MEC) for self-reporting of medical errors. In addition the study examined the comparative influence of individual, structural, and organizational factors on the frequency of self-reported medical errors.

*Research design:* A three-step process was followed in order to develop three checklists, for internists, surgeons and pediatricians respectively. The Maslach Burnout Inventory (MBI), the Utrecht Work Engagement Scale (UWES) and the teamwork-subscale of the Hospital Survey on Patient Safety Culture (AHRQ) were used in order to measure physicians' levels of burnout, job engagement and teamwork respectively. A total of 231 doctors working in a large teaching hospital in Greece participated in the study (response rate: 49.8%).

*Results:* Internal reliability coefficients were high for all three checklists. Gender, age, clinical experience, and working hours were not related to medical errors in any of the medical specialties. In surgeons, medical errors were negatively related to engagement ($R^2 = 0.210$, $p = 0.004$), while teamwork and depersonalization were the only predictive factors of frequency of medical errors, in both pediatricians and internists ($R^2 = 0.306$ $p < 0.001$).

*Conclusions:* The Medical Error Checklists developed in this study advance the study of medical errors by proposing a comprehensive, valid and reliable self-assessment tool. The results highlight the importance of hospital organizational factors in preventing medical errors.



## 1. Introduction

Incident reporting and analysis has been systematically used in an attempt to improve patient safety. The main reason for reporting incidents to improve patient safety is the belief that safety can be improved by learning from incidents and near misses, rather than pretending that they have not happened (Smith, 2007). However, a consistent finding in the literature is that nurses and physicians can identify error events, but nurses are more likely to submit written reports or use error-reporting systems than are physicians (Mahajan, 2010). One of the main factors contributing to the use of incident reporting is the way the data are gathered. Traditional mechanisms have utilized self-reports to clinically significant medical errors; yet the correlation with actual errors has been low (Cullen, Bates, & Small, 1995). However, self reports are still a widely used method for error recording, especially in studies examining associations between individual and organizational risk factors and medical errors. The exemplar studies in this area have used single-item open-ended assessments (Hayashino, Utsugi-Ozaki, Feldman, & Fukuhara, 2012; Shanafelt et al., 2010; West et al., 2006). For example, Shanafelt et al. (2010) used one question ("Are you concerned you have made any major medical error in the last 3 months?") to assess medical errors among 7905 American surgeons (Shanafelt et al., 2010). This study showed a strong association between medical errors reported by surgeons and burnout. Using the same methodology, West et al. (2006) and Hayashino et al. (2012) found the same relationship between burnout and medical error with residents and practicing physicians, respectively (Hayashino et al., 2012; West et al., 2006).

The aforementioned studies highlight the link between error reporting and burnout. However, single-item assessments suffer from common method bias that overestimates relationships (Brannick, Chan, Conway, Lance, & Spector, 2010). In addition, retrospective and social desirability biases associated with single-item

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assessments can also confound the reported relationships between burnout and reported medical errors. The problems associated with the use of single-item approaches can be overcome via the development of a systematic reliable and valid checklist that will allow us to link specific errors to specific risk and preventive factors in different medical specialties (Resar, Rozich, & Classen, 2003). Additionally, checklists that use behavioural rather than attitudinal items, have the potential to more reliably assess the relationship between self-report measures. They achieve this by reducing the tendency for respondents to believe that two constructs are related by an implicit theory (i.e., making mistakes and being stressed), because if they are, then the respondents are motivated to provide answers that are consistent with that theory (Podsakoff, Whiting, Podsakoff, & Blume, 2009).

Self-reports can be used effectively for error prevention purposes, as well as for training doctors or involving them in quality improvement practices (Thomas and Petersen, 2003). The only study using a systematic methodology to assess medical errors with self-reports was the MEMO study conducted in primary care settings (Williams, Manwell, Konrad, & Linzer, 2007). Their nine item scale assessing the likelihood of future errors was related to a single item measure of burnout, but at a very low level of significance, in contrast to single-item studies which indicate moderate-high correlations. To our knowledge no instrument exists to systematically self assess frequency of medical errors in hospital settings.

The aim of this cross-sectional study was to develop an evidence-based systematic checklist for self reporting of medical errors in hospital settings. In addition, using the newly developed checklist, the study examined the comparative influence of individual, structural, and organizational factors on the frequency of self-reported medical errors.

## 2. Material and methods

The study reported in the manuscript has been approved by the "Ethical committee of the Medical School, Aristotle University of Thessaloniki". Written consent was obtained from all participants and questionnaires were completed and analyzed anonymously.

Burnout, work engagement and teamwork were assessed as organizational factors, while gender, age and clinical experience were assessed as individual factors. Working hours were assessed as a potential contributing structural factor.

### 2.1. Measures

#### 2.1.1. Development of the medical error checklists (MEC)

A three-step process was adopted in order to develop the Medical Error Checklists. The purpose of the first two phases was to develop an evidence-based, exhaustive pool of items to be used for the checklists. *Firstly,* a systematic review of the literature on self reported medical errors was conducted. The aim of the review was to identify all different types of medical errors which have been reported in three different specialties: surgery, internal medicine and pediatrics. *In the second phase*, focus groups with doctors from the three different specialties were conducted. For each specialty two focus-groups were conducted, one addressing medical residents and the other addressing medical specialists. Participants were asked to respond and discuss two questions: *"What types of medical errors can occur in your specialty"* and *"What types of medical errors have you observed occurring in your specialty"*. They were also asked to discuss the list of errors compiled from the review conducted in the first phase. The focus groups were coordinated by two members of the research team. Thematic analysis was used to analyze the results of the focus groups. Results from phase I and II were compiled to produce three checklists of medical errors, one for each specialty. In *phase III*, the checklists were reviewed by three expert panels, consisting of senior researchers from each specialty. Each item in the checklist was rated for clarity, specificity, relevance, and differential validity.

This three-step process resulted in the development of three checklists (see Appendix A), MEC-I for internists, MEC-S for surgeons and MEC-P for pediatricians. The items included in the checklists represent all types of medical errors (diagnostic, treatment, failure of communication, system failure). MEC-I consists of 26 items, MEC-S of 23 items, and MEC-P of 25 items. Each item represents a different error. To reduce biases associated with retrospective assessment and social desirability, respondents are asked to indicate in a visual analogue scale how often they have observed the occurrence of each error in their present work context.

#### 2.1.2. Individual and structural factors (sex, age, specialty, clinical experience, working hours/per week)

A demographic questionnaire was developed for the purpose of the study. Clinical experience was evaluated as the total number of working years, including the years of specialty.

#### 2.1.3. Job burnout

Job burnout was assessed using the Maslach Burnout Inventory (MBI). We used two components of burnout, emotional exhaustion (9 items) and depersonalization (5 items) (Maslach, Jackson, & Leiter, 1996). The Greek version of the MBI has been previously validated among Greek health care professionals (Panagopoulou, Montgomery, & Benos, 2006).

#### 2.1.4. Job engagement

Engagement was assessed with the Utrecht Work Engagement Scale (UWES) (Schaufeli, Salanova, González-romá, & Bakker, 2002). The scale assesses three dimensions of engagement, Vigor (six items), Dedication (five items), and Absorption (six items). Responses are given in a 6- Likert scale, ranging from 0 "never" to 6 "always". The UWES has been validated in a Greek sample (Matziari, Montgomery, Georganta, & Doulougeri, 2016). In order to avoid response bias, burnout and engagement items were randomly merged into the final questionnaire.

#### 2.1.5. Teamwork

Teamwork was measured with the teamwork-subscale of the Hospital Survey on Patient Safety Culture which was developed by the US Agency for Healthcare Research and Quality (AHRQ) (Miller, Hill, Kottke, & Ockene, 1997). The teamwork subscale includes four items. Responses are given in a 6-Likert scale, ranging from 1 "strongly disagree" to 5 "strongly agree". The total score comes by obtaining the mean of the responses to the 4 items and ranges from 1 to 5.

### 2.2. Procedure

The study took place in a city University hospital in the area of Thessaloniki, Greece. After obtaining ethical permission of the "Ethical committee of the Medical School of the Aristotle University of Thessaloniki", all medical staff working in the Departments of Internal medicine, Surgery, and Pediatrics were informed about the study. Staff interested in participating in the study were invited in a meeting in the hospital lecture hall and after obtaining their written consent, they were given the questionnaire to complete. Questionnaires were completed anonymously and sealed in envelopes. Clinic directors were not present during the completion of questionnaires.

**Table 1**
Descriptive information.

| Frequency of medical errors | Mean | SD | min | max | α-coefficients |
|---|---|---|---|---|---|
| MEC-I | 1.99 | 1.07 | 0.33 | 4.42 | 0.953 |
| MEC-S | 1.15 | 0.69 | 0.00 | 3.41 | 0.932 |
| MEC-P | 1.57 | 1.14 | 0.24 | 4.56 | 0.966 |

### 2.3. Sample

A total of 231 doctors participated in the study (response rate: 49.80%), 154 men (66.7%) and 77 women (33.3%). The sample consisted of 66 internists (28.6%), 48 pediatricians (20.8%) and 117 surgeons (50.6%). At the time of the study, participating doctors were working on average 56.37 h/week (SD: 22.2), and their working experience was on average 7.89 working years (SD: 12.46).

### 2.4. Statistical analysis

Responses in each checklist were averaged to produce a final score (range 0–7). Given the small number of participants, exploratory factor analysis was not performed, and all items in each checklist contributed to the total score. Alpha-reliability coefficients were calculated for each checklist.

Pearson correlations and independent Students –t test were used to initially assess the relationship between medical mistakes and each predicting factor. Multiple linear regression analysis was used to study the impact of individual, structural and organizational factors on the frequency of medical mistakes in each specialty. Only factors with significant associations in the univariate analysis were entered in the regression models.

## 3. Results

Mean, standard deviation range of scores, and α-coefficients for MEC-I, MEC-S, and MEC-P are shown in Table 1. Internal reliability coefficients were high for all three checklists.

In order to increase the power of the regression analysis, responses to MEC-I and MEC-P were merged into one score, using all common items from the two checklists. The α coefficient for the new measure was α = 0.89. Therefore all further analyses were conducted in two subgroups, one for surgeons (N = 117), and one for internists and pediatricians (N = 114).

Univariate analyses showed a significant negative association because MEC- P & I and team work (R = –0.506, p < 0.001), and a significant positive association between MEC- P & I and depersonalisation (R = 0.388, p < 0.001).

For MEC – S, results show significant positive associations with emotional exhaustion (R = 0.200, p = 0.006), depersonalisation (R = 0.264, p = 0.005), and significant negative associations with team work (R = –0.260, p = 0.006), and engagement (R = –0.331, p > 0.001). No associations were found for any of the other factors and MEC S.

Multiple regression analysis showed that for internists and pediatricians, medical errors were predicted mainly by team work, and depersonalization. In surgeons, medical errors were related only to engagement. (Table 2)

**Table 2**
Multiple regression analyses.

| Specialty | Factors | Beta | p-value |
|---|---|---|---|
| Internists & Pediatricians | Teamwork | –0.422 | 0.000 |
| $R^2$ = 0.306 | Depersonalization | 0.239 | 0.005 |
| F = 22.95 | | | |
| Sig = 0.000 | | | |
| Surgeons | | | |
| $R^2$ = 0.210 | | | |
| F = 6.64 | Engagement | –0.280 | 0.016 |
| Sig = 0.004 | | | |

## 4. Discussion

In contrast to previous studies relying mostly on open-ended, or single item assessments, the checklists developed in this study, include an evidence-based list of medical errors (Resar et al., 2003). In contrast to studies using a single-item approach, this study showed no association between burnout and medical errors for surgical specialists, and a moderate association only for depersonalization, for internists and pediatricians (Hayashino et al., 2012; Shanafelt et al., 2010; West et al., 2006). This finding suggests the importance of the multidimensional approach to the assessment of burnout. Recently, Maslach and Leiter (2016) have argued that it is possible that people experience only one dimension of burnout, i.e. emotional exhaustion, or depersonalisation (Maslach and Leiter 2016). This study suggests that different dimensions of burnout might be related to different outcomes. In terms of burnout, our results are in contrast with previous studies showing strong associations between high rates of burnout and increased frequency of self-reported medical errors (West et al., 2006). However, in a previous study conducted by Fahrenkopf et al. (2008) using objective indicators of medical errors,no association was found between medical errors and burnout (Fahrenkopf et al., 2008). It is therefore plausible to argue that the relationship between burnout and existing self-reports of medical errors might be overestimated due to common method variance. Future research should explore the role of different assessment methods in examining the association between different dimensions of burnout and medical errors.

This study was the first attempt to develop and test a systematic, evidence-based checklist for the self-assessment of medical errors. The Medical Error Checklists advance the study of medical errors by proposing a comprehensive, valid and reliable self-assessment tool, to be used for examining the causal role of specific risk factors to medical errors. Our results are consistent with the trend in the MEMO study, where their nine-item measure of error likelihood indicated low correlations with other self-report measures (Williams et al., 2007), which were significantly lower than the correlations between the other variables measured. The strength of the MEC approach is that it's systematic, uses multiple behavioural items and specialty specific. The checklists proposed in this study can also be used for training purposes in daily medical practice as well as in promoting the involvement of doctors in quality and patient safety programs (Thomas and Petersen, 2003).

The findings of this study support previous finding that hospital organizational factors play a core role in medical errors, while the role of other factors such as clinical experience, or working hours may be overestimated. In terms of clinical experience, results of this study agree with a recent study in the UK of prescription errors in hospitals, which indicated that experience was not an important predictor (Ross, Wallace, & Paton, 2000). Working hours were not related to frequency of self-reported medical errors, which is in agreement with studies conducted by Shanafelt et al. (Shanafelt, Bradley, Wipf, & Back, 2002).

Our results highlight the protective role of engagement in preventing medical errors among surgeons. Engagement is defined as a positive, fulfilling, work-related state of mind characterized by vigor, dedication, and absorption (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001). Previous studies have also documented the beneficial role of work engagement on medical errors (Prins et al., 2009).

In addition, this study also highlighted the protective role of teamwork among internists and pediatricians. This finding is in

agreement with the existing evidence in medical errors research, which shows that teamwork breakdowns are one of the main factors contributing to errors in surgical practice (Helmreich and Davies, 1996; Singh, Thomas, Petersen, & Studdert, 2007), in the emergency room (Risser et al., 1999; Schenkel, Khare, Rosenthal, Sutcliffe, & Lewton, 2003) and in intensive care units (Donchin et al., 1995; Landrigan et al., 2004). They also indicate that the relationship is also present in other specialties such as internal medicine (Lockley et al., 2004) and pediatrics (Ross et al., 2000).

### 4.1. Limitations

Despite the fact that the Medical Error Checklists developed in this study, suggest a more systematic, evidence-based self-assessment of medical errors they are still subject to the limitations associated with self reports. In specific, respondents might have overrepresented preventable errors compared to other types of errors, however research indicates physician reports of adverse events agree largely with medical records (O'Neil et al., 1993). Additionally, the fact that burnout was not related to medical errors in any of the specialties suggests that the biases associated with common method variance were not present in this study. Also, since there is no information on non-responders' level of burnout it is likely that the burnout levels of participants of our sample were under-estimated. In addition, future studies should test the validity and reliability of the MECs in randomised samples in different hospital settings, using longitudinal designs.

## 5. Conclusions

Reducing medical errors is a critical priority for all health care systems. So far, none of the methods used to study the prevalence of errors seems to be ideal for all purposes (Thomas and Petersen, 2003). The use of Medical Error Checklists is a comprehensive alternative to medical error detection. It is also in agreement with the literature on the use of safety checklists, which have been successfully used by high-risk professionals (pilots, submarine crews and nuclear plant operators) to ensure safety (Gawande, Zinner, Studdert, & Brennan, 2003; Karl, 2010; Reason, 2000). In medicine, checklists have also been widely used in order to ensure the completion of critical procedures at hospitals (O'Neil et al., 1993).

Findings of this study can be used in order to develop training programs for health professionals. Providing safe healthcare depends on highly trained professionals with different roles acting together in the best interests of the patient. In order to achieve that, health professionals need to be able to work effectively in teams. Indeed, team training programs that address teamwork and communication for health professionals are increasing in number, being more heterogeneous and being evaluated for frequently (Thomas 2011). In addition, the findings highlight the important of leadership programs in healthcare. Ultimately, physician leaders are responsible for leading healthcare and will directly impact the quality of care delivered to our patients. (Maykel, 2013).

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## Appendix A.

See Table A1–A3 .

**Table A1**
MEC-I: Read carefully the following list and check whether and how often you were **involved** in the following **problems** during your clinical work in the last semester. On the scale next to each statement put an x for your answer.

| | | |
|---|---|---|
| 1 | Failure to take adequate precaution to prevent infections | Never – Every day |
| 2 | Failure to investigate history of allergy | Never – Every day |
| 3 | Omission of basic medical processes (i.e. measurement of blood pressure) | Never – Every day |
| 4 | Delay of basic medical processes (i.e. glucose measurement) | Never – Every day |
| 5 | Incomplete medical record (essential information not recorded, incomplete or erroneous) | Never – Every day |
| 6 | Errors in management of specimens (i.e. wrong name in a patient's blood sample) | Never – Every day |
| 7 | Errors or omissions in the required paraclinical test in order to diagnose a patient | Never – Every day |
| 8 | Incomplete recording of clinical information in the referral forms for paraclinical tests ??? | Never – Every day |
| 9 | Failure to investigate the possibility of pregnancy before conducting radiological control in women of childbearing age | Never – Every day |
| 10 | Unnecessary medical procedures (i.e. unnecessary paraclinical examinations, tests) | Never – Every day |
| 11 | Equipment failure (medical and diagnostic tools that are not functioning properly or have dead batteries can lead to serious injury or death) | Never – Every day |
| 12 | Diagnostic mistakes (a condition not/wrongly diagnosed, complications not diagnosed, underlying disease/associated diseases not diagnosed) | Never – Every day |
| 13 | Treatment mistakes (wrong condition treated, wrong choice of treatment plan, wrong type of treatment given, wrongly delayed treatment) | Never – Every day |
| 14 | Drug administration errors (incorrect/wrong drug given, incorrect dose given, drug given by the wrong route, incorrect rate of administration) | Never – Every day |
| 15 | Dose delayed | Never – Every day |
| 16 | Dose omitted | |
| 17 | Extra dose given | Never – Every day |
| 18 | Errors in patient nutrition | Never – Every day |
| 19 | Omissions or errors to the transmission of information/orders from doctors to nurses | Never – Every day |
| 20 | Prescription mistakes (inappropriate/wrong medication, wrong medication combinations, adverse reactions to medication, side effects of medication) | Never – Every day |
| 21 | Incomplete prescription (i.e. not signed, dose not stated) | Never – Every day |
| 22 | Illegible prescription | |
| 23 | Unnecessary medical treatment (unnecessary medication, visits) | Never – Every day |
| 24 | Incomplete information to the patient for the diagnosis | Never – Every day |
| 25 | Incomplete information to the patient for the treatment | Never – Every day |
| 26 | Failure to take a patient's consent before performing medical procedures | Never – Every day |

**Table A2**
MEC-S: Read carefully the following list and check whether and how often you were **involved** in the following **problems** during your clinical work in the last semester. On the scale next to each statement put an x for your answer.

| | | |
|---|---|---|
| 1 | Error in diagnosis | Never — Every day |
| 2 | Delay in diagnosis | Never — Every day |
| 3 | Errors or omissions in the required paraclinical test in order to diagnose a patient | Never — Every day |
| 4 | Error in the design of treatment plan (surgical or non surgical treatment choice) | Never — Every day |
| 5 | Error in choice of operative procedure | Never — Every day |
| 6 | Error in choice of preoperative preparation | Never — Every day |
| 7 | Errors in patient nutrition | Never — Every day |
| 8 | Omissions or errors in the transmission of information/orders between doctors or between doctors and nurses | Never — Every day |
| 9 | Incomplete/incorrect patient information before surgery | Never — Every day |
| 10 | Failure to take patient's consent before surgery | Never — Every day |
| 11 | Delay to operating room due to inadequate preoperative evaluation/preparation | Never — Every day |
| 12 | Incomplete hospital record: Essential information not recorded, incomplete or erroneous | Never — Every day |
| 13 | Incomplete hospital record: Wrong side or wrong body part described | Never — Every day |
| 14 | Incomplete hospital record: No documentation of operative procedure | Never — Every day |
| 15 | Error in technique during surgery | Never — Every day |
| 16 | Accidental dislocation of drains/nasogastric tubes/i.v. lines | Never — Every day |
| 17 | Break in sterile technique during surgery | Never — Every day |
| 18 | Patient injury resulting in falls | Never — Every day |
| 19 | Nerve and joint injuries according to bad positioning | Never — Every day |
| 20 | Improper identification, mishandling or loss of specimens | Never — Every day |
| 21 | Retained drains, gauzes or stitches in wound | Never — Every day |
| 22 | Errors/omissions in patient's postoperative management | Never — Every day |
| 23 | Drug errors postoperatively | Never — Every day |

**Table A3**
MEC-P: Read carefully the following list and check whether and how often you were **involved** in the following **problems** during your clinical work in the last semester. On the scale next to each statement put an x for your answer.

| | | |
|---|---|---|
| 1 | Failure to take adequate precaution to prevent infections | Never — Every day |
| 2 | Failure to investigate history of allergy | Never — Every day |
| 3 | Omission of basic medical processes (i.e. measurement of body weight) | Never — Every day |
| 4 | Delay of basic medical processes (i.e. glucose measurement) | Never — Every day |
| 5 | Incomplete medical record (essential information not recorded, incomplete or erroneous) | Never — Every day |
| 6 | Errors in management of specimens (i.e. wrong name in a patient's blood sample) | Never — Every day |
| 7 | Errors or omissions in the required paraclinical test in order to diagnose a patient | Never — Every day |
| 8 | Incomplete recording of clinical information in the referral forms for paraclinical tests ??? | Never — Every day |
| 9 | Unnecessary medical procedures (i.e. unnecessary paraclinical examinations, tests) | Never — Every day |
| 10 | Equipment failure (medical and diagnostic tools that are not functioning properly or have dead batteries can lead to serious injury or death) | Never — Every day |
| 11 | Diagnostic mistakes (a condition not/wrongly diagnosed, complications not diagnosed, underlying disease/associated diseases not diagnosed) | Never — Every day |
| 12 | Treatment mistakes (wrong condition treated, wrong choice of treatment plan, wrong type of treatment given, wrongly delayed treatment) | Never — Every day |
| 13 | Drug administration errors (incorrect/wrong drug given, incorrect dose given, drug given by the wrong route, incorrect rate of administration) | Never — Every day |
| 14 | Dose delayed | Never — Every day |
| 15 | Dose omitted | Never — Every day |
| 16 | Extra dose given | Never — Every day |
| 17 | Errors in patient nutrition | Never — Every day |
| 18 | Omissions or errors to the transmission of information/orders from doctors to nurses | Never — Every day |
| 19 | Prescription mistakes (inappropriate/wrong medication, wrong medication combinations, adverse reactions to medication, side effects of medication) | Never — Every day |
| 20 | Incomplete prescription (i.e. not signed, dose not stated) | Never — Every day |
| 21 | Illegible prescription | Never — Every day |
| 22 | Unnecessary medical treatment (unnecessary medication, visits) | Never — Every day |
| 23 | Incomplete information to a patient's parents (or guardians) for the diagnosis | Never — Every day |
| 24 | Incomplete information to a patient's parents (or guardians) for the treatment | Never — Every day |
| 25 | Failure to take a consent from a patient's parents (or guardians)before performing medical procedures | Never — Every day |

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