"When the clock is ticking": The influence of time pressure on adherence to guidelines in primary care. A cross sectional study.

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2013-002700
Article Type:	Research
Date Submitted by the Author:	07-Feb-2013
Complete List of Authors:	Tsiga, Evangelia; Aristotle University of Thessaloniki, School of Medicine Panagopoulou, Efharis; Aristotle University of Thessaloniki, School of Medicine Sevdalis, Nick; Imperial College, London, Department of Surgery and Cancer Montgomery, Anthony; University of Macedonia, Social Sciences, Department of Educational and Social Policy Benos, Alexios; Aristotle University of Thessaloniki, School of Medicine
Primary Subject Heading:	General practice / Family practice
Secondary Subject Heading:	General practice / Family practice
Keywords:	PRIMARY CARE, GENERAL MEDICINE (see Internal Medicine), Health & safety < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

"When the clock is ticking'': The influence of time pressure on adherence to guidelines in primary care. A cross sectional study.

Corresponding author: Tsiga Evangelia

Postal address: Aristotle University of Thessaloniki, Medical School, Laboratory of Hygiene, GR-54124, Thessaloniki, Greece, e-mail: evelyntsiga@gmail.com, tel:00302310999154, fax:00302310999131

Tsiga Evangelia

School of Medicine, Aristotle University of Thessaloniki, Greece

Panagopoulou Efharis

School of Medicine, Aristotle University of Thessaloniki, Greece

Sevdalis Nick

Department of Surgery and Cancer, Imperial College, London, UK

Anthony Montgomery

Department of Educational and Social Policy, University of Macedonia, Social Sciences, Greece

Benos Alexios

School of Medicine, Aristotle University of Thessaloniki, Greece

Keywords: decision making, patient safety, primary care, General practice

Word count: 1684

ABSTRACT:

Objectives: Evidence from cognitive sciences has systematically shown that time pressure influences decision making processes. However, very few studies have examined the role of time pressure on adherence to guidelines in clinical practice. The aim of this study was to examine the influence of time pressure on adherence to guidelines in primary care concerning: history taking, clinical examination and advice giving. Design: A within-subjects experimental design was used. Setting: Academic. Participants: 34 GPs were assigned to two experimental conditions (time pressure vs no time pressure) consecutively, and presented with two scenarios involving virus respiratory tract infections. Primary and secondary outcome measures: Outcome measures included adherence to guidelines on history taking, clinical examination, and advice giving. Results: Under time pressure, General practitioners asked significantly less questions concerning presenting symptoms, than the ones indicated by the guidelines, (p =.019), conducted a less through clinical examination (p =.028), while they gave less advice on lifestyle (p =.05). Conclusion: As time pressure increases as a result of high workload, there is a need to examine how adherence to guidelines is affected in order to safeguard patient safety.

ARTICLE SUMMARY

Article focus

- Time pressure is a daily stressor in primary care and can significantly impact upon quality of health care delivered.
- Very few studies have examined the role of time pressure on adherence to guidelines in clinical practice.
- The aim of this study was to examine the influence of time pressure on adherence to guidelines in primary care concerning: history taking, clinical examination and advice giving.

Key messages

- This study showed that under time pressure, adherence to guidelines concerning history taking and advice giving is compromised.
- Given the tendency towards a reduction of consultation times across Europe, it is important to safeguard the accuracy and efficiency of the diagnostic and treatment process, in order to reduce medical errors and increase patient safety.

Strengths and limitations from this study

- This is the first study using an experimental design to examine the role of time pressure on medical decision making in primary care.
- Decisions taken in everyday clinical practice are more complex, and influenced by a multitude of explicit and implicit factors.

INTRODUCTION

Despite the fact that most medical decisions are taken in a context of pressure and uncertainty, time pressure has not been systematically addressed in relation to medical decision making.

Evidence from the cognitive sciences suggests that in situations with high time pressure or increased ambiguity, experts use intuitive decision making strategies rather than structured approaches[1-2]. It is therefore more likely for practicing physicians to rely on intuitive processes rather than evidence-based information, when formulating a decision under time pressure. In addition, evidence from psychological studies has systematically shown that time pressure influences risk assessment[3-5], the ability to learn[6-7], and complex cognitive processing[8]. Under time-pressure, individuals process information faster, while use of analytic thinking is reduced[9-10]. Additionally, when faced with time-constraint conditions, individuals rely more often on emotional cues[11-12].

Several studies have suggested that time pressure is one of the most important barriers to the use of evidence-based medicine in primary care[13-14]. A systematic review on observational studies showed that longer consultations were associated with reduced medication prescriptions and increased advice on lifestyle changes[15]. Similarly, Tamblyn et al showed that GPs tend to prescribe inappropriate medications during shorter office visits[16]. The study of Campbell et al showed that the most powerful predictor of the quality of management of chronic disease was the length of the consultation[17].

Although the above studies suggest a possible link between time pressure and evidence-based practice, their predictive validity is restricted by the fact that time pressure was assessed using self reports or observational methods. In addition shorter time visits were treated as synonymous to time pressure. To our knowledge, there is no experimental study on how time pressure impacts upon physicians adherence to guidelines.

However, evidence from several European countries suggests that the length of medical consultations is systematically decreasing. For example, in a study conducted by Deveugele in primary care settings across six European countries, it was shown that the mean length of consultation decreased by about 6.5 seconds for every increase of 10 contact units a week in a doctor's workload[18]. As time pressure increases as a result of high workload, there is a need to examine how adherence to guidelines is affected.

The aim of this study was to examine the influence of time pressure on GPs' adherence to guidelines concerning: history taking, clinical examination and advice giving.

METHODS

Research design

In order to increase power and decrease the error variance associated with differences among doctors, a within-subjects experimental design was used. Participants were assigned to two experimental conditions (time pressure vs no time pressure) consecutively. In each condition, participants were presented with two scenarios involving virus respiratory tract infections (RTI). They were asked to respond to questions concerning medical history taking, clinical examination, referrals for lab tests, likelihood and certainty of final diagnosis, treatment recommendations. In the experimental condition participants were given a specific time for each question. Participants in the control condition received no time constraints (figure 1). In order to avoid the effects of learning associated with within subjects' designs, the counterbalancing technique was used to define the order of presentation of each condition.

Clinical scenarios

For the purposes of the study, four clinical scenarios concerning the diagnosis and treatment of virus respiratory tract infections (RTI) were developed, using expert focus groups. All scenarios were standardised in an initial pilot study in terms of the amount, and quality of information included (see Appendix I).

Adherence to guidelines

Participant responses were evaluated by two independent experts based on the national guidelines set by the Greek Center for Disease Control and Prevention of Infectious Diseases[19-20].

Time pressure

A pilot study involving 12 general practitioners was conducted, in order to define the response time for each question in the time pressure condition[3, 21]. Using the equation suggested by Ordonez & Benson (1997) the response time for each question (T) was derived from the following equation: $T= TM_P-SD_P$. TM_P corresponded to the mean response time for each question in the pilot study, while SD_P to the mean standard deviation for each question in the pilot study.

Participants

For a within-subjects two group comparison where the difference is expected to be one standard deviation (ES=0.5, f=0.25), and where alpha is 0.05 and power is 0.8, the total sample size (per group) is expected to be 35. Participants were recruited using an advertisement in the electronic newsletter of the General Practitioner Society of Thessaloniki, Greece. They were invited to participate in a study concerning medical decision making in general practice. Of the 198 general practitioners working in primary health care in the Thessaloniki metropolitan area, 73 responded to the advertisement and finally 34 participated in the study. 38% of participants

were male, while the mean age of participants was 38.41 years (SD=0.97). All participants participated in both experimental conditions.

Procedure

The study took place in a quiet, non-hospital based setting. Participants were informed about the procedure and instructed to respond to the questions in the same way they would manage a patient in their daily practice. Demographic information was collected before the experiment. During the experiment, information on the presenting case appeared on the screen gradually followed by each question (Figure 1).

Statistical analysis

Results were analyzed in two steps: Firstly t-tests were used to compare the two conditions on the following general indicators: number of questions asked on present illness, number of questions asked on medical history, number of signs sought in clinical examination, number of diagnostic tests ordered, number of prescribed medications, and number of times lifestyle advice was given. In addition, the number of unnecessary diagnostic tests and treatment recommendations were assessed. Secondly, chi-square test was used to compare the two experimental conditions in terms of the number of correct responses.

RESULTS

Table 1 shows adherence of participants to the national guidelines concerning the management of viral respiratory infections. Under time pressure, general practitioners asked significantly less questions concerning presenting symptoms than the ones indicated by the guidelines, ($p = .019$), conducted a less through clinical examination ($p = .028$), while they gave less advice on lifestyle ($p = .05$).

In specific, statistically significant differences between the two experimental conditions were observed on answers concerning consciousness disorders ($p < 0.05$), nervous system examination ($p < 0.05$), confidence in diagnosis ($p < 0.05$) and smoking reduction advice ($p < 0.05$), with all the above being lower under the time pressure condition.

TABLE 1: GP answers according to Guidelines on RTI scenarios

		Time pressure no	Time pressure yes	p-value
Indicators				
Number of questions on present illness (Mean)		1.79	1.19	**0.019**
Number of signs in clinical examination (Mean)		5.69	4.48	**0.028**
Number of advice on lifestyle treatment used (Mean)		0.93	0.61	**0.050**
Number of other advice (Mean)		0.93	0.61	**0.050**
Questions about present illness	Nasal congestion	20.59%	8.82%	0.092
	Fever	55.88%	51.47%	0.679
	Cough	57.35%	38.24%	0.070
	Breathlessness	11.76%	8.82%	0.653
	Chest pain	1.47%	1.47%	1.000
	Dizziness	5.88%	0.00%	0.103
	Consciousness Disorders	13.24%	1.47%	**0.026**
	Intense/Continuous Vomiting	13.24%	7.35%	0.341
	Flu symptoms initially improved and returned or are getting worse the last 2 days	7.35%	1.47%	0.325
Questions on general medical history	Major disease/immunosuppression	22.06%	20.59%	0.871
Elements of Physical examination	Temperature measurement	41.18%	35.29%	0.600
	Pharynx inspection	89.71%	85.29%	0.517
	Neck lymph node palpation	27.94%	13.24%	0.063
	Lung auscultation	94.12%	98.53%	0.170
	Heart auscultation	29.41%	25.00%	0.660
	Examination of nervous system	82.35%	41.18%	**0.000**
Diagnosis	Respiratory viral infection	98.53%	98.53%	1.000
	% Confidence on the diagnosis	85.63%	62.67%	**0.006**
Medication Lifestyle treatment	Antipyretics/painkillers	89.71%	77.94%	0.113
	Increase fluid intake	64.71%	47.06%	0.115
	Rest/stay at home	47.06%	38.24%	0.424
	Avoid smoking	13.24%	0.00%	**0.010**
Other advice	Prevent transmission	2.94%	5.88%	0.523
	Re-examination, if symptoms persist or are getting worse	52.94%	52.94%	1.000

**Responses were averaged between the two scenarios of each condition*

DISCUSSION

This study examined the influence of time pressure on compliance with national guidelines, and diagnostic certainty.

Overall, GPs' adherence to guidelines in the management of viral respiratory tract infections, was low in both experimental conditions regarding history taking, and advice concerning life-style. This is in agreement with previous studies indicating that evidence-based guidelines, are still not being adequately implemented in daily clinical practice[22-23]. It is also related to the shift of modern medical practice towards more technocratic models of diagnosis and treatment[24-25].

However, under time pressure, participants asked less questions concerning symptoms of the presenting illness, and conducted less thorough clinical examinations, as indicated by the national guidelines. For example, participants were less likely to ask about consciousness disorders during history taking, and less likely to examine the nervous system during the clinical examination, in order to exclude the possibility of meningitis. Since symptoms of VRIs can also be the presenting symptoms of both types of meningitis (bacterial and viral) the Greek Center for Disease Control and Prevention of Infectious Diseases, have included investigation of consciousness disorders, and nervous system examination as standard practice of the medical consultation. Failure to differentially diagnose meningitis can seriously compromise patient safety. This finding suggests that under time pressure GP's were more likely to overlook less frequent conditions (availability heuristic)[26]. This tendency could have been exacerbated by the fact that the study was conducted during the time of the influenza pandemic in Greece.

In addition, under time pressure participants were less compliant with guidelines on giving advice on life style, especially concerning smoking habits. This finding is in accordance with a study by Wilson et al. showing that when the consultation time was increased, advice on smoking cessation, and alcohol reduction was more frequent[27]. Failure to give advice on life style changes compromises patient recovery, especially since evidence shows that in terms of treating VRIs lifestyle advice including smoking cessation, and increased fluid intake is the main treatment option.

Time pressure did not increase the ordering of diagnostic tests, a finding which is in contradiction with previous studies[28-29]. This could be due to the fact that in previous studies simulated patients were used instead of clinical scenarios, which increases the fear of malpractice and the tendency for defensive medicine. It could also be attributed to the content of the scenarios themselves which was consistent and therefore not requiring further testing.

In terms of diagnostic decisions no differences were observed between the two experimental conditions in terms of diagnostic accuracy. However, under time

pressure participants felt less confident with their diagnosis. These findings are in accordance with studies showing that time pressure has a strong negative effect on information seeking, while diagnosis confidence was negatively related to the amount of information accessed in an experimental study in airplane pilots[30].

Limitations

This study used an experimental design based on clinical scenarios. However, decisions taken in everyday clinical practice are more complex, and influenced by a multitude of explicit and implicit factors[31]. The use of simulated patients instead of clinical scenarios would have increased the ecological validity of the study. Another limitation concerns the nature of the scenarios used. Respiratory tract infections represent routine clinical cases with limited management options. It is possible that the effect of time pressure on guidelines adherence and on diagnostic accuracy, would have been more pronounced in more clinical ambiguous situations. Further research, using a broader content of clinical cases is needed in order to investigate the effect of time pressure on GP's diagnostic accuracy and confidence.

Conclusions

Time pressure is a daily stressor in primary care and can significantly impact upon quality of health care delivered[27,29]. However its influence on doctors' adherence to guidelines has not been systematically addressed. This study showed that under time pressure, adherence to guidelines concerning history taking and advice giving is compromised. Given the tendency towards a reduction of consultation times across Europe[32], it is important to safeguard the accuracy and efficiency of the diagnostic and treatment process, in order to reduce medical errors and increase patient safety.

FUNDING

This research received no specific funding

REFERENCES

1 Dror I, Busemeyer J, Basola B. Decision making under time pressure: An independent test of sequential sampling models. Mem Cognit 1999;27(4):713-25.

2 Croskerry P. The Cognitive Imperative: Thinking about How We Think. Em Med 2000;7:1223-31.

3 Ordonez L, Benson L. Decisions under time pressure: How time constraint affects risky decision making. Organizational behaviour and human decision processes 1997;71(2):121-40.

4 Ben Zur H, Breznitz JS. The effect of time pressure on risky choice behaviour. Acta Psychologica 1981;47:89-104.

5 Kerstholt JH. The effect of time pressure on decision-making behaviour in a dynamic task environment. Acta Psychologica 1994;86:89-104.

6 DeDonno MA, Demaree HA. Perceived time pressure and the Iowa Gambling Task. Judgm Decis Mak 2008; 3(8):636–640.

7 Cella M, Dymond S, Cooper A, et al. Effects of decision-phase time constraints on emotion-based learning in the Iowa Gambling Task. Brain Cogn 2007;64:164-169.

8 Van Harreveld F, Wagenmakers E, Van der Maas HL. The effects of time pressure on chess skill: an investigation into fast and slow processes underlying expert performance. Psychol Res 2007;71:591-7.

9 Benson L, Beach LR. The effects of time constraints on the prechoice screening of decision options. Organizational behaviour and human decision processes 1996;67(2):222–228.

10 Verplanken B. Need for cognition and external information search. J Res Pers 1993;27:238-52.

11 Wright P. The harassed decision maker: Time pressures, distractions, and the use of evidence. J Appl Psychol 1974;59(5):555-61.

12 Finucane ML, Alhakami A, Slovic P, et al. The affect heuristic on judgements on risks and benefits. J Behav Decis Mak 2000:13:1-17.

13 McKenna HP, Ashton S, Keeney S. Barriers to evidence-based practice in primary care. J Adv Nurs 2004;45(2):178-89.

14 McColl A, Smith H, White P and Field J. General practitioners' perceptions of the route to evidence based medicine: a questionnaire survey. BMJ 1998;316:7128.

15 Wilson A, Childs S. The relationship between consultation length, process and outcomes in general practice: a systematic review. Br J Gen Pract 2002;52:1012-20.

16 Tamblyn R, Berkson L, Dauphinee D, et al. Unnecessary prescribing of NSAIDS and the management of NSAID-related gastropathy in medical practice. Ann Intern Med 1997; 127:429-38.

17 Campbell SM, Hann M, Hacker J, et al. Identifying predictors of high quality care in English general practice: observational study. BMJ 2001;323:1-6.

18 Deveugele M, Derese A, van den Brink-Muinen A, et al. Consultation length in general practice: cross sectional study in six European countries. BMJ 2002 :31;325(7362):472.

19 Center for Disease Control and Prevention. Scientific Committee for Hospital Infections. Guidelines for diagnosis and empirical treatment of Infectious Diseases. Athens: Focus on Health Ltd 2007:4-11.

20 Center for Disease Control and Prevention. Greek Ministry of Health and Public Solidarity. Current clinical guidelines for the treatment of H1N1 clinical cases in health care services. Available at: www.keelpno.gr/Portals/0/Αρχεία/Γρίπη%20και%20εποχική%20γρίπη/gripi_nosok%5B1%5D.pdf. Accessed September 6, 2012.

21 Benson L, Svenson O. Post decision consolidation following the debriefing of subjects about experimental manipulations affecting their prior decisions. Psychological Research Bulletin 1993;32:1-13

22 Cleland JG, Cohen-Solal A, Aguilar JC, et al. Management of heart failure in primary care (the IMPROVEMENT of Heart Failure Programme): an international survey. Lancet 2002;360(9346):1631-9.

23 Steel N, Bachmann M, Maisey S, et al. Self reported receipt of care consistent with 32 quality indicators: national population survey of adults aged 50 or more in England. BMJ 2008;337:957.

24 Hampton R, Harrison MJ, Mitchel JR, et al. Relative contributions of history-taking, physical examination, and laboratory investigation to diagnosis and management of medical outpatients. BMJ 1975;2:486-89.

25 Davis-Floyd R. The technocratic, humanistic, and holistic paradigms of childbirth. Int J Gynaecol Obstet 2001:5-23.

26 Ely JW, Graber ML, Croskerry P. Checklists to Reduce Diagnostic Errors. Acad Med 2011;86(3):307-13.

27 Wilson A, McDonald P, Haynes L, et al. Health Promotion in the general practice consultation: a minute makes a difference. BMJ 1992;304:227-30.

28 Van der Weijden T, Van Bokhoven MA, Dinant G, et al. Understanding laboratory testing in diagnostic uncertainty: a qualitative study in general practice. Br J of Gen Pract 2002;52:974-80.

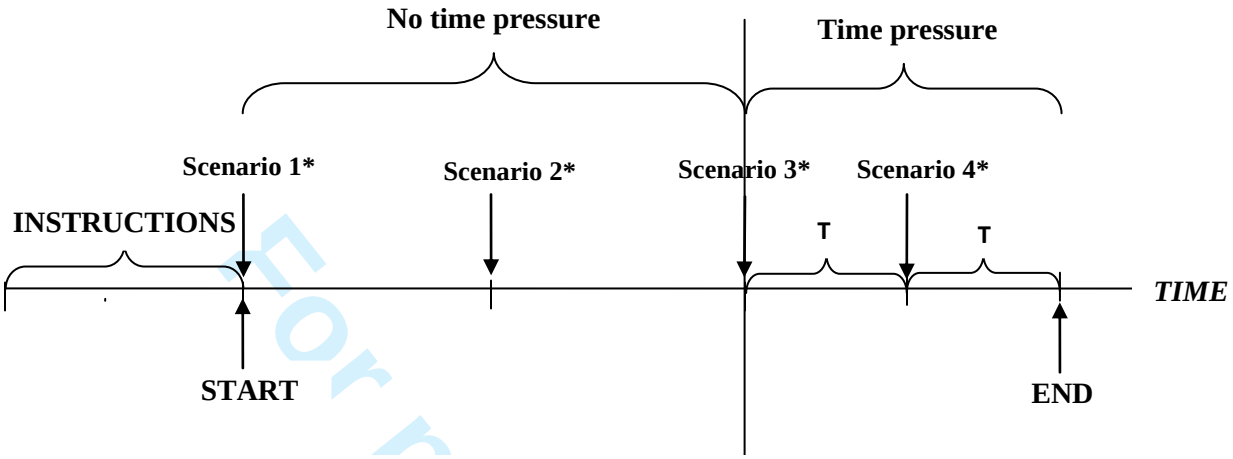
29 Whiting P, Toerien M, De Salis I, et al. A review identifies and classifies reasons for ordering diagnostic tests. J Clin Epidemiol 2007;60:981-9.

30 Mosier KL, Sethi N, McCauley S, et al. What you don't know can hurt you: Factors impacting diagnosis in the automated Cockpit. Human factors 2007;49(2):300-10.

31 Beullens J, Rethans JJ, Goedhuys J, et al. The use of standardized patients in research in General Practice. Fam Pract 1997;14(1):58-62.

32 Mechanic D. Politics, medicine and social science. Bristol: John Wiley, 1974.

FIGURE 1: Experimental design and procedure



*

SLIDE ORDER	INFORMATION ON THE SCREEN DURING EACH SCENARIO	QUESTIONS ON THE SCREEN AFTER VIEWING EACH PIECE OF INFORMATION
SLIDE 1	• *Presenting complaint*	Q1: Which are the most important questions you would like to ask this patient on his current illness/medical history?
SLIDE 2	• *Presenting complaint* • *Past Medical History*	Q2: Which are the most important signs that you want to look at in the physical examination? Q3: Are there any other questions you would like to ask this patient?
SLIDE 3	• *Presenting complaint* • *Past Medical History* • *Clinical Examination*	Q4: Are there any diagnostic tests you would like to order for this patient?
SLIDE 4	• *Presenting complaint* • *Past Medical History* • *Clinical Examination* • *Laboratory Tests (Only for the UTI Scenario)*	Q5: According to the above information what is the most likely diagnosis for this patient? Q6: How % confident you feel about this diagnosis? Q7: What is your treatment plan for this patient?

APPENDIX I: Example of clinical scenario used in the study

MEDICAL HISTORY	**IDENTIFING DATA**	**SEX**	male
		AGE	30 years
		MARITAL STATUS	married
		RESIDENCE	Thessaloniki, Greece
	PRESENTING COMPLAINT	Fever and cough	
	PRESENT ILLNESS	The present illness began 24 hours ago, with fever (up to 38.0^{o}C), dry cough, headache, sore throat, body aches and weakness. Fever subsides easily after taking paracetamol tablets of 500 mg, while cough is very annoying during the whole day.	
	PAST MEDICAL HISTORY	Free	
	MEDICATION	He is on no medication.	
	FAMILY HISSTORY	• Father 65 years old with hypertension (in medication). • Mother 58 years old with osteoporosis (in medication). • Brother 30 years old, free medical history.	
	PERSONAL AND SOCIAL HISTORY	**SMOKING STATUS**	12 pack years
PHYSICAL EXAMINATION	**VITAL SIGNS**	**Pulse**	102/min
		Blood Pressure	130/80 mmHg
		Temperature	38^{o}C
		Respiratory rate	16/min
		SpO_2	100%
	SKIN	Pale. Nails without clubbing, cyanosis.	
	HEAD, EYES, EARS, NOSE, THROAT	Mild redness of the pharynx. Other normal.	
	NECK	Normal.	
	LYMPH NODES	No tonsillar, cervical, axillary and inguinal nodes.	
	RESPIRATORY SYSTEM	Thorax symmetric with good excursion. Lungs resonant. Breath sounds vesicular with no added sounds.	
	CARDIOVASCULAR SYSTEM	Good S_1, S_2, no space, no S_3 or S_4. Tachycardia, no abnormal heart sounds or murmurs.	
	ABDOMEN	Bowel sounds active. No tenderness or masses.	
	MUSCULOSKELETAL SYSTEM	Normal.	
	NERVOUS SYSTEM	Normal.	
	GENITAL & URINARY SYSTEM	Normal.	

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5,6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5,6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	9
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8
Generalisability	21	Discuss the generalisability (external validity) of the study results	9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Please wait...

If this message is not eventually replaced by the proper contents of the document, your PDF viewer may not be able to display this type of document.

You can upgrade to the latest version of Adobe Reader for Windows®, Mac, or Linux® by visiting http://www.adobe.com/go/reader_download.

For more assistance with Adobe Reader visit http://www.adobe.com/go/acrreader.

Please wait...

If this message is not eventually replaced by the proper contents of the document, your PDF viewer may not be able to display this type of document.

You can upgrade to the latest version of Adobe Reader for Windows®, Mac, or Linux® by visiting http://www.adobe.com/go/reader_download.

For more assistance with Adobe Reader visit http://www.adobe.com/go/acrreader.

Please wait...

If this message is not eventually replaced by the proper contents of the document, your PDF viewer may not be able to display this type of document.

You can upgrade to the latest version of Adobe Reader for Windows®, Mac, or Linux® by visiting http://www.adobe.com/go/reader_download.

For more assistance with Adobe Reader visit http://www.adobe.com/go/acrreader.

Please wait...

If this message is not eventually replaced by the proper contents of the document, your PDF viewer may not be able to display this type of document.

You can upgrade to the latest version of Adobe Reader for Windows®, Mac, or Linux® by visiting http://www.adobe.com/go/reader_download.

For more assistance with Adobe Reader visit http://www.adobe.com/go/acrreader.

Please wait...

If this message is not eventually replaced by the proper contents of the document, your PDF viewer may not be able to display this type of document.

You can upgrade to the latest version of Adobe Reader for Windows®, Mac, or Linux® by visiting http://www.adobe.com/go/reader_download.

For more assistance with Adobe Reader visit http://www.adobe.com/go/acrreader.

The influence of time pressure on adherence to guidelines in primary care. An experimental study.

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2013-002700.R1
Article Type:	Research
Date Submitted by the Author:	08-Mar-2013
Complete List of Authors:	Tsiga, Evangelia; Aristotle University of Thessaloniki, School of Medicine Panagopoulou, Efharis; Aristotle University of Thessaloniki, School of Medicine Sevdalis, Nick; Imperial College, London, Department of Surgery and Cancer Montgomery, Anthony; University of Macedonia, Social Sciences, Department of Educational and Social Policy Benos, Alexios; Aristotle University of Thessaloniki, School of Medicine
Primary Subject Heading:	General practice / Family practice
Secondary Subject Heading:	Evidence based practice
Keywords:	PRIMARY CARE, GENERAL MEDICINE (see Internal Medicine), Health & safety < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

The influence of time pressure on adherence to guidelines in primary care. An experimental study.

Corresponding author: Tsiga Evangelia

Postal address: Aristotle University of Thessaloniki, Medical School, Laboratory of Hygiene, GR-54124, Thessaloniki, Greece, e-mail: evelyntsiga@gmail.com, tel:00302310999154, fax:00302310999131

Tsiga Evangelia

School of Medicine, Aristotle University of Thessaloniki, Greece

Panagopoulou Efharis

School of Medicine, Aristotle University of Thessaloniki, Greece

Sevdalis Nick

Department of Surgery and Cancer, Imperial College, London, UK

Montgomery Anthony

Department of Educational and Social Policy, University of Macedonia, Social Sciences, Greece

Benos Alexios

School of Medicine, Aristotle University of Thessaloniki, Greece

Keywords: decision making, patient safety, primary care, General practice

Word count: 2042

ABSTRACT:

Objectives: Evidence from cognitive sciences has systematically shown that time pressure influences decision making processes. However, very few studies have examined the role of time pressure on adherence to guidelines in clinical practice. The aim of this study was to examine the influence of time pressure on adherence to guidelines in primary care concerning: history taking, clinical examination and advice giving. Design: A within-subjects experimental design was used. Setting: Academic. Participants: 34 GPs were assigned to two experimental conditions (time pressure vs no time pressure) consecutively, and presented with two scenarios involving virus respiratory tract infections. Primary and secondary outcome measures: Outcome measures included adherence to guidelines on history taking, clinical examination, and advice giving. Results: Under time pressure, General practitioners asked significantly less questions concerning presenting symptoms, than the ones indicated by the guidelines, (p =.019), conducted a less through clinical examination (p =.028), while they gave less advice on lifestyle (p =.05). Conclusion: As time pressure increases as a result of high workload, there is a need to examine how adherence to guidelines is affected in order to safeguard patient safety.

ARTICLE SUMMARY

Article focus

- Time pressure is a daily stressor in primary care and can significantly impact upon quality of health care delivered.
- Very few studies have examined the role of time pressure on adherence to guidelines in clinical practice.
- The aim of this study was to examine the influence of time pressure on adherence to guidelines in primary care concerning: history taking, clinical examination and advice giving.

Key messages

- This study showed that under time pressure, adherence to guidelines concerning history taking and advice giving is compromised.
- Given the tendency towards a reduction of consultation times across Europe, it is important to safeguard the accuracy and efficiency of the diagnostic and treatment process, in order to reduce medical errors and increase patient safety.

Strengths and limitations from this study

- This is the first study using an experimental design to examine the role of time pressure on medical decision making in primary care.
- Decisions taken in everyday clinical practice are more complex, and influenced by a multitude of explicit and implicit factors.

INTRODUCTION

Despite the fact that most medical decisions are taken in a context of pressure and uncertainty, time pressure has not been systematically addressed in relation to medical decision making. As time pressure increases as a result of high workload and decreased resources, there is a need to examine how adherence to guidelines is affected.

Evidence from the cognitive sciences suggests that in situations with high time pressure or increased ambiguity, experts use intuitive decision making strategies rather than structured approaches[1-2]. It is therefore more likely for practicing physicians to rely on intuitive processes rather than evidence-based information, when formulating a decision under time pressure. In addition, evidence from psychological studies has systematically shown that time pressure influences risk assessment[3-5], the ability to learn[6-7], and complex cognitive processing[8]. Under time-pressure, individuals process information faster, while use of analytic thinking is reduced[9-10]. Additionally, when faced with time-constraint conditions, individuals rely more often on emotional cues[11-12].

Several studies have suggested that time pressure is one of the most important barriers to the use of evidence-based medicine in primary care[13-14]. A systematic review on observational studies showed that longer consultations were associated with reduced medication prescriptions and increased advice on lifestyle changes[15]. Similarly, Tamblyn et al showed that GPs tend to prescribe inappropriate medications during shorter office visits[16]. The study of Campbell et al showed that the most powerful predictor of the quality of management of chronic disease was the length of the consultation[17].

Although the above studies suggest a possible link between time pressure and evidence-based practice, their predictive validity is restricted by the fact that time pressure was assessed using self reports or observational methods. In addition shorter time visits were treated as synonymous to time pressure. To our knowledge, there is no experimental study on how time pressure impacts upon physicians adherence to guidelines.

The aim of this study was to examine the influence of time pressure on GPs' adherence to guidelines concerning: history taking, clinical examination and advice giving.

METHODS

Research design

In order to increase power and decrease the error variance associated with differences among doctors, a within-subjects experimental design was used. Participants were assigned to two experimental conditions (time pressure vs no time pressure) consecutively. In each condition, participants were presented with two scenarios involving virus respiratory tract

infections (RTI). They were asked to respond to questions concerning medical history taking, clinical examination, referrals for lab tests, likelihood and certainty of final diagnosis, treatment recommendations. In the experimental condition participants were given a specific time for each question. Participants in the control condition received no time constraints (figure 1). In order to avoid the effects of learning associated with within subjects' designs, the counterbalancing technique was used to define the order of presentation of each condition.

Clinical scenarios

For the purposes of the study, four clinical scenarios concerning the diagnosis and treatment of virus respiratory tract infections (RTI) were developed, using expert focus groups. All scenarios were standardised in an initial pilot study in terms of the amount, and quality of information included (see Appendix I).

Adherence to guidelines

Participant responses were evaluated by two independent experts (k = .89) based on the national guidelines set by the Greek Center for Disease Control and Prevention of Infectious Diseases[18-19].

Time pressure

A pilot study involving 12 general practitioners was conducted, in order to define the response time for each question in the time pressure condition[3,20]. Using the equation suggested by Ordonez & Benson (1997) the response time for each question (T) was derived from the following equation: $T= TM_P-SD_P$. TM_P corresponded to the mean response time for each question in the pilot study, while SD_P to the mean standard deviation for each question in the pilot study.

Participants

For a within-subjects two group comparison where the difference is expected to be one standard deviation, and where alpha is 0.05 and power is 0.8, the total sample size (per group) is expected to be 35. Participants were recruited using an advertisement in the electronic newsletter of the General Practitioner Society of Thessaloniki, Greece. They were invited to participate in a study concerning medical decision making in general practice. Of the 198 general practitioners working in primary health care in the Thessaloniki metropolitan area, 73 responded to the advertisement and finally 34 participated in the study. 38% of participants were male, while the mean age of participants was 38.41 years (SD=0.97). All participants participated in both experimental conditions.

Procedure

The study took place in a quiet, non-hospital based setting. Participants were informed about the procedure and instructed to respond to the questions in the same way they would manage a patient in their daily practice. Demographic information was collected before the experiment. During the experiment, information on the presenting case appeared on the screen gradually followed by each question (Figure 1). In the time-pressure condition, a countdown clock was ticking on the screen. When the predefined time of a section was finished, the next information was presented independent of the performance of participants.

Statistical analysis

Results were analyzed in two steps: Firstly, chi-square test was used to compare the two experimental conditions in terms of correct responses (according to the guidelines) in each phase of the consultation: (i.e. medical history taking, clinical examination, treatment recommendations). Chi square tests also compared the two conditions in terms of the correct diagnosis as well as confidence associated with the diagnostic decision.

Secondly, the number of correct responses in each phase were added for each participant in order to produce four continuous indicators, namely, number of questions asked on present illness (range: 0-10), number of signs sought in clinical examination (range: 0-6), number of times lifestyle-advice was given (range: 0-3), and number of other necessary advice (range: 0-2). Multivariate analysis of variance (MANOVA) was used to compare the two conditions on the derived indicators.

RESULTS

Table 1 shows the differences between the two conditions in terms of correct responses as indicated by national guidelines. In specific, statistically significant differences between the two experimental conditions were observed on answers concerning consciousness disorders ($p < 0.05$), nervous system examination ($p < 0.05$), confidence in diagnosis ($p < 0.05$) and smoking reduction advice ($p < 0.05$), with all the above being lower under the time pressure condition.

In terms of the continuous indicators, under time pressure, general practitioners asked significantly less questions concerning presenting symptoms than the ones indicated by the guidelines, ($F = 5.821$, $p = .019$), conducted a less thorough clinical examination ($F = 5.024$, $p = .028$), while they gave less advice on lifestyle ($F = 3.742$, $p = .05$).

TABLE 1: GP responses according to Guidelines on RTI scenarios

		Time pressure no	Time pressure yes	p-value
Questions about present illness	Nasal congestion	20.59%	8.82%	0.092
	Fever	55.88%	51.47%	0.679
	Cough	57.35%	38.24%	0.070
	Breathlessness	11.76%	8.82%	0.653
	Chest pain	1.47%	1.47%	1.000
	Dizziness	5.88%	0.00%	0.103
	Consciousness Disorders	13.24%	1.47%	**0.026**
	Intense/Continuous Vomiting	13.24%	7.35%	0.341
	Flu symptoms initially improved and returned or are getting worse the last 2 days	7.35%	1.47%	0.325
Elements of Physical examination	Temperature measurement	41.18%	35.29%	0.600
	Pharynx inspection	89.71%	85.29%	0.517
	Neck lymph node palpation	27.94%	13.24%	0.063
	Lung auscultation	94.12%	98.53%	0.170
	Heart auscultation	29.41%	25.00%	0.660
	Examination of nervous system	82.35%	41.18%	**0.000**
Diagnosis	Respiratory viral infection	98.53%	98.53%	1.000
	% Confidence on the diagnosis	85.63%	62.67%	**0.006**
Medication	Antipyretics/painkillers	89.71%	77.94%	0.113
Lifestyle treatment	Increase fluid intake	64.71%	47.06%	0.115
	Rest/stay at home	47.06%	38.24%	0.424
	Avoid smoking	13.24%	0.00%	**0.010**
Other advice	Prevent transmission	2.94%	5.88%	0.523
	Re-examination, if symptoms persist or are getting worse	52.94%	52.94%	1.000
Continuous Indicators				
Number of questions on present illness (Mean)		1.79	1.19	**0.019**
Number of signs in clinical examination (Mean)		5.69	4.48	**0.028**
Number of advice on lifestyle treatment used (Mean)		0.93	0.61	**0.050**
Number of other advice (Mean)		0.56	0.59	0.794

**Responses were averaged between the two scenarios of each condition*

DISCUSSION

This study examined the influence of time pressure on compliance with national guidelines, and diagnostic certainty.

Overall, GPs' adherence to guidelines in the management of viral respiratory tract infections was low in both experimental conditions regarding history taking, and advice concerning life-style. This is in agreement with previous studies indicating that evidence-based guidelines, are still not being adequately implemented in daily clinical practice[21-22]. It is also related to the shift of modern medical practice towards more technocratic models of diagnosis and treatment[23-24].

However, under time pressure, participants asked less questions concerning symptoms of the presenting illness, and conducted less thorough clinical examinations, as indicated by the national guidelines. For example, participants were less likely to ask about consciousness disorders during history taking, and less likely to examine the nervous system during the clinical examination, in order to exclude the possibility of meningitis. Since symptoms of VRIs can also be the presenting symptoms of both types of meningitis (bacterial and viral) the Greek Center for Disease Control and Prevention of Infectious Diseases, have included investigation of consciousness disorders, and nervous system examination as standard practice of the medical consultation. Failure to differentially diagnose meningitis can seriously compromise patient safety. This finding suggests that under time pressure GP's were more likely to overlook less frequent conditions (availability heuristic)[25]. This tendency could have been exacerbated by the fact that the study was conducted during the time of the influenza pandemic in Greece.

In addition, under time pressure participants were less compliant with guidelines on giving advice on life style, especially concerning smoking habits. This finding is in accordance with a study by Wilson et al. showing that when the consultation time was increased, advice on smoking cessation, and alcohol reduction was more frequent[26]. Failure to give advice on life style changes compromises patient recovery, especially since evidence shows that in terms of treating VRIs lifestyle advice including smoking cessation, and increased fluid intake is the main treatment option.

Time pressure did not increase the ordering of diagnostic tests, a finding which is in contradiction with previous studies[27-28]. This could be due to the fact that in previous studies simulated patients were used instead of clinical scenarios, which increases the fear of malpractice and the tendency for defensive medicine. It could also be attributed to the content of the scenarios themselves which was consistent and therefore not requiring further testing.

In terms of diagnostic decisions no differences were observed between the two experimental conditions in terms of diagnostic accuracy. However, under time pressure participants felt less confident with their diagnosis. These findings are in

accordance with studies showing that time pressure has a strong negative effect on information seeking, while diagnosis confidence was negatively related to the amount of information accessed in an experimental study in airplane pilots[29].

Limitations

This study used an experimental design based on clinical scenarios. However, decisions taken in everyday clinical practice are more complex, and influenced by a multitude of explicit and implicit factors[30]. The use of simulated patients instead of clinical scenarios would have increased the ecological validity of the study. Another limitation concerns the nature of the scenarios used. Respiratory tract infections represent routine clinical cases with limited management options. It is possible that the effect of time pressure on guidelines adherence and on diagnostic accuracy, would have been more pronounced in more clinical ambiguous situations. Further research, using a broader content of clinical cases is needed in order to investigate the effect of time pressure on GP's diagnostic accuracy and confidence. Given that guideline adherence is a complex psychological phenomenon shaped by the individual as well as by the context, future research should further examine the reasons of non adherence to guidelines. For example the concept rule violation could provide an interesting framework for examining the role of high expertise, lack of rule relevance, or situation constraints on non-adherence in a time pressure situation[31-32].

Conclusions

Time pressure is a daily stressor in primary care and can significantly impact upon quality of health care delivered[26,28]. The present study showed that under time pressure, adherence to guidelines concerning history taking and advice giving is compromised. In an attempt to decrease the effects of time pressure on healthcare delivery, it has been suggested that consultation times should be increased, especially in primary care. However, despite the fact that there is a tendency to increase consultation time in some countries (i.e. UK)[33] this is not a standard practice mainly due to the associated financial cost. For example, in a study conducted by Deveugele in primary care settings across six European countries, it was shown that the mean length of consultation decreased by about 6.5 seconds for every increase of 10 contact units a week in a doctor's workload[34]. In addition, evidence on the effect of extending consultation times on health outcomes and patient satisfaction is limited and contradicting. A recent systematic review of Wilson & Childs (2009) concluded that several aspects of doctors' behaviour (prescribing, referral, investigation and re-consultation) remain unchanged, despite major changes in appointment length [35]. However, the small number of the studies included in the above review and their methodological limitations do not allow drawing a safe conclusion for the link between consultation times and quality of care. Consultation time may play a more

core role in patients with psychological problems or co-morbidities[36]. Overall, simply increasing consultation times is not enough to decrease the effects of time pressure. This is also due to the increased workload, and decreased resources which significantly increase the pressures of clinical practice in primary care. It is therefore important to safeguard the accuracy and efficiency of the diagnostic and treatment process, in order to reduce medical errors and increase patient safety.

FUNDING

This research received no specific funding.

CONTRIBUTORSHIP

For the preparation of this paper, Dr. E. Panagopoulou designed the study, supervised the data analysis and interpretation of results. Dr N. Sevdalis wrote the first draft of the manuscript and conducted the statistical analysis. E. Tsiga collected the data and revised the first draft of the manuscript. Dr Benos coordinated the study and the analysis of the outcomes. Dr. A. Montgomery supervised the interpretation of results and edited the final draft and the language of the manuscript.

DATA SHARING

There are no additional unpublished data from the study.

REFERENCES

1 Dror I, Busemeyer J, Basola B. Decision making under time pressure: An independent test of sequential sampling models. Mem Cognit 1999;27(4):713-25.

2 Croskerry P. The Cognitive Imperative: Thinking about How We Think. Em Med 2000;7:1223-31.

3 Ordonez L, Benson L. Decisions under time pressure: How time constraint affects risky decision making. Organizational behaviour and human decision processes 1997;71(2):121-40.

4 Ben Zur H, Breznitz JS. The effect of time pressure on risky choice behaviour. Acta Psychologica 1981;47:89-104.

5 Kerstholt JH. The effect of time pressure on decision-making behaviour in a dynamic task environment. Acta Psychologica 1994;86:89-104.

6 DeDonno MA, Demaree HA. Perceived time pressure and the Iowa Gambling Task. Judgm Decis Mak 2008; 3(8):636–640.

7 Cella M, Dymond S, Cooper A, et al. Effects of decision-phase time constraints on emotion-based learning in the Iowa Gambling Task. Brain Cogn 2007;64:164-169.

8 Van Harreveld F, Wagenmakers E, Van der Maas HL. The effects of time pressure on chess skill: an investigation into fast and slow processes underlying expert performance. Psychol Res 2007;71:591-7.

9 Benson L, Beach LR. The effects of time constraints on the prechoice screening of decision options. Organizational behaviour and human decision processes 1996;67(2):222–228.

10 Verplanken B. Need for cognition and external information search. J Res Pers 1993;27:238-52.

11 Wright P. The harassed decision maker: Time pressures, distractions, and the use of evidence. J Appl Psychol 1974;59(5):555-61.

12 Finucane ML, Alhakami A, Slovic P, et al. The affect heuristic on judgements on risks and benefits. J Behav Decis Mak 2000:13:1-17.

13 McKenna HP, Ashton S, Keeney S. Barriers to evidence-based practice in primary care. J Adv Nurs 2004;45(2):178-89.

14 McColl A, Smith H, White P and Field J. General practitioners' perceptions of the route to evidence based medicine: a questionnaire survey. BMJ 1998;316:7128.

15 Wilson A, Childs S. The relationship between consultation length, process and outcomes in general practice: a systematic review. Br J Gen Pract 2002;52:1012-20.

16 Tamblyn R, Berkson L, Dauphinee D, et al. Unnecessary prescribing of NSAIDS and the management of NSAID-related gastropathy in medical practice. Ann Intern Med 1997; 127:429-38.

17 Campbell SM, Hann M, Hacker J, et al. Identifying predictors of high quality care in English general practice: observational study. BMJ 2001;323:1-6.

18 Center for Disease Control and Prevention. Scientific Committee for Hospital Infections. Guidelines for diagnosis and empirical treatment of Infectious Diseases. Athens: Focus on Health Ltd 2007:4-11.

19 Center for Disease Control and Prevention. Greek Ministry of Health and Public Solidarity. Current clinical guidelines for the treatment of H1N1 clinical cases in health care services. Available at:

www.keelpno.gr/Portals/0/Αρχεία/Γρίπη%20και%20εποχική%20γρίπη/gripi_nosok%5B1%5D.pdf. Accessed September 6, 2012.

20 Benson L, Svenson O. Post decision consolidation following the debriefing of subjects about experimental manipulations affecting their prior decisions. Psychological Research Bulletin 1993;32:1-13.

21 Cleland JG, Cohen-Solal A, Aguilar JC, et al. Management of heart failure in primary care (the IMPROVEMENT of Heart Failure Programme): an international survey. Lancet 2002;360(9346):1631-9.

22 Steel N, Bachmann M, Maisey S, et al. Self reported receipt of care consistent with 32 quality indicators: national population survey of adults aged 50 or more in England. BMJ 2008;337:957.

23 Hampton R, Harrison MJ, Mitchel JR, et al. Relative contributions of history-taking, physical examination, and laboratory investigation to diagnosis and management of medical outpatients. BMJ 1975;2:486-89.

24 Davis-Floyd R. The technocratic, humanistic, and holistic paradigms of childbirth. Int J Gynaecol Obstet 2001:5-23.

25 Ely JW, Graber ML, Croskerry P. Checklists to Reduce Diagnostic Errors. Acad Med 2011;86(3):307-13.

26 Wilson A, McDonald P, Haynes L, et al. Health Promotion in the general practice consultation: a minute makes a difference. BMJ 1992;304:227-30.

27 Van der Weijden T, Van Bokhoven MA, Dinant G, et al. Understanding laboratory testing in diagnostic uncertainty: a qualitative study in general practice. Br J of Gen Pract 2002;52:974-80.

28 Whiting P, Toerien M, De Salis I, et al. A review identifies and classifies reasons for ordering diagnostic tests. J Clin Epidemiol 2007;60:981-9.

29 Mosier KL, Sethi N, McCauley S, et al. What you don't know can hurt you: Factors impacting diagnosis in the automated Cockpit. Human factors 2007;49(2):300-10.

30 Beullens J, Rethans JJ, Goedhuys J, et al. The use of standardized patients in research in General Practice. Fam Pract 1997;14(1):58-62.

31 Lawton R. Not working to rule: Understanding procedural violations at work. Saf Sci 1998;28(2):77-95.

32 Reason J, Parker D, Lawton R. Organizational controls and safety: the variety of rule related behavior. J Occup Organ Psychol 1998;71:289–304.

33. DOH 1998. Department of Health. Review body on doctors' and dentists' remuneration report. Appendix E (pamphlet). London: The Stationery Office, 1998.

34 Deveugele M, Derese A, van den Brink-Muinen A, et al. Consultation length in general practice: cross sectional study in six European countries. BMJ 2002:31;325(7362):472.

35 Wilson AD, Childs S. Effects of interventions aimed at changing the length of primary care physicians' consultation. Cohrane Database Syst Rev. 2006;1.

36. Hutton C, Gunn J. Do longer consultations improve the management of psychological problems in general practice? A systematic literature review. BMC Health Serv Res 2006;7:71.

The influence of time pressure on adherence to guidelines in primary care. An experimental study.

Corresponding author: Tsiga Evangelia

Postal address: Aristotle University of Thessaloniki, Medical School, Laboratory of Hygiene, GR-54124, Thessaloniki, Greece, e-mail: evelyntsiga@gmail.com, tel:00302310999154, fax:00302310999131

Tsiga Evangelia

School of Medicine, Aristotle University of Thessaloniki, Greece

Panagopoulou Efharis

School of Medicine, Aristotle University of Thessaloniki, Greece

Sevdalis Nick

Department of Surgery and Cancer, Imperial College, London, UK

Montgomery Anthony

Department of Educational and Social Policy, University of Macedonia, Social Sciences, Greece

Benos Alexios

School of Medicine, Aristotle University of Thessaloniki, Greece

Keywords: decision making, patient safety, primary care, General practice

Word count: 2042

ABSTRACT:

Objectives: Evidence from cognitive sciences has systematically shown that time pressure influences decision making processes. However, very few studies have examined the role of time pressure on adherence to guidelines in clinical practice. The aim of this study was to examine the influence of time pressure on adherence to guidelines in primary care concerning: history taking, clinical examination and advice giving. Design: A within-subjects experimental design was used. Setting: Academic. Participants: 34 GPs were assigned to two experimental conditions (time pressure vs no time pressure) consecutively, and presented with two scenarios involving virus respiratory tract infections. Primary and secondary outcome measures: Outcome measures included adherence to guidelines on history taking, clinical examination, and advice giving. Results: Under time pressure, General practitioners asked significantly less questions concerning presenting symptoms, than the ones indicated by the guidelines, (p =.019), conducted a less through clinical examination (p =.028), while they gave less advice on lifestyle (p =.05). Conclusion: As time pressure increases as a result of high workload, there is a need to examine how adherence to guidelines is affected in order to safeguard patient safety.

ARTICLE SUMMARY

Article focus

- Time pressure is a daily stressor in primary care and can significantly impact upon quality of health care delivered.
- Very few studies have examined the role of time pressure on adherence to guidelines in clinical practice.
- The aim of this study was to examine the influence of time pressure on adherence to guidelines in primary care concerning: history taking, clinical examination and advice giving.

Key messages

- This study showed that under time pressure, adherence to guidelines concerning history taking and advice giving is compromised.
- Given the tendency towards a reduction of consultation times across Europe, it is important to safeguard the accuracy and efficiency of the diagnostic and treatment process, in order to reduce medical errors and increase patient safety.

Strengths and limitations from this study

- This is the first study using an experimental design to examine the role of time pressure on medical decision making in primary care.
- Decisions taken in everyday clinical practice are more complex, and influenced by a multitude of explicit and implicit factors.

INTRODUCTION

Despite the fact that most medical decisions are taken in a context of pressure and uncertainty, time pressure has not been systematically addressed in relation to medical decision making. As time pressure increases as a result of high workload and decreased resources, there is a need to examine how adherence to guidelines is affected.

Evidence from the cognitive sciences suggests that in situations with high time pressure or increased ambiguity, experts use intuitive decision making strategies rather than structured approaches[1-2]. It is therefore more likely for practicing physicians to rely on intuitive processes rather than evidence-based information, when formulating a decision under time pressure. In addition, evidence from psychological studies has systematically shown that time pressure influences risk assessment[3-5], the ability to learn[6-7], and complex cognitive processing[8]. Under time-pressure, individuals process information faster, while use of analytic thinking is reduced[9-10]. Additionally, when faced with time-constraint conditions, individuals rely more often on emotional cues[11-12].

Several studies have suggested that time pressure is one of the most important barriers to the use of evidence-based medicine in primary care[13-14]. A systematic review on observational studies showed that longer consultations were associated with reduced medication prescriptions and increased advice on lifestyle changes[15]. Similarly, Tamblyn et al showed that GPs tend to prescribe inappropriate medications during shorter office visits[16]. The study of Campbell et al showed that the most powerful predictor of the quality of management of chronic disease was the length of the consultation[17].

Although the above studies suggest a possible link between time pressure and evidence-based practice, their predictive validity is restricted by the fact that time pressure was assessed using self reports or observational methods. In addition shorter time visits were treated as synonymous to time pressure. To our knowledge, there is no experimental study on how time pressure impacts upon physicians adherence to guidelines.

The aim of this study was to examine the influence of time pressure on GPs' adherence to guidelines concerning: history taking, clinical examination and advice giving.

METHODS

Research design

In order to increase power and decrease the error variance associated with differences among doctors, a within-subjects experimental design was used. Participants were assigned to two experimental conditions (time pressure vs no time pressure) consecutively. In each condition, participants were presented with two scenarios involving virus respiratory tract

infections (RTI). They were asked to respond to questions concerning medical history taking, clinical examination, referrals for lab tests, likelihood and certainty of final diagnosis, treatment recommendations. In the experimental condition participants were given a specific time for each question. Participants in the control condition received no time constraints (figure 1). In order to avoid the effects of learning associated with within subjects' designs, the counterbalancing technique was used to define the order of presentation of each condition.

Clinical scenarios

For the purposes of the study, four clinical scenarios concerning the diagnosis and treatment of virus respiratory tract infections (RTI) were developed, using expert focus groups. All scenarios were standardised in an initial pilot study in terms of the amount, and quality of information included (see Appendix I).

Adherence to guidelines

Participant responses were evaluated by two independent experts (k = .89) based on the national guidelines set by the Greek Center for Disease Control and Prevention of Infectious Diseases[18-19].

Time pressure

A pilot study involving 12 general practitioners was conducted, in order to define the response time for each question in the time pressure condition[3,20]. Using the equation suggested by Ordonez & Benson (1997) the response time for each question (T) was derived from the following equation: $T= TM_P-SD_P$. TM_P corresponded to the mean response time for each question in the pilot study, while SD_P to the mean standard deviation for each question in the pilot study.

Participants

For a within-subjects two group comparison where the difference is expected to be one standard deviation, and where alpha is 0.05 and power is 0.8, the total sample size (per group) is expected to be 35. Participants were recruited using an advertisement in the electronic newsletter of the General Practitioner Society of Thessaloniki, Greece. They were invited to participate in a study concerning medical decision making in general practice. Of the 198 general practitioners working in primary health care in the Thessaloniki metropolitan area, 73 responded to the advertisement and finally 34 participated in the study. 38% of participants were male, while the mean age of participants was 38.41 years (SD=0.97). All participants participated in both experimental conditions.

Procedure

The study took place in a quiet, non-hospital based setting. Participants were informed about the procedure and instructed to respond to the questions in the same way they would manage a patient in their daily practice. Demographic information was collected before the experiment. During the experiment, information on the presenting case appeared on the screen gradually followed by each question (Figure 1). In the time-pressure condition, a countdown clock was ticking on the screen. When the predefined time of a section was finished, the next information was presented independent of the performance of participants.

Statistical analysis

Results were analyzed in two steps: Firstly, chi-square test was used to compare the two experimental conditions in terms of correct responses (according to the guidelines) in each phase of the consultation: (i.e. medical history taking, clinical examination, treatment recommendations). Chi square tests also compared the two conditions in terms of the correct diagnosis as well as confidence associated with the diagnostic decision.

Secondly, the number of correct responses in each phase were added for each participant in order to produce four continuous indicators, namely, number of questions asked on present illness (range: 0-10), number of signs sought in clinical examination (range: 0-6), number of times lifestyle-advice was given (range: 0-3), and number of other necessary advice (range: 0-2). Multivariate analysis of variance (MANOVA) was used to compare the two conditions on the derived indicators.

RESULTS

Table 1 shows the differences between the two conditions in terms of correct responses as indicated by national guidelines. In specific, statistically significant differences between the two experimental conditions were observed on answers concerning consciousness disorders ($p < 0.05$), nervous system examination ($p < 0.05$), confidence in diagnosis ($p < 0.05$) and smoking reduction advice ($p < 0.05$), with all the above being lower under the time pressure condition.

In terms of the continuous indicators, under time pressure, general practitioners asked significantly less questions concerning presenting symptoms than the ones indicated by the guidelines, ($F = 5.821$, $p = .019$), conducted a less thorough clinical examination ($F = 5.024$, $p = .028$), while they gave less advice on lifestyle ($F = 3.742$, $p = .05$).

TABLE 1: GP responses according to Guidelines on RTI scenarios

		Time pressure no	Time pressure yes	p-value
Questions about present illness	Nasal congestion	20.59%	8.82%	0.092
	Fever	55.88%	51.47%	0.679
	Cough	57.35%	38.24%	0.070
	Breathlessness	11.76%	8.82%	0.653
	Chest pain	1.47%	1.47%	1.000
	Dizziness	5.88%	0.00%	0.103
	Consciousness Disorders	13.24%	1.47%	**0.026**
	Intense/Continuous Vomiting	13.24%	7.35%	0.341
	Flu symptoms initially improved and returned or are getting worse the last 2 days	7.35%	1.47%	0.325
Elements of Physical examination	Temperature measurement	41.18%	35.29%	0.600
	Pharynx inspection	89.71%	85.29%	0.517
	Neck lymph node palpation	27.94%	13.24%	0.063
	Lung auscultation	94.12%	98.53%	0.170
	Heart auscultation	29.41%	25.00%	0.660
	Examination of nervous system	82.35%	41.18%	**0.000**
Diagnosis	Respiratory viral infection	98.53%	98.53%	1.000
	% Confidence on the diagnosis	85.63%	62.67%	**0.006**
Medication	Antipyretics/painkillers	89.71%	77.94%	0.113
Lifestyle treatment	Increase fluid intake	64.71%	47.06%	0.115
	Rest/stay at home	47.06%	38.24%	0.424
	Avoid smoking	13.24%	0.00%	**0.010**
Other advice	Prevent transmission	2.94%	5.88%	0.523
	Re-examination, if symptoms persist or are getting worse	52.94%	52.94%	1.000
Continuous Indicators				
Number of questions on present illness (Mean)		1.79	1.19	**0.019**
Number of signs in clinical examination (Mean)		5.69	4.48	**0.028**
Number of advice on lifestyle treatment used (Mean)		0.93	0.61	**0.050**
Number of other advice (Mean)		0.56	0.59	0.794

**Responses were averaged between the two scenarios of each condition*

DISCUSSION

This study examined the influence of time pressure on compliance with national guidelines, and diagnostic certainty.

Overall, GPs' adherence to guidelines in the management of viral respiratory tract infections was low in both experimental conditions regarding history taking, and advice concerning life-style. This is in agreement with previous studies indicating that evidence-based guidelines, are still not being adequately implemented in daily clinical practice[21-22]. It is also related to the shift of modern medical practice towards more technocratic models of diagnosis and treatment[23-24].

However, under time pressure, participants asked less questions concerning symptoms of the presenting illness, and conducted less thorough clinical examinations, as indicated by the national guidelines. For example, participants were less likely to ask about consciousness disorders during history taking, and less likely to examine the nervous system during the clinical examination, in order to exclude the possibility of meningitis. Since symptoms of VRIs can also be the presenting symptoms of both types of meningitis (bacterial and viral) the Greek Center for Disease Control and Prevention of Infectious Diseases, have included investigation of consciousness disorders, and nervous system examination as standard practice of the medical consultation. Failure to differentially diagnose meningitis can seriously compromise patient safety. This finding suggests that under time pressure GP's were more likely to overlook less frequent conditions (availability heuristic)[25]. This tendency could have been exacerbated by the fact that the study was conducted during the time of the influenza pandemic in Greece.

In addition, under time pressure participants were less compliant with guidelines on giving advice on life style, especially concerning smoking habits. This finding is in accordance with a study by Wilson et al. showing that when the consultation time was increased, advice on smoking cessation, and alcohol reduction was more frequent[26]. Failure to give advice on life style changes compromises patient recovery, especially since evidence shows that in terms of treating VRIs lifestyle advice including smoking cessation, and increased fluid intake is the main treatment option.

Time pressure did not increase the ordering of diagnostic tests, a finding which is in contradiction with previous studies[27-28]. This could be due to the fact that in previous studies simulated patients were used instead of clinical scenarios, which increases the fear of malpractice and the tendency for defensive medicine. It could also be attributed to the content of the scenarios themselves which was consistent and therefore not requiring further testing.

In terms of diagnostic decisions no differences were observed between the two experimental conditions in terms of diagnostic accuracy. However, under time pressure participants felt less confident with their diagnosis. These findings are in

accordance with studies showing that time pressure has a strong negative effect on information seeking, while diagnosis confidence was negatively related to the amount of information accessed in an experimental study in airplane pilots[29].

Limitations

This study used an experimental design based on clinical scenarios. However, decisions taken in everyday clinical practice are more complex, and influenced by a multitude of explicit and implicit factors[30]. The use of simulated patients instead of clinical scenarios would have increased the ecological validity of the study. Another limitation concerns the nature of the scenarios used. Respiratory tract infections represent routine clinical cases with limited management options. It is possible that the effect of time pressure on guidelines adherence and on diagnostic accuracy, would have been more pronounced in more clinical ambiguous situations. Further research, using a broader content of clinical cases is needed in order to investigate the effect of time pressure on GP's diagnostic accuracy and confidence. Given that guideline adherence is a complex psychological phenomenon shaped by the individual as well as by the context, future research should further examine the reasons of non adherence to guidelines. For example the concept rule violation could provide an interesting framework for examining the role of high expertise, lack of rule relevance, or situation constraints on non-adherence in a time pressure situation[31-32].

Conclusions

Time pressure is a daily stressor in primary care and can significantly impact upon quality of health care delivered[26,28]. The present study showed that under time pressure, adherence to guidelines concerning history taking and advice giving is compromised. In an attempt to decrease the effects of time pressure on healthcare delivery, it has been suggested that consultation times should be increased, especially in primary care. However, despite the fact that there is a tendency to increase consultation time in some countries (i.e. UK)[33] this is not a standard practice mainly due to the associated financial cost. For example, in a study conducted by Deveugele in primary care settings across six European countries, it was shown that the mean length of consultation decreased by about 6.5 seconds for every increase of 10 contact units a week in a doctor's workload[34]. In addition, evidence on the effect of extending consultation times on health outcomes and patient satisfaction is limited and contradicting. A recent systematic review of Wilson & Childs (2009) concluded that several aspects of doctors' behaviour (prescribing, referral, investigation and re-consultation) remain unchanged, despite major changes in appointment length [35]. However, the small number of the studies included in the above review and their methodological limitations do not allow drawing a safe conclusion for the link between consultation times and quality of care. Consultation time may play a more

core role in patients with psychological problems or co-morbidities[36]. Overall, simply increasing consultation times is not enough to decrease the effects of time pressure. This is also due to the increased workload, and decreased resources which significantly increase the pressures of clinical practice in primary care. It is therefore important to safeguard the accuracy and efficiency of the diagnostic and treatment process, in order to reduce medical errors and increase patient safety.

FUNDING

This research received no specific funding.

REFERENCES

1 Dror I, Busemeyer J, Basola B. Decision making under time pressure: An independent test of sequential sampling models. Mem Cognit 1999;27(4):713-25.

2 Croskerry P. The Cognitive Imperative: Thinking about How We Think. Em Med 2000;7:1223-31.

3 Ordonez L, Benson L. Decisions under time pressure: How time constraint affects risky decision making. Organizational behaviour and human decision processes 1997;71(2):121-40.

4 Ben Zur H, Breznitz JS. The effect of time pressure on risky choice behaviour. Acta Psychologica 1981;47:89-104.

5 Kerstholt JH. The effect of time pressure on decision-making behaviour in a dynamic task environment. Acta Psychologica 1994;86:89-104.

6 DeDonno MA, Demaree HA. Perceived time pressure and the Iowa Gambling Task. Judgm Decis Mak 2008; 3(8):636–640.

7 Cella M, Dymond S, Cooper A, et al. Effects of decision-phase time constraints on emotion-based learning in the Iowa Gambling Task. Brain Cogn 2007;64:164-169.

8 Van Harreveld F, Wagenmakers E, Van der Maas HL. The effects of time pressure on chess skill: an investigation into fast and slow processes underlying expert performance. Psychol Res 2007;71:591-7.

9 Benson L, Beach LR. The effects of time constraints on the prechoice screening of decision options. Organizational behaviour and human decision processes 1996;67(2):222–228.

10 Verplanken B. Need for cognition and external information search. J Res Pers 1993;27:238-52.

11 Wright P. The harassed decision maker: Time pressures, distractions, and the use of evidence. J Appl Psychol 1974;59(5):555-61.

12 Finucane ML, Alhakami A, Slovic P, et al. The affect heuristic on judgements on risks and benefits. J Behav Decis Mak 2000:13:1-17.

13 McKenna HP, Ashton S, Keeney S. Barriers to evidence-based practice in primary care. J Adv Nurs 2004;45(2):178-89.

14 McColl A, Smith H, White P and Field J. General practitioners' perceptions of the route to evidence based medicine: a questionnaire survey. BMJ 1998;316:7128.

15 Wilson A, Childs S. The relationship between consultation length, process and outcomes in general practice: a systematic review. Br J Gen Pract 2002;52:1012-20.

16 Tamblyn R, Berkson L, Dauphinee D, et al. Unnecessary prescribing of NSAIDS and the management of NSAID-related gastropathy in medical practice. Ann Intern Med 1997; 127:429-38.

17 Campbell SM, Hann M, Hacker J, et al. Identifying predictors of high quality care in English general practice: observational study. BMJ 2001;323:1-6.

18 Center for Disease Control and Prevention. Scientific Committee for Hospital Infections. Guidelines for diagnosis and empirical treatment of Infectious Diseases. Athens: Focus on Health Ltd 2007:4-11.

19 Center for Disease Control and Prevention. Greek Ministry of Health and Public Solidarity. Current clinical guidelines for the treatment of H1N1 clinical cases in health care services. Available at:

www.keelpno.gr/Portals/0/Αρχεία/Γρίπη%20και%20εποχική%20γρίπη/gripi_nosok%5B1%5D.pdf. Accessed September 6, 2012.

20 Benson L, Svenson O. Post decision consolidation following the debriefing of subjects about experimental manipulations affecting their prior decisions. Psychological Research Bulletin 1993;32:1-13.

21 Cleland JG, Cohen-Solal A, Aguilar JC, et al. Management of heart failure in primary care (the IMPROVEMENT of Heart Failure Programme): an international survey. Lancet 2002;360(9346):1631-9.

22 Steel N, Bachmann M, Maisey S, et al. Self reported receipt of care consistent with 32 quality indicators: national population survey of adults aged 50 or more in England. BMJ 2008;337:957.

23 Hampton R, Harrison MJ, Mitchel JR, et al. Relative contributions of history-taking, physical examination, and laboratory investigation to diagnosis and management of medical outpatients. BMJ 1975;2:486-89.

24 Davis-Floyd R. The technocratic, humanistic, and holistic paradigms of childbirth. Int J Gynaecol Obstet 2001:5-23.

25 Ely JW, Graber ML, Croskerry P. Checklists to Reduce Diagnostic Errors. Acad Med 2011;86(3):307-13.

26 Wilson A, McDonald P, Haynes L, et al. Health Promotion in the general practice consultation: a minute makes a difference. BMJ 1992;304:227-30.

27 Van der Weijden T, Van Bokhoven MA, Dinant G, et al. Understanding laboratory testing in diagnostic uncertainty: a qualitative study in general practice. Br J of Gen Pract 2002;52:974-80.

28 Whiting P, Toerien M, De Salis I, et al. A review identifies and classifies reasons for ordering diagnostic tests. J Clin Epidemiol 2007;60:981-9.

29 Mosier KL, Sethi N, McCauley S, et al. What you don't know can hurt you: Factors impacting diagnosis in the automated Cockpit. Human factors 2007;49(2):300-10.

30 Beullens J, Rethans JJ, Goedhuys J, et al. The use of standardized patients in research in General Practice. Fam Pract 1997;14(1):58-62.

31 Lawton R. Not working to rule: Understanding procedural violations at work. Saf Sci 1998;28(2):77-95.

32 Reason J, Parker D, Lawton R. Organizational controls and safety: the variety of rule related behavior. J Occup Organ Psychol 1998;71:289–304.

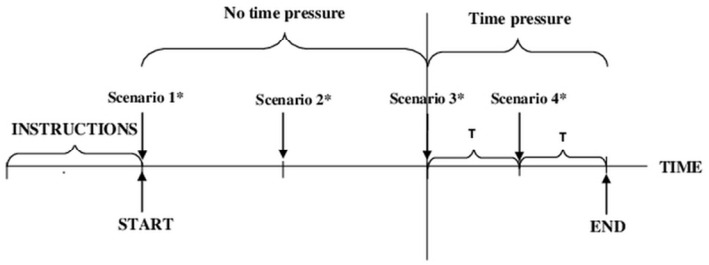
33. DOH 1998. Department of Health. Review body on doctors' and dentists' remuneration report. Appendix E (pamphlet). London: The Stationery Office, 1998.

34 Deveugele M, Derese A, van den Brink-Muinen A, et al. Consultation length in general practice: cross sectional study in six European countries. BMJ 2002:31;325(7362):472.

35 Wilson AD, Childs S. Effects of interventions aimed at changing the length of primary care physicians' consultation. Cohrane Database Syst Rev. 2006;1.

36. Hutton C, Gunn J. Do longer consultations improve the management of psychological problems in general practice? A systematic literature review. BMC Health Serv Res 2006;7:71.

FIGURE 1: Experimental design and procedure



*

SLIDE ORDER	INFORMATION ON THE SCREEN DURING EACH SCENARIO	QUESTIONS ON THE SCREEN AFTER VIEWING EACH PIECE OF INFORMATION
SLIDE 1	• Presenting complaint	Q1: Which are the most important questions you would like to ask this patient on his current illness/medical history?
SLIDE 2	• Presenting complaint • Past Medical History	Q2: Which are the most important signs that you want to look at in the physical examination? Q3: Are there any other questions you would like to ask this patient?
SLIDE 3	• Presenting complaint • Past Medical History • Clinical Examination	Q4: Are there any diagnostic tests you would like to order for this patient?
SLIDE 4	• Presenting complaint • Past Medical History • Clinical Examination • Laboratory Tests (Only for the UTI Scenario)	Q5: According to the above information what is the most likely diagnosis for this patient? Q6: How % confident you feel about this diagnosis? Q7: What is your treatment plan for this patient?

90x116mm (300 x 300 DPI)

APPENDIX I: Example of clinical scenario used in the study

MEDICAL HISTORY	**IDENTIFING DATA**	**SEX**	male
		AGE	30 years
		MARITAL STATUS	married
		RESIDENCE	Thessaloniki, Greece
	PRESENTING COMPLAINT	Fever and cough	
	PRESENT ILLNESS	The present illness began 24 hours ago, with fever (up to 38.0^{o}C), dry cough, headache, sore throat, body aches and weakness. Fever subsides easily after taking paracetamol tablets of 500 mg, while cough is very annoying during the whole day.	
	PAST MEDICAL HISTORY	Free	
	MEDICATION	He is on no medication.	
	FAMILY HISSTORY	• Father 65 years old with hypertension (in medication). • Mother 58 years old with osteoporosis (in medication). • Brother 30 years old, free medical history.	
	PERSONAL AND SOCIAL HISTORY	**SMOKING STATUS**	12 pack years
PHYSICAL EXAMINATION	**VITAL SIGNS**	**Pulse**	102/min
		Blood Pressure	130/80 mmHg
		Temperature	38^{o}C
		Respiratory rate	16/min
		SpO_2	100%
	SKIN	Pale. Nails without clubbing, cyanosis.	
	HEAD, EYES, EARS, NOSE, THROAT	Mild redness of the pharynx. Other normal.	
	NECK	Normal.	
	LYMPH NODES	No tonsillar, cervical, axillary and inguinal nodes.	
	RESPIRATORY SYSTEM	Thorax symmetric with good excursion. Lungs resonant. Breath sounds vesicular with no added sounds.	
	CARDIOVASCULAR SYSTEM	Good S_1, S_2, no space, no S_3 or S_4. Tachycardia, no abnormal heart sounds or murmurs.	
	ABDOMEN	Bowel sounds active. No tenderness or masses.	
	MUSCULOSKELETAL SYSTEM	Normal.	
	NERVOUS SYSTEM	Normal.	
	GENITAL & URINARY SYSTEM	Normal.	

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5,6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5,6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	9
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8
Generalisability	21	Discuss the generalisability (external validity) of the study results	9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Please wait...

If this message is not eventually replaced by the proper contents of the document, your PDF viewer may not be able to display this type of document.

You can upgrade to the latest version of Adobe Reader for Windows®, Mac, or Linux® by visiting http://www.adobe.com/go/reader_download.

For more assistance with Adobe Reader visit http://www.adobe.com/go/acrreader.

Please wait...

If this message is not eventually replaced by the proper contents of the document, your PDF viewer may not be able to display this type of document.

You can upgrade to the latest version of Adobe Reader for Windows®, Mac, or Linux® by visiting http://www.adobe.com/go/reader_download.

For more assistance with Adobe Reader visit http://www.adobe.com/go/acrreader.

Please wait...

If this message is not eventually replaced by the proper contents of the document, your PDF viewer may not be able to display this type of document.

You can upgrade to the latest version of Adobe Reader for Windows®, Mac, or Linux® by visiting http://www.adobe.com/go/reader_download.

For more assistance with Adobe Reader visit http://www.adobe.com/go/acrreader.

Please wait...

If this message is not eventually replaced by the proper contents of the document, your PDF viewer may not be able to display this type of document.

You can upgrade to the latest version of Adobe Reader for Windows®, Mac, or Linux® by visiting http://www.adobe.com/go/reader_download.

For more assistance with Adobe Reader visit http://www.adobe.com/go/acrreader.

Please wait...

If this message is not eventually replaced by the proper contents of the document, your PDF viewer may not be able to display this type of document.

You can upgrade to the latest version of Adobe Reader for Windows®, Mac, or Linux® by visiting http://www.adobe.com/go/reader_download.

For more assistance with Adobe Reader visit http://www.adobe.com/go/acrreader.