



Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:

Cooke, G; Tapley, A; Holliday, E; Morgan, S; Henderson, K; Ball, J; van Driel, M; Spike, N; Kerr, R; Magin, P

Title:

Responses to clinical uncertainty in Australian general practice trainees: a cross-sectional analysis

Date:

2017-12-01

Citation:

Cooke, G., Tapley, A., Holliday, E., Morgan, S., Henderson, K., Ball, J., van Driel, M., Spike, N., Kerr, R. & Magin, P. (2017). Responses to clinical uncertainty in Australian general practice trainees: a cross-sectional analysis. *Medical Education*, 51 (12), pp.1277-1288. <https://doi.org/10.1111/medu.13408>.

Persistent Link:

<https://hdl.handle.net/11343/293846>

DR. GEORGA COOKE (Orcid ID : 0000-0002-6204-8099)

Article type : Research Papers

Corresponding Author: [georga.cooke@gmail.com](mailto:georga.cooke@gmail.com)

Responses to clinical uncertainty in Australian GP trainees – a cross-sectional analysis

ABSTRACT (300 words)

### **Objectives**

Tolerance for ambiguity is essential for optimal learning and professional competence. General practice trainees must be, or must learn to be, adept at managing clinical uncertainty. However, few studies have examined associations of intolerance of uncertainty in this group. The aim of this study was to establish levels of tolerance of uncertainty in Australian general practice trainees and associations of uncertainty with demographic, educational and training practice factors.

### **Methods**

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/medu.13408](https://doi.org/10.1111/medu.13408)

This article is protected by copyright. All rights reserved

A cross-sectional analysis was performed on the Registrar Clinical Encounters in Training (ReCENT) project, an ongoing multisite cohort study. Scores on three of the four independent subscales of the Physicians' Reaction to Uncertainty (PRU) instrument were analysed as outcome variables in linear regression models with trainee and practice factors as independent variables.

## **Results**

594 trainees contributed data on a total of 1,209 occasions. Trainees in earlier training terms had higher scores for anxiety due to uncertainty, concern about bad outcomes and reluctance to disclose diagnosis/treatment uncertainty to patients. Beyond this, our findings suggest two distinct sets of associations regarding reaction to uncertainty. Firstly, affective aspects of uncertainty ('anxiety' and 'concern' subscales) were associated with female gender, less experience in hospital prior to commencing GP training, and trainees who graduated overseas. Secondly, maladaptive response to uncertainty ('reluctance to disclose' subscale) was associated with urban practice, health qualifications prior to studying medicine, practice in a higher socioeconomic area, and being Australian-trained.

## **Conclusions**

We have established levels of three measures of trainees' response to uncertainty and associations of these responses. Our findings suggest differing 'phenotypes' of trainees with high 'affective' response to uncertainty and those reluctant to disclose uncertainty to patients. More research is needed to examine the relationship of clinical uncertainty with clinical outcomes, temporal changes in tolerance for uncertainty, and strategies to assist physicians in developing adaptive responses to clinical uncertainty.

2993 words (excluding tables, references and acknowledgement)

## Introduction

A degree of uncertainty is inevitable in medicine.(1, 2) Epstein (3) has described tolerance of ambiguity and anxiety as a key dimension of clinical competence, and tolerance for uncertainty is seen as an essential skill for the general practitioner (GP).(4) Doctors who feel more challenged by uncertainty generate more costs for the health system.(5) Intolerance of uncertainty is also associated with increased test ordering(6, 7), which has potential for patient harm (8) as well as having financial implications. Furthermore, doctors who deal better with uncertainty are likely to practise with less cost to their own health and wellbeing.(9) A low tolerance for uncertainty has also been associated with burnout in a cohort of general practice trainees (10) and emergency medicine residents.(11) Indeed, in a study of emergency physicians, low tolerance for uncertainty was the strongest predictor of burnout.(12) An educationally relevant aspect of intolerance of uncertainty is anxiety. Anxiety and stress have been associated with impairments in learning.(13-15)

The response from educators has been to include patient-centred communication training and bedside teaching around ambiguity in medical school, role-modelling and reflective practice strategies.(16, 17) Tolerance for ambiguity has even been touted as a possible selection criterion for medical school with commentators hypothesizing that students who begin medical school with a higher tolerance for uncertainty will have greater tolerance for it by the end of medical school through a positive feedback loop.(18) The Physician Response to Uncertainty scales were developed to examine the emotional, cognitive and coping behaviours that doctors use in relation to clinical uncertainty.(19) However, despite the acknowledged importance of tolerance of uncertainty and efforts to include it in medical curricula, few studies have examined its associations. In two studies, female physicians and doctors-in-training have reported greater anxiety about uncertainty.(19, 20) In a Finnish study, experienced GPs (with 5+ years of experience) reported a greater tolerance for uncertainty than less experienced GPs (less than 5 years of experience).(21) Anxiety from uncertainty was also associated with fewer working hours in a cohort of general practitioners.(20) However, studies investigating associations of tolerance of uncertainty have been small in scale and examined a limited number of associations.

Uncertainty is particularly prevalent in the general practice environment, where undifferentiated illness is commonplace and where patients generally present earlier in their illness than in hospital settings.(19, 22) Also, given this and that uncertainty in emergency medicine and general practice training has been associated with adverse clinician outcomes (burnout (10, 11)), GP trainees are a

group in which tolerance of uncertainty is of particular interest. The levels of particular responses to uncertainty, and their associations, in this population are important research questions. The aim of this study was to establish levels of tolerance of uncertainty in Australian general practice trainees and its associations with demographic, educational and training practice factors.

## Methods

This study was conducted within the Registrar Clinical Encounters in Training (ReCEnT) project. ReCEnT is an ongoing multisite cohort study. Participants were GP trainees from four of Australia's 17 GP Regional Training Providers (RTPs) across four Australian states during 2011-2013. RTPs are government-funded, not-for-profit, geographically-defined organisations delivering Australian general practice vocational training.

The methodology of the ReCEnT study has been described in detail elsewhere.<sup>(23)</sup> Briefly, trainees provide data once during each 6-month training term (or 12-month term for part-time doctors) as a routine part of their educational program.<sup>(24)</sup> This results in trainees contributing data during their three compulsory GP training terms. Some trainees in one RTP provided data during an optional fourth GP term. Trainees may consent to this data being used for research as well as educational purposes.

Data collection included demographics, education and work experience of participating trainees, and characteristics of the practice in which they are working each term. These variables are recorded by each trainee via a questionnaire at the beginning of training and a further questionnaire during each training term. In-consultation data collected in the ReCEnT project was not utilized in this analysis.

### Outcome factors

The outcome factors in this analysis were scores on the first three of the four subscales (domains) of the Physicians' Reaction to Uncertainty (PRU) instrument.<sup>(19, 25)</sup> A technical fault with our questionnaire printing resulted in lack of complete data for the fourth subscale (Reluctance to Disclose Mistakes to Physicians). The three subscales, each with items ranked on a 6 point Likert scale, measure a doctor's affective response to uncertainty (the first two subscales) and a component of coping or adaptation (the third subscale). The subscales are:

1. Anxiety due to uncertainty about diagnosis/treatment (5 items – maximum possible score 30)
2. Concern about a bad outcome for the patient (3 items - maximum possible score 18)

3. Reluctance to disclose diagnosis/treatment uncertainty to patients (5 items – maximum possible score 30)

Each subscale is scored by summing physicians' responses to each item in the scale. For scoring, responses on the scale range from 'strongly disagree' (scored 1) to 'strongly agree' (scored 6), with relevant items reverse scored. The subscales are distinct constructs and no overall 'uncertainty' score is calculated. Higher subscale scores represent a higher level of the construct being measured. The PRU subscales have shown good psychometric properties with Cronbach's alpha values ranging from .74 to .85.(25, 26)

#### Independent variables

Trainee demographic and educational factors were age, gender, training term (Terms 1 to 4), place of basic medical qualification (Australia or overseas), full-time/part-time status, health qualifications prior to studying medicine, whether the trainee had postgraduate medical qualifications (e.g. Master of Public Health), whether the trainee also did other clinical non-GP work, whether the trainee did other medical non-clinical work (such as education or research), whether the trainee had previously worked at their current practice, and how many years of hospital work the trainee had completed. The RTP with which the trainee trained was also an independent variable.

Training practice factors were degree of rurality (major city, inner regional, outer regional, remote), practice size (number of full-time equivalent GPs), if the practice routinely bulk-bills (that is, there is no financial cost to the patient for the consultation), and the socioeconomic status of the suburb in which the practice is located. Practice postcode was used to define the Australian Standard Geographical Classification-Remoteness Area classification (ASGC-RA: the degree of rurality) of the practice location (27) and to define the practice location's Socioeconomic Index for Area Relative Index of Disadvantage (SEIFA) (28).

#### Statistical analyses

This was a cross-sectional analysis from the longitudinal ReCEnT study. Analysis was performed on five rounds of data from 2011 to 2013 (rounds during which the PRU scales were included in trainees' questionnaires). Analysis was at the level of trainees' individual completions of the PRU. Analyses were programmed using STATA 13.1 and SAS V9.4.

For each of the three outcomes, univariate and multivariable linear regression was used to assess associations, with estimation performed within the generalised estimating equations (GEE) framework to account for repeated measures within trainees. An exchangeable working correlation

structure was assumed. All covariates with a p-value <0.20 in the univariate analysis were included in the multiple regression model.

Mean substitution was used to reduce the number of missing values for all three outcomes, dependent upon no more than half of the items being missing. For 'anxiety due to uncertainty about diagnosis/treatment' and 'reluctance to disclose diagnosis/treatment uncertainty to patients' (each with 5 items), if 1 or 2 individual items were missing, the mean of the non-missing items was substituted for the missing items. For 'concern about a bad outcome for the patient' (with 3 items), if 1 item was missing, the mean of the non-missing 2 items was substituted for the missing item. Total scores for each outcome for each participant were calculated with the mean-substituted data included.

In a post-hoc analysis, we calculated Cohen's *d* as a measure of effect size of independent variables significantly associated with scores on the relevant subscales.

#### Ethical approval

This study had ethics approval from the University of Newcastle Human Research Ethics Committee (Reference H-2009-0323).

## Results

There were 1,209 PRU completions, contributed by 594 trainees. The response rate during the five rounds of data collection reported here was 93.6%. Most trainees were female (66.0%) and had qualified in Australia (75.4%). The majority of trainees worked in a major city (60.1%). The demographics of trainees and of practices are summarised in Table 1.

Each subscale had a modest amount of missing data (8 – 11%). After mean substitution was used to impute missing values, 'anxiety due to uncertainty', 'bad outcome' and 'reluctance to disclose to patients' each had 7% missingness for the total score. The Pearson correlation coefficient between 'anxiety' and 'bad outcome' scores was 0.60. Between 'anxiety' and reluctance' as well as 'bad outcome' scores, the Pearson correlation coefficient was 0.24.

The mean scores (and standard deviations) on the three subscales were as follows: 'Anxiety due to uncertainty about diagnosis/treatment', 17.65 (4.95); 'Concern about a bad outcome for the patient', 9.95 (3.40); 'Reluctance to disclose diagnosis/treatment uncertainty to patients', 13.41 (3.66) (Table 1).

## Associations of uncertainty

The descriptive statistics and univariate associations of trainee and practice factors for the three subscales are presented in Appendix Tables S1, S2 and S3 respectively (available online). The simple (univariate) and adjusted (multivariable) associations of trainee and practice factors with each PRU subscale are presented in Table 2, Table 3 and Table 4. The Cohen's *d* for the significant associations of 'anxiety due to uncertainty' ranged from 0.19 to 0.35; for 'concern about a bad outcome' from 0.14 to 0.32; for 'reluctance to disclose' from 0.20 to 0.50. These indicated small to moderate effect sizes.

In the multivariable analyses, variables significantly associated with higher 'anxiety due to uncertainty about diagnosis/treatment' were: the trainee being female; having qualified as a doctor outside Australia; being in term 1 or term 2 compared to terms 3 and 4; and not having previously worked at their current practice. Regarding, 'concern about a bad outcome for the patient', significant associations were: the trainee being female; being in term 1 or term 2 compared to terms 3 and 4; and with having fewer years of hospital practice prior to entering general practice. 'Reluctance to disclose diagnosis/treatment uncertainty to patients' was significantly associated with: the trainee having qualified as a doctor in Australia; having health qualifications prior to studying medicine; working in a major city, compared to an outer regional or remote/very remote area (and working in an inner regional area compared to an outer regional or remote/very remote area); working in a higher socioeconomic area; and being in term 1 compared to term 3.

## Discussion

### Summary of main findings and comparison with existing literature

Seniority in training was strongly associated with attenuated scores across all three uncertainty domains. Otherwise, our findings demonstrate that two phenotypes can be distinguished. The 'phenotype' of the trainee with high 'anxiety due to uncertainty' and/or 'concern about a bad outcomes' (female, non-Australian trained, not having worked at the practice previously, fewer years of hospital work prior to GP terms) was very different from that of the trainee with high 'reluctance to disclose uncertainty to patients' (Australian university trained, having health qualifications prior to studying medicine, working in major cities or inner regional areas, and working in a higher socioeconomic area).

Trainee PRU scores in this study were similar to those of established clinicians in previous studies.

(19, 29) In the original validation study(19), 337 internal medicine physicians in Indiana had a mean score (SD) of 18.8 (4.7) for anxiety due to uncertainty, which is comparable to our cohort. In a study

of surgeons treating patients with breast cancer, levels of anxiety due to uncertainty were again similar to our study (18, [SD 8.2]) (29) . In the validation study(19), scores for concern about bad outcomes (9.5 [SD 3.1]) and reluctance to disclose uncertainty to patients (13.6 [SD 4.2]) were also similar to our study. In a German adaption of the PRU, 93 GPs also had similar scores to our cohort across each subscale (anxiety due to uncertainty - 17.6 [6.2], concern about bad outcomes - 8.2 [3.9], reluctance to disclose uncertainty to patients - 14.9 [5.2]). Compared to scores by trainee clinicians in other studies, however, our trainees' scores may be lower. Internal medicine trainees in the Gerrity study(19) had significantly higher scores on each of these subscales than more senior clinicians.

As originally developed, there were two PRU subscales: 'stress from uncertainty' and 'reluctance to disclose uncertainty to others'.(30) Later work refined the PRU and produced the current instrument with four subscales. The first two subscales, 'anxiety due to uncertainty about diagnosis/treatment' and 'concern about a bad outcome for the patient' (corresponding to 'stress from uncertainty' in the original PRU), have been found to have comparatively high overlap.(26) Our findings of two distinct sets of associations can be seen to apply to, firstly, affective aspects of uncertainty ('stress from uncertainty') and, secondly, to adaptation to uncertainty – albeit likely problematic adaptation ('reluctance to disclose diagnosis/treatment uncertainty to patients').

### Strengths and limitations

Our study has several strengths. Our response rate was very high for a study of GPs (31) and we have presented findings for a large cohort of trainees from a selection of RTPs across four of Australia's six states and encompassing practices in major cities to very remote locations. It is likely that our findings are generalizable to the GP training population in Australia. One of the strengths of our study was that we measured and included a number of potential confounders. This was not common in other studies although gender was noted as a significant factor in several studies.(19, 20)

However, this study has several limitations. As this is a cross-sectional analysis, conclusions about causality are not possible. We chose one validated measure of tolerance for uncertainty, but several other scales exist, some of which have been recently developed and have examined this construct from different perspectives.(32, 33) Our finding in a cohort of general practice trainees may not be generalizable to other medical trainee cohorts.

### Implications for educational practice

Geller (18) has suggested that selecting medical school applicants for tolerance for uncertainty may address issues with imbalances in physician supply and lead to higher quality care in complex health

conditions. This same argument could be made for selection into general practice training programs. Indeed, senior medical students who have a low uncertainty preference tend to have more negative attitudes towards geriatric patients and chronic pain patients, and are less likely to want to work in internal medicine, psychiatry and general practice compared to radiology, surgery and anaesthetics.(34)

However, tolerance of uncertainty is only one of many desirable characteristics of a GP vocational trainee (and of an established GP). Our study (though the cross-sectional findings should be interpreted cautiously) suggests that trainees' distressed responses and maladaptive approach to uncertainty may attenuate with time. Therefore, rather than selecting applicants with high tolerance of uncertainty into GP training, emphasis may be directed within training to developing greater tolerance of uncertainty and to learning strategies for functional rather than maladaptive coping with or dealing with uncertainty.(4, 35, 36)

Our findings demonstrate quite different sets of associations of an individual's affective response of uncertainty (anxiety and concern) and of maladaptive approach to dealing with uncertainty (reluctance to disclose uncertainty to patients). An appreciation of these differing profiles or phenotypes may inform practical educational strategies. For example, being non-Australian trained was associated with the high 'affective' response phenotype and being Australian-trained was associated with the 'non-disclosure' phenotype, both of which may be, to some extent, culturally determined. A recent Australian study of GP trainees comparing temperament and character traits of International Medical Graduates and Australian Medical Graduates(37), however, found no significant difference in 'harm avoidance' (which included traits of anxiousness and intolerance of uncertainty and risk). Also contrary to our findings, non-Australian trained GPs are perceived to have difficulty adjusting to 'a culture in which the doctor-patient relationship is more equitable'(38) and might be expected to have particular reluctance to disclose uncertainty to patients. Thus, further research is required to elucidate cultural considerations that may further inform educational approaches to addressing uncertainty.

One approach to managing clinical uncertainty has been to provide education on managing uncertainty.(39) Tools for managing uncertainty deal with minimising cognitive bias (such as in Murtagh's diagnostic model (40)), consultation and communications skills such as safety-netting (41), and the adoption of shared decision making approaches.(42) Both university and vocational training programs commonly include education on these foundational skills. Despite this, GP trainees have reported struggling with uncertainty, which is an integral part of managing patients, such as those who present with medically unexplained symptoms.(43) While group educational

sessions with trainees to discuss clinical uncertainty and its management may be generic, individual trainee mentoring and practice allocation processes may benefit from taking our findings into account.

### Implications for further research

Our study reveals several areas warranting further research. Longitudinal studies could assess temporal trends in uncertainty within individuals as they progress through training and predictors of change in uncertainty during training. Further studies could examine the relationship of trainees' clinical uncertainty with clinical outcomes; for example, consultation time, prescribing, test-ordering, requests for supervisor assistance, specialist referral and organization of clinical follow-up. As early career GPs have less tolerance than more experienced GPs (21), the early post-fellowship may be a particularly important period in development of tolerance of uncertainty, and longitudinal studies from trainee through early post-fellowship may be of value in tracking this process and establishing predictors of adaptive change. Finally, this area of inquiry would benefit from research into educational interventions to attenuate stress from uncertainty and to promote adaptive responses to clinical uncertainty.

### Conclusion

In our study of general practice trainees, tolerance for uncertainty was lower in females and in earlier stages of training. Non-Australian trained trainees displayed a different pattern of reactions to uncertainty compared to trainees who attended an Australian university. Previous work in a practice and additional years of hospital work also played a role in GP trainee's responses to uncertainty. Training structures in general practice must address this issue and support trainees in developing greater tolerance of uncertainty. A close appreciation of the demography and associations of uncertainty in GP trainees will inform such initiatives.

### Acknowledgements

The authors would like to acknowledge the GP registrars, GP supervisors and practices who have participated in the ReCENT project.

The ReCENT project was funded during the period of collection of data presented in this paper by the participating educational organizations: General Practice Training Valley to Coast, the Victorian Metropolitan Alliance, General Practice Training Tasmania, and Adelaide to Outback GP Training Program which were funded by the Australian Government. From 2016 ReCENT is funded by an Australian Department of Health commissioned research grant and supported by GP Synergy Regional Training Organisation.

Table 1: Characteristics of trainees and ‘trainee rounds’ (trainee and practice pairings by term) and Physicians’ Reaction to Uncertainty (PRU) subscale scores

Characteristics	n (%) <sup>a</sup>
<b>Trainee Variables (n=594)</b>	
Female	392 (66.0)
Qualified as a doctor in Australia	442 (75.4)
Previous health qualifications prior to studying medicine	69 (11.8)
Trainee age (years) – mean (SD)	32.7 (6.5) <sup>b</sup>
Previous hospital experience (years) – mean (SD)	3.2 (3.2) <sup>b</sup>
Postgraduate medical qualifications	158 (26.9)
<b>Practice Pairing Variables (n=1209)</b>	
Performs other clinical, non-GP, work	162 (13.4)
Performs other education/research work	75 (6.2)
Trainee worked at the practice previously	371 (31.1)
Trainee training term	
Term 1	440 (36.4)
Term 2	450 (37.2)
Term 3	261 (21.6)
Term 4	58 (4.8)
Trainee works full-time <sup>c</sup>	927 (78.5)

Number of GPs working at the practice	1-5	378 (32.0)
	6+	805 (68.1)
Rurality of practice	Major City	727 (60.1)
	Inner regional	329 (27.2)
	Outer regional, remote or very remote	153 (12.7)
SEIFA <sup>d</sup> Index (decile) of practice mean (SD)		5.5 (2.9) <sup>b</sup>
Practice routinely bulk bills <sup>e</sup>		210 (17.5)

---

**Trainees' PRU subscale scores (n=1126)**

Anxiety due to uncertainty	17.65 (4.95) <sup>b</sup>
Concern about bad outcome	9.95 (3.40) <sup>b</sup>
Reluctance to disclose uncertainty to patients	13.41 (3.66) <sup>b</sup>

---

<sup>a</sup> Trainee variables (calculated from n=594). All other variables are calculated on basis of trainee and practice pairings by term (n = 1209)

<sup>b</sup> Mean (SD)

<sup>c</sup> 8 or more sessions per week

<sup>d</sup> Socioeconomic Index for Area (SEIFA) Relative Index of Disadvantage

<sup>e</sup> The practice routinely bulk-bills (that is, there is no financial cost to the patient for the consultation)

Table 2: Associations of scores on outcome subscale ‘anxiety due to uncertainty about diagnosis/treatment’: simple (univariate) and adjusted (multiple) linear regression

		Simple		Adjusted		Adjusted Means <sup>#</sup>		
Variable	Class	Coefficient (95% CI)	P	Coefficient (95% CI)	P	Mean (95% CI)	Mean difference	Mean difference (95% CI)
Trainee gender	Female	1.82 (1.05, 2.59)	<0.0 01	1.75 (0.98, 2.53)	<0.0 01	18.09 (17.39, 18.79)		
	Male					16.34 (15.53, 17.14)	Male minus Female	-1.75 (-2.53, - 0.98)
Trainee age		-0.07 (-0.13, -0.01)	0.03 4	-0.06 (-0.13, 0.01)	0.07 3			
Qualified as doctor in Australia	No					17.94 (17.05, 18.83)	No minus Yes	1.45 (0.56, 2.34)
	Yes	-1.01 (-1.87, -0.15)	0.02 1	-1.45 (-2.34, -0.56)	0.00 1	16.49 (15.81, 17.16)		
Postgraduate medical qualifications	No					17.01 (16.38, 17.65)	No minus Yes	-0.40 (- 1.25, 0.45)
	Yes	0.57 (-0.30, 1.44)	0.20	0.40 (-0.45, 1.25)	0.35	17.41 (16.51, 18.31)		
Other education/rese arch work	No					17.42 (16.89, 17.96)	No minus Yes	0.42 (- 0.52, 1.36)
	Yes	-0.92 (-1.94, 0.11)	0.08 0	-0.42 (-1.36, 0.52)	0.38	17.00 (16.00, 18.01)		

		Simple		Adjusted		Adjusted Means <sup>#</sup>		
Variable	Class	Coefficient (95% CI)	P	Coefficient (95% CI)	P	Mean (95% CI)	Mean difference	Mean difference (95% CI)
Training term/post	Term1					18.01 (17.30, 18.71)	Term1 minus Term2	-0.02 (- 0.48, 0.45)
	Term2	-0.48 (-0.89, -0.07)	0.02 1	0.02 (-0.45, 0.48)	0.94	18.02 (17.35, 18.70)		
	Term3	-2.05 (-2.54, -1.56)	<0.0 01	-1.60 (-2.13, -1.07)	<0.0 01	16.40 (15.70, 17.11)	Term3 minus Term2	-1.62 (- 2.10, - 1.14)
	Term4	-2.47 (-3.46, -1.47)	<0.0 01	-1.59 (-2.64, -0.53)	0.00 3	16.42 (15.33, 17.50)	Term4 minus Term2	-1.61 (- 2.56, - 0.66)
Worked at practice previously	No					17.69 (17.01, 18.36)	No minus Yes	0.94 (0.47, 1.42)
	Yes	-1.19 (-1.63, -0.76)	<0.0 01	-0.94 (-1.42, -0.47)	<0.0 01	16.74 (16.03, 17.46)		

<sup>#</sup> Adjusted means and adjusted mean differences provide covariate-adjusted estimates of group means and group mean differences in 'anxiety due to uncertainty about diagnosis/treatment' between the levels of each categorical variable.

Table 3: Associations of scores on outcome subscale 'concern about a bad outcome for the patient' - simple (univariate) and adjusted (multiple) linear regression

		Simple		Adjusted		Adjusted Means <sup>#</sup>		
Variable	Class	Coefficient t (95% CI)	P	Coefficient (95% CI)	P	Mean (95% CI)	Mean difference	Mean difference (95% CI)

		Simple		Adjusted		Adjusted Means <sup>#</sup>		
Variable	Class	Coefficient t (95% CI)	P	Coefficient (95% CI)	P	Mean (95% CI)	Mean difference	Mean difference (95% CI)
Trainee gender	Female	0.87 (0.34, 1.40)	0.001	0.82 (0.28, 1.36)	0.003	9.85 (9.39, 10.32)		
	Male					9.03 (8.51, 9.56)	Male minus Female	-0.82 (- 1.36, - 0.28)
Trainee age		-0.08 (- 0.11, - 0.04)	<0.001	-0.03 (-0.08, 0.02)	0.20			
Hospital work prior to GP terms (years)		-0.16 (- 0.24, - 0.08)	<0.001	-0.13 (-0.22, - 0.04)	0.004			
Other education/ research work	No					9.63 (9.33, 9.92)	No minus Yes	0.36 (- 0.32, 1.05)
	Yes	-0.47 (- 1.18, 0.23)	0.19	-0.36 (-1.05, 0.32)	0.29	9.26 (8.56, 9.96)		
Training term/post	Term1					9.95 (9.47, 10.42)	Term1 minus Term2	0.23 (- 0.11, 0.57)
	Term2	-0.21 (- 0.52, 0.09)	0.17	-0.23 (-0.57, 0.11)	0.18	9.72 (9.28, 10.15)		

		Simple		Adjusted		Adjusted Means <sup>#</sup>		
Variable	Class	Coefficient t (95% CI)	P	Coefficient (95% CI)	P	Mean (95% CI)	Mean difference	Mean difference (95% CI)
	Term3	-0.69 (- 1.05, - 0.33)	<0.001	-0.69 (-1.07, - 0.31)	<0.001	9.26 (8.80, 9.72)	Term3 minus Term2	-0.46 (- 0.79, - 0.13)
	Term4	-1.26 (- 1.93, - 0.60)	<0.001	-1.10 (-1.86, - 0.34)	0.005	8.85 (8.12, 9.58)	Term4 minus Term2	-0.87 (- 1.54, - 0.19)
Worked at practice previously <sup>§</sup>	No					9.46 (9.02, 9.90)	No minus Yes	0.03 (- 0.31, 0.38)
	Yes	-0.34 (- 0.65, - 0.04)	0.027	-0.03 (-0.38, 0.31)	0.86	9.43 (8.97, 9.88)		

<sup>#</sup> Adjusted means and adjusted mean differences provide covariate-adjusted estimates of group means and group mean differences in 'concern about a bad outcome for the patient' between the levels of each categorical variable.

<sup>§</sup> The covariate "worked at practice before" was tested for removal from the multivariable model. Its removal altered the model so this covariate was included in the final multivariable model.

Table 4: Associations of scores on outcome subscale ‘Reluctance to disclose diagnosis/treatment uncertainty to patients’ - simple (univariate) and adjusted (multiple) linear regression

Variable	Class	Simple		Adjusted		Adjusted Means <sup>#</sup>		
		Coefficient (95% CI)	P	Coefficient t (95% CI)	P	Mean (95% CI)	Mean difference	Mean difference (95% CI)
Trainee gender	Female	0.66 (0.09, 1.24)	0.023	0.53 (-0.04, 1.09)	0.0681	13.04 (12.38, 13.70)		
	Male					12.51 (11.78, 13.25)	Male minus Female	-0.53 (-1.09, 0.04)
Trainee age		-0.08 (-0.12, -0.03)	<0.001	-0.03 (-0.08, 0.01)	0.1726			
Qualified as doctor in Australia	No					12.17 (11.35, 13.00)	No minus Yes	-1.21 (-1.90, -0.51)
	Yes	1.75 (1.14, 2.36)	<0.001	1.21 (0.51, 1.90)	0.0006	13.38 (12.77, 13.99)		

		Simple		Adjusted		Adjusted Means <sup>#</sup>		
Variable	Class	Coefficient (95% CI)	P	Coefficient t (95% CI)	P	Mean (95% CI)	Mean difference	Mean difference (95% CI)
Previous health qualifications	No					12.25 (11.76, 12.73)	No minus Yes	-1.06 (-2.02, -0.09)
	Yes	0.99 (0.06, 1.92)	0.037	1.06 (0.09, 2.02)	0.0313	13.31 (12.29, 14.33)		
Other education/research work	No					13.15 (12.59, 13.70)	No minus Yes	0.74 (-0.01, 1.48)
	Yes	-0.85 (-1.59, -0.10)	0.027	-0.74 (-1.48, 0.01)	0.0522	12.41 (11.52, 13.29)		
Training term/post	Term1					13.19 (12.53, 13.85)	Term1 minus Term2	0.38 (-0.02, 0.78)
	Term2	-0.27 (-0.62, 0.09)	0.14	-0.38 (-0.78, 0.02)	0.061	12.81 (12.17, 13.44)		
	Term3	-0.66 (-1.10, -0.23)	0.003	-0.74 (-1.21, -0.27)	0.002	12.45 (11.77, 13.13)	Term3 minus Term2	-0.36 (-0.73, 0.02)
	Term4	-0.47 (-1.28, 0.34)	0.26	-0.52 (-1.46, 0.41)	0.27	12.66 (11.64, 13.69)	Term4 minus Term2	-0.14 (-1.01, 0.73)
Worked at practice previously§	No					12.73 (12.07, 13.39)	No minus Yes	-0.09 (-0.47, 0.30)

		Simple		Adjusted		Adjusted Means <sup>#</sup>		
Variable	Class	Coefficient (95% CI)	P	Coefficient t (95% CI)	P	Mean (95% CI)	Mean difference	Mean difference (95% CI)
	Yes	-0.32 (-0.65, 0.02)	0.062	0.09 (- 0.30, 0.47)	0.66	12.82 (12.15, 13.49)		
Rurality	Inner Regional	-0.56 (-1.08, -0.03)	0.040	-0.32 (- 0.90, 0.25)	0.27	13.18 (12.41, 13.94)		
	Major City					13.50 (12.80, 14.20)	Major City minus Inner Reg	0.32 (-0.25, 0.90)
	Outer Regional / Remote / Very remote	-2.09 (-2.81, -1.38)	<0.001	-1.84 (- 2.70, - 0.99)	<0.001	11.66 (10.79, 12.52)	Outer Reg/Rem minus Inner Reg	-1.52 (-2.38, - 0.66)
Regional Training Provider (RTP)	RTP 2	0.02 (-0.87, 0.91)	0.97	0.57 (- 0.34, 1.48)	0.2223	13.10 (12.28, 13.92)		
	RTP 3	-0.34 (-1.20, 0.52)	0.44	0.18 (- 0.78, 1.15)	0.7092	12.72 (11.81, 13.63)	RTP 4 minus RTP 2	-0.38 (-1.40, 0.63)
	RTP 4	0.89 (0.25, 1.53)	0.006	0.22 (- 0.47, 0.92)	0.5258	12.76 (11.91, 13.61)	RTP 5 minus RTP 2	-0.34 (-1.22, 0.54)
	RTP 1					12.53 (11.73, 13.34)	RTP 1 minus RTP 2	-0.57 (-1.48, 0.34)

		Simple		Adjusted		Adjusted Means <sup>#</sup>		
Variable	Class	Coefficient (95% CI)	P	Coefficient t (95% CI)	P	Mean (95% CI)	Mean difference	Mean difference (95% CI)
SEIFA Index*		0.15 (0.08, 0.21)	<0.001	0.09 (0.02, 0.16)	0.010			

<sup>#</sup> Adjusted means and adjusted mean differences provide covariate-adjusted estimates of group means and group mean differences in 'Reluctance to disclose diagnosis/treatment uncertainty to patients' between the levels of each categorical variable.

\* Socioeconomic Index for Area (SEIFA) Relative Index of Disadvantage

## References

1. Beresford EB. Uncertainty and the shaping of medical decisions. The Hastings Center Report. 1991 1991 July-August:6-11.
2. Ghosh A. Understanding medical uncertainty: a primer for physicians. JAPI. 2004;52:739-42.
3. Epstein RM, Hundert EM. Defining and assessing professional competence. Jama. 2002;287(2):226-35.
4. O'Riordan M, Dahinden A, Akturk Z, Ortiz JMB, Dagdeviren N, Elwyn G, et al. Dealing with uncertainty in general practice: an essential skill for the general practitioner. Quality in Primary Care. 2011;19(3):175-81.
5. Allison JJ, Kiefe CI, Cook EF, Gerrity MS, Orav EJ, Centor R. The Association of Physician Attitudes about Uncertainty and Risk Taking with Resource Use in a Medicare HMO. Med Decis Making. 1998;18(3):320-9.
6. van der Weijden T, van Bokhoven MA, Dinant G-J, van Hasselt CM, Grol RPTM. Understanding laboratory testing in diagnostic uncertainty: a qualitative study in general practice. The British Journal of General Practice. 2002;52(485):974-80.
7. Pedersen AF, Carlsen AH, Vedsted P. Association of GPs' risk attitudes, level of empathy, and burnout status with PSA testing in primary care. Br J Gen Pract. 2015 Dec;65(641):e845-51.
8. Barth JH, Jones RG. Indiscriminate investigations have adverse effects. Bmj. 2003 Feb 15;326(7385):393.

9. Bovier PA, Perneger TV. Stress from uncertainty from graduation to retirement—a population-based study of Swiss physicians. *Journal of general internal medicine*. 2007;22(5):632-8.
10. Cooke GP, Doust JA, Steele MC. A survey of resilience, burnout, and tolerance of uncertainty in Australian general practice registrars. *BMC Med Educ*. 2013;13:2.
11. Kimo Takayesu J, Ramoska EA, Clark TR, Hansoti B, Dougherty J, Freeman W, et al. Factors associated with burnout during emergency medicine residency. *Academic Emergency Medicine*. 2014 Sep;21(9):1031-5.
12. Kuhn G, Goldberg R, Compton S. Tolerance for uncertainty, burnout, and satisfaction with the career of emergency medicine. *Ann Emerg Med*. 2009 Jul;54(1):106-13.e6.
13. Friedlander MJ, Andrews L, Armstrong EG, Aschenbrenner C, Kass JS, Ogden P, et al. What can medical education learn from the neurobiology of learning? *Academic Medicine*. 2011;86(4):415-20.
14. Pekrun R, Goetz T, Titz W, Perry RP. Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational psychologist*. 2002;37(2):91-105.
15. Conrad C, Konuk Y, Werner PD, Cao CG, Warshaw AL, Rattner DW, et al. A quality improvement study on avoidable stressors and countermeasures affecting surgical motor performance and learning. *Annals of surgery*. 2012;255(6):1190.
16. Luther VP, Crandall SJ. Commentary: ambiguity and uncertainty: neglected elements of medical education curricula? *Academic Medicine*. 2011;86(7):799-800.
17. Nevalainen M, Mantyranta T, Pitkala K. Facing uncertainty as a medical student—a qualitative study of their reflective learning diaries and writings on specific themes during the first clinical year. *Patient education and counseling*. 2010;78(2):218-23.
18. Geller G. Tolerance for Ambiguity: An Ethics-Based Criterion for Medical Student Selection. *Academic Medicine*. 2013;88(5):581-4.
19. Gerrity MS, White KP, DeVellis RF, Dittus RS. Physicians' reactions to uncertainty: refining the constructs and scales. *Motivation and Emotion*. 1995;19(3):175-91.
20. Politi MC, Légaré F. Physicians' reactions to uncertainty in the context of shared decision making. *Patient education and counseling*. 2010;80(2):155-7.
21. Nevalainen M, Kuikka L, Pitkälä K. Medical errors and uncertainty in primary healthcare: A comparative study of coping strategies among young and experienced GPs. *Scandinavian Journal of Primary Health Care*. 2014 2014/06/01;32(2):84-9.

22. Evans L, Trotter DR. Epistemology and uncertainty in primary care: an exploratory study. *Fam Med*. 2009;41(5):319-26.
23. Morgan S, Magin PJ, Henderson KM, Goode SM, Scott J, Bowe SJ, et al. Study protocol: the registrar clinical encounters in training (ReCEnT) study. *BMC family practice*. 2012;13(1):1.
24. Magin P, Morgan S, Henderson K, Tapley A, Scott J, Spike N, et al. The Registrars' Clinical Encounters in Training (ReCEnT) project: Educational and research aspects of documenting general practice trainees' clinical experience. *Aust Fam Physician*. 2015;44(9):681.
25. Gerrity MS, DeVellis RF, Earp JA. Physicians' reactions to uncertainty in patient care: A new measure and new insights. *Medical care*. 1990;724-36.
26. Schneider A, Szecsenyi J, Barie S, Joest K, Rosemann T. Validation and cultural adaptation of a German version of the Physicians' Reactions to Uncertainty scales. *BMC Health Services Research*. 2007;7:81.
27. Australian Bureau of Statistics. Australian Standard Geographical Classification 2006 [updated 27 September 2007; cited 2015 3 January]. Available from: <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/1AE106C101420508CA2571A900170741>.
28. Australian Bureau of Statistics. 2039.0 - Information Paper: An Introduction to Socio-Economic Indexes for Areas (SEIFA) Canberra: Australian Bureau of Statistics; 2006 [updated 25 March 2009; cited 2015 3 January]. Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/mf/2039.0/>.
29. Politi MC, Clark MA, Ombao H, Légaré F. The impact of physicians' reactions to uncertainty on patients' decision satisfaction. *Journal of Evaluation in Clinical Practice*. 2011;17(4):575-8.
30. Gerrity MS, DeVellis RF, Earp JA. Physicians' reactions to uncertainty in patient care. A new measure and new insights. *Med Care*. 1990 Aug;28(8):724-36.
31. Bonevski B, Magin P, Horton G, Foster M, Girgis A. Trialling two recruitment strategies for improving response rates in general practitioner surveys: mission impossible. *Aust Fam Physician*. 2011;40(6):427-30.
32. Hancock J, Roberts M, Monrouxe L, Mattick K. Medical student and junior doctors' tolerance of ambiguity: development of a new scale. *Advances in Health Sciences Education*. 2014;20(1):113-30.

33. Weissenstein A, Ligges S, Brouwer B, Marschall B, Friederichs H. Measuring the ambiguity tolerance of medical students: a cross-sectional study from the first to sixth academic years. *BMC family practice*. 2014;15(1):6.
34. Merrill JM, Camacho Z, Laux LF, Lorimor R, Thornby JI, Vallbona C. Uncertainties and ambiguities: measuring how medical students cope. *Medical Education*. 1994;28(4):316-22.
35. Hewson MG, Kindy PJ, Van Kirk J, Gennis VA, Day RP. Strategies for managing uncertainty and complexity. *Journal of General Internal Medicine*. 1996;11(8):481-5.
36. Wray CM, Loo LK. The Diagnosis, Prognosis, and Treatment of Medical Uncertainty. *J Grad Med Educ*. 2015 Dec;7(4):523-7.
37. Laurence CO, Eley DS, Walters L, Elliott T, Cloninger CR. Personality characteristics and attributes of international medical graduates in general practice training: Implications for supporting this valued Australian workforce. *Aust J Rural Health*. 2016;24(5):333-9.
38. Pilotto LS, Duncan GF, Anderson-Wurf J. Issues for clinicians training international medical graduates: a systematic review. *Med J Aust*. 2007;187(4):225-8.
39. Morgan S, Chan M, Starling C. Starting off in general practice-consultation skill tips for new GP registrars. *Aust Fam Physician*. 2014;43(9):645.
40. Murtagh J. *John Murtagh's general practice / John Murtagh, Jill Rosenblatt*. 6th edition.. ed: North Ryde, N.S.W. : McGraw-Hill Education Australia; 2015.
41. Neighbour R. *The inner consultation : how to develop an effective and intuitive consulting style / roger Neighbour*. 2nd ed.. ed. Oxford: Oxford : Radcliffe; 2005.
42. Epstein RM, Alper BS, Quill TE. Communicating evidence for participatory decision making. *JAMA*. 2004;291.
43. Howman M, Walters K, Rosenthal J, Ajjawi R, Buszewicz M. "You kind of want to fix it don't you?" Exploring general practice trainees' experiences of managing patients with medically unexplained symptoms. *BMC Med Educ*. 2016;16(1):27.