

BMJ Open Prevalence and factors associated with missed hospital appointments: a retrospective review of multiple clinics at Royal Hospital, Sultanate of Oman

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ABSTRACT

Objectives Missed hospital appointments pose a major challenge for healthcare systems. There is a lack of information about drivers of missed hospital appointments in non-Western countries and extent of variability between different types of clinics. The aim was to evaluate the rate and predictors of missed hospital appointments and variability in drivers between multiple outpatient clinics. **Setting** Outpatient clinics in the Royal hospital (tertiary referral hospital in Oman) between 2014 and 2018.

Participants All patients with a scheduled outpatient clinic appointment (N=7 69 118).

Study design Retrospective cross-sectional analysis.

Primary and secondary outcome measures A missed appointment was defined as a patient who did not show up for the scheduled hospital appointment without notifying or asking for the appointment to be cancelled or rescheduled. The outcomes were the rate and predictors of missed hospital appointments overall and variations by clinic. Conditional logistic regression compared patients who attended and those who missed their appointment.

Results The overall rate of missed hospital appointments was 22.3%, which varied between clinics (14.0% for Oncology and 30.3% for Urology). Important predictors were age, sex, service costs, patient's residence distance from hospital, waiting time and appointment day and season. Substantive variability between clinics in ORs for a missed appointment was present for predictors such as service costs and waiting time. Patients aged 81–90 in the Diabetes and Endocrine clinic had an adjusted OR of 0.53 for missed appointments (95% CI 0.37 to 0.74) while those in Obstetrics and Gynaecology had OR of 1.70 (95% CI 1.11 to 2.59). Adjusted ORs for longer waiting times (>120 days) were 2.22 (95% CI 2.10 to 2.34) in Urology but 1.26 (95% CI 1.18 to 1.36) in Oncology.

Conclusion Predictors of a missed appointment varied between clinics in their effects. Interventions to reduce the rate of missed appointments should consider these factors and be tailored to clinic.

BACKGROUND

A missed appointment has been defined as a patient who does not show up for the scheduled hospital appointment without notifying the health care facility or asking for the appointment to be cancelled or rescheduled.¹

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Large data set including data from multiple clinic specialties.
- ⇒ Provides information about the frequency and drivers of missed hospital appointments in non-Western country (Oman) over 5-year period.
- ⇒ Substantial missing data for some of the risk factors (not missing at random); a missingness indicator variable was used in the logistic models.
- ⇒ The study examined one hospital from the tertiary care level and results may not be generalisable to other care levels.

Missed hospital appointments are a challenge to healthcare systems around the world. In the USA, it is estimated that 5%–55% of hospital appointments are missed.^{2–4} In the UK, 1 in 10 outpatient appointments are missed annually in the National Health Service.⁵ A missed hospital appointment affects work flow, reduces patient and staff satisfaction and can lead to a loss in revenue as well as having a negative impact on patient's health.⁶

Several studies have explored the reasons for a missed hospital appointment. Some patient-related reasons include forgetting, being confused about the appointment date and time, not receiving an appointment reminder, not having transportation to attend, work or family commitments, feeling unwell or being admitted to the hospital on the same day of the appointment.^{7–12} Factors associated with missed hospital appointments around the world include age, sex, appointment time, how long it took to get an appointment, distance to the hospital, marital status and socioeconomic level.^{13–17} Different strategies have been used to reduce the rate of a missed hospital appointment. The most common strategies used were short message service (SMS) text message reminders, phone call reminders, overbooking of the appointments, charging a fine to patients who miss

their appointment and the use of an online scheduling system to ease the process of appointment cancellation and rebooking.^{18–23}

There is a lack of information about the frequency and drivers of missed hospital appointments in non-Western countries such as Oman. The limited knowledge available tends to focus on overall rates of missed hospital appointments within one specialty. The aim of this study was to evaluate the rate and predictors of missed hospital appointments in the main tertiary referral hospital in Oman (Royal Hospital). In particular, this study focused on the unique tertiary hospital located in the capital city, Muscat, because patients who require specialised consultation and treatment can only receive treatment by referral to this tertiary hospital. The specific objectives were to identify the rate of missed appointments over time and identify the variation between different specialty clinics in the rate and predictors of missed appointments.

METHODS

Study design

A retrospective cross-sectional analysis including patients with a scheduled appointment between 1 January 2014 and 31 December 2018 at the Royal Hospital in the capital city Muscat, Oman.

Setting

The sultanate of Oman is located in the southeast part of the Arabian Peninsula. The total population of 4 618 268 (2019) includes 2 655 453 Omani and 1 962 815 non-Omani inhabitants. The population is spread over 309 500 km². There are 61 Wilayats (cities) making up 11 governorates (see online supplemental figure 1 for a map of Oman depicting the governorates regions).

The government manages the healthcare system in Oman where there are three levels of healthcare facilities: primary, secondary and tertiary hospitals. Some additional hospitals are managed by other government sectors such as The Royal Police hospital, The Armed Force hospital and Sultan Qaboos University Hospital. In addition to hospitals, there are 207 local health centres throughout Oman. These centres provide primary health services, similar to general practice in the UK health system. Patients can seek basic health services at these centres before referral to specialist hospitals.

The Royal hospital located in the capital city of Muscat has 50 specialty and subspecialty clinics. It is considered a referral tertiary care hospital that receives patients from all regional primary and secondary hospitals in the Sultanate of Oman. The Royal hospital has 630 beds providing inpatient, outpatient and emergency medical service. The national cardiac centre, the national oncology centre and the national diabetic centre are all within the Royal Hospital. It is also the only government hospital that provides cancer care. Around 500 patients are referred to the outpatient's clinics daily. Omani citizens, citizens of other GCC countries (The Cooperation Council for

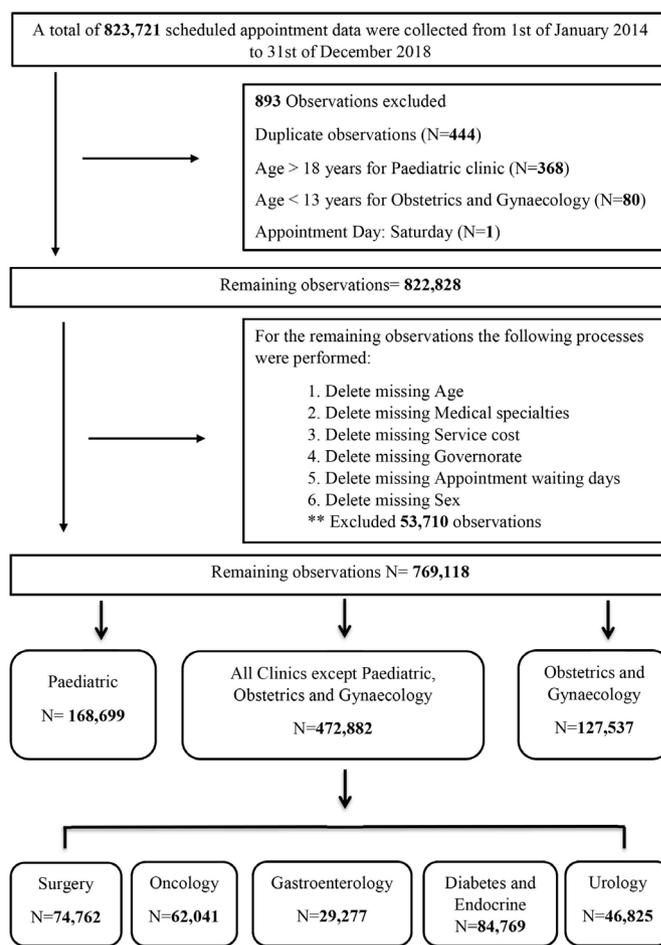


Figure 1 Inclusion and exclusion criteria for the study population.

the Arab States of the Gulf) and expatriates working in the government sector receive free medical service with the requirement to pay an annual fee equating to two Great British Pound sterling for the maintenance of their patient record, alongside a visit fee equating to 50 Pence for each hospital visit.

Study sample

The final study sample included 769 118 scheduled appointments at the Royal Hospital. **Figure 1** shows the exclusion process and the final analysis-ready data sets generated. A total of 893 observations were excluded in the first step due to outlying age for the clinic or appointments recorded on a Saturday and for duplication. Then, 53 710 appointments were excluded because of the missing data for age, medical specialties, service cost, governorates and appointment waiting days. The remaining 769 118 observations were divided three data sets: one data set including appointments from Paediatric clinic only (N=1 68 699), another data set including appointments from Obstetrics and Gynaecology clinic only (N=1 27 537), and an overall data set including appointments from all remaining medical specialties, except for Paediatrics and Obstetrics and Gynaecology (N=4 72 882). The reason for not including Paediatrics

or Obstetrics and Gynaecology appointments into the overall data set was because the age and sex structure was different from other clinics and this would cause analytical problems in the regression model as some of the age and sex categories would be empty. The Paediatric clinic only included children who were 18 years or less, and the Obstetrics and Gynaecology clinic appointment included female patients only.

Regression models were performed separately for the overall data set (N=472 882) adjusting for medical specialty; the Paediatric data set (N=1 68 699) and the Obstetrics and Gynaecology data set (N=1 275 37). Then, from the overall data set, five subsets of data were created, one for each of the top five clinics with (a) a large sample size (and, therefore, reasonable numbers of cases and controls) and (b) a higher rate of missed appointment. Separate model was then performed for these top five clinics including Diabetes and Endocrine clinic (N=84 769), Surgery clinic (N=74 762), Oncology clinic (N=62 041), Urology clinic (N=46 825) and Gastroenterology clinic (N=29 277).

Measures

The outcome of interest was a missed outpatient hospital appointment. This was defined, in line with previous research,²⁴ as a patient who had a scheduled appointment but did not attend the appointment without contacting the hospital to cancel or rebook his/her appointment and is recorded in the system as failed to attend. The following predictors were evaluated: age, sex, the day, month and year of the appointment, marital status, region of patients' residence (defined by the governorate), service cost, appointment waiting time, education level, patients' nationality and specialty clinic. The appointment date was subtracted from the appointment schedule date to calculate the number of days that patients waited for their appointment. The Walayat parameter was used to group patients according to the 11 governorates in the Sultanate of Oman (online supplemental figure 1). Clinics within the same specialty were grouped together under one department making up 23 medical specialties. Education, nationality and financial level parameters were categorised into larger groups due to small numbers.

Data collection

The Royal Hospital uses electronic health records (EHRs) to record and store all clinical and non-clinical patient information. The EHRs (recorded to the ALSHIFA system; V.3+) were used to extract data for all patients who had a scheduled outpatient clinic appointment.

Statistical analysis

Descriptive statistics were used to describe the rate of missed hospital appointments. Conditional logistic regression was performed to determine the relationship between each factor and the likelihood of missing a hospital appointment with statistical adjustment for each variables (estimating the adjusted OR and 95% CIs). Independent

predictors included age category, sex, appointment status (missed or attended), appointment day, appointment month, appointment year, marital status, governorate and the financial contribution service cost, appointment waiting days, education level and nationality. The R statistical programme (V.3.6.2) was used for the statistical analyses.^{25 26} An overall model was performed for all clinics (excluding Obstetrics and Gynaecology and Paediatric clinic) adjusting for clinic, and individual models were also performed for each of the clinics with the highest rate of missed hospital appointments. The logistic models stratified the analyses by the number of previous appointments (deciles). For example, scheduled appointments in stratum 1 included patients with no prior appointment, where those in stratum 9 had 9–15 prior appointments. For more details, see online supplemental table 1.

Patient and public involvement statement

The study did not require the involvement of patients and the public, but our future research will survey patients for the reasons of missed hospital appointments.

RESULTS

There were 769 118 scheduled outpatient appointments between 2014 and 2018 included in the analysis. As shown in table 1, 464 081 (60.3%) of the appointments were for female patients and 166 942 (21.7%) were for patients aged between 30 and 40. A total of 171 951 appointments was missed (rate of 22.3%). The overall rate of missed hospital appointments was 22.4% in 2014 and 21.5% in 2018. When looking at monthly trends, the highest rate of missed appointments occurred in June (25.2%) and the lowest rate of missed appointments in March (20.3%). Additional baseline characteristics of the study population are found in online supplemental tables 2 and 3. Figure 2 shows the rate of missed appointments across the top seven clinics. Most appointments were missed for Urology (30.3%) followed by Gastroenterology (27.4%), then Diabetes and Endocrine (26.4%).

The adjusted OR of missed hospital appointment for patients with social affair coverage (exempted from all medical fees) was 0.64 (95% CI 0.60 to 0.68), indicating they were 36% less likely to miss their appointment compared with patients who had to pay the registration and visit fees (table 2). Patients living in a governorate that was further away from the hospital were more likely to attend their appointments (table 3). As example, patients living in the governorate of Musandam (540–620 km from Muscat) were 21% more likely to attend their appointment compared with patients who live in the capital city of South Batina (adjusted OR 0.79 (95% CI 0.76 to 0.82)).

Evaluating the predictors by individual clinic, a substantial heterogeneity in effects of predictors of missed hospital appointments was observed. Figure 3 shows the effects of age on missed appointments stratified by clinic. For example, a patient aged 71–80 years was a strong

**Table 1** Characteristics of the final study population overall and stratified by attended and missed appointments (online supplemental table 2 provides additional details)

Variable	Patients* N=1 746 777	Scheduled appointments† N=7 691 118	Attended N (%) 597 229 (77.7%)	Missed N (%) 171 889 (22.3%)
Sex				p value<0.001
Female	97 513 (55.8)	464 081 (60.3)	364 842 (78.6)	99 239 (21.4)
Male	77 164 (44.2)	305 037 (39.7)	232 387 (76.2)	72 650 (23.8)
Age category				p value<0.001
≤5 years old	29 054 (16.6)	91 155 (11.9)	72 149 (79.1)	19 006 (20.9)
6–10 years old	7 483 (4.3)	36 087 (4.7)	29 660 (82.2)	6 427 (17.8)
11–13 years old	3 491 (2.0)	18 716 (2.4)	15 038 (80.3)	3 678 (19.7)
14–18 years old	5 230 (3.0)	23 645 (3.1)	18 144 (76.7)	5 501 (23.3)
19–30 years old	33 419 (19.1)	132 519 (17.2)	101 330 (76.5)	31 189 (23.5)
31–40 years old	34 926 (20.0)	166 942 (21.7)	130 934 (78.4)	36 008 (21.6)
41–50 years old	20 426 (11.7)	101 555 (13.2)	79 016 (77.8)	22 539 (22.2)
51–60 years old	17 117 (9.8)	86 887 (11.3)	67 657 (77.9)	19 230 (22.1)
61–70 years old	13 298 (7.6)	66 874 (8.7)	50 982 (76.2)	15 892 (23.8)
71–80 years old	7 929 (4.5)	35 770 (4.7)	26 081 (72.9)	9 689 (27.1)
81–90 years old	2 054 (1.2)	8 140 (1.1)	5 691 (69.9)	2 449 (30.1)
>90 years old	250 (0.1)	828 (0.1)	547 (66.1)	281 (33.9)
Appointment day by of working week				p value<0.001
Sunday	36 278 (20.8)	160 770 (20.9)	122 683 (76.3)	38 087 (23.7)
Monday	36 572 (20.9)	158 890 (20.7)	123 783 (77.9)	35 107 (22.1)
Tuesday	34 127 (19.5)	156 786 (20.4)	123 033 (78.5)	33 753 (21.5)
Wednesday	36 957 (21.2)	160 577 (20.9)	123 681 (77.0)	36 896 (23.0)
Thursday	30 743 (17.6)	132 095 (17.2)	104 049 (78.8)	28 046 (21.2)
Governorate				p value<0.001
Muscat	941 440 (53.9)	422 664 (55.0)	323 259 (76.5)	99 405 (23.5)
South Batina	2 918 (1.7)	11 210 (1.5)	8 332 (74.3)	2 878 (25.7)
AL Dhakiliya	1 020 (0.6)	3 905 (0.5)	2 895 (74.1)	1 010 (25.9)
North Batina	2 112 (1.2)	8 570 (1.1)	6 336 (73.9)	2 234 (26.1)
North Sharqiya	14 454 (8.3)	67 629 (8.8)	55 363 (81.9)	12 266 (18.1)
South Sharqiya	14 979 (8.6)	67 958 (8.8)	53 852 (79.2)	14 106 (20.8)
AL Dhahira	17 221 (9.9)	73 186 (9.5)	58 071 (79.3)	15 115 (20.7)
AL Buriami	10 626 (6.1)	40 237 (5.2)	30 668 (76.2)	9 569 (23.8)
AL Wusta	9 152 (5.2)	38 135 (5.0)	29 941 (78.5)	8 194 (21.5)
Musandam	7 059 (4.0)	31 826 (4.1)	25 691 (80.7)	6 135 (19.3)
Dhofar	969 (0.6)	3 711 (0.5)	2 748 (74.1)	963 (25.9)
GCC countries	27 (0.0)	87 (0.0)	73 (83.9)	14 (16.1)
Service cost				p value<0.001
Pay visit and registration fees	145 542 (83.3)	673 088 (87.5)	522 932 (77.7)	150 156 (22.3)
‡≤2 years old	20 641 (11.8)	56 469 (7.3)	43 883 (77.7)	12 586 (22.3)
Pay all medical service fees	6 892 (3.9)	24 739 (3.2)	17 796 (71.9)	6 943 (28.1)
§Under social affair coverage	1 602 (0.9)	14 822 (1.9)	12 618 (85.1)	2 204 (14.9)
Appointment waiting days				p value<0.001
≤30 days	67 437 (38.6)	306 087 (39.8)	251 365 (82.1)	54 722 (17.9)
31–60 days	28 128 (16.1)	117 126 (15.2)	90 805 (77.5)	26 321 (22.5)

Continued

Table 1 Continued

Variable	Patients* N=174677	Scheduled appointments† N=769118	Attended N (%) 597 229 (77.7%)	Missed N (%) 171 889 (22.3%)
61–90 days	20856 (11.9)	101 825 (13.2)	78 878 (77.5)	22 947 (22.5)
91–120 days	14 740 (8.4)	67 543 (8.8)	50 268 (74.4)	17 275 (25.6)
>120 days	43 516 (24.9)	176 537 (23.0)	125 913 (71.3)	50 624 (28.7)

*One appointment per patient scheduled during the 5-year period selected at random.

†All appointments scheduled during the 5-year period with multiple appointments per patient.

‡Exempted from all medical service fees.

§Exempted from all medical service fees.

GCC, Gulf Cooperation Council.

predictor for missing an appointment for all clinics except for Diabetes and Endocrine.

Variations between clinics were also found for the number of days patients waited for their appointment. A waiting time of 60+ days was a strong predictor of missing an appointment for most clinics but had only a small effect for Oncology (figure 4). Details on the effects of other predictors by clinics are found in online supplemental tables 4–7 and figures 2–4.

DISCUSSION

This is the first study that explored the prevalence and the factors associated with missed hospital appointments at outpatients' clinics at tertiary referral hospital in the Sultanate of Oman. The rate of missed hospital appointments was found to vary by patient characteristics and clinics.

This study found that the overall missed hospital appointment was lower than some studies from neighbouring countries (Qatar, Iran), reporting rates of approximately 50%.^{3 4} Possible reasons for this could be the differences in the healthcare system structure, the healthcare coverage provided to patients by the government or variations between clinics. In addition, the rate

of missed hospital appointments could have been lower in Oman because of the mobile phone SMS text reminder service implemented within the appointment system in 2010 (reminders sent 48 hours before the day of an appointment), while other studies included hospitals that did not use text reminder system. One study showed a reduction in missed hospital appointment rate from 49% to 18% when text reminder system was used.³

The current analysis showed that patients who had to wait longer for their appointment were more likely to miss their hospital appointment across all clinics. This finding was similar to the findings from the previous studies.^{13 15 27} This could be explained by the fact that patients who had to wait for long time will seek medical service somewhere else. In some cases, patient may have passed away while waiting for the appointment if he/she had a severe illness. Since all the healthcare services are free for all citizens, patients might find another appointment in other hospitals or seek care at private hospitals to avoid the wait.

Patients under social affair coverage were less likely to miss their appointment compared with other patients. On the other hand, patients who had to pay for all their medical service were more likely to miss their hospital

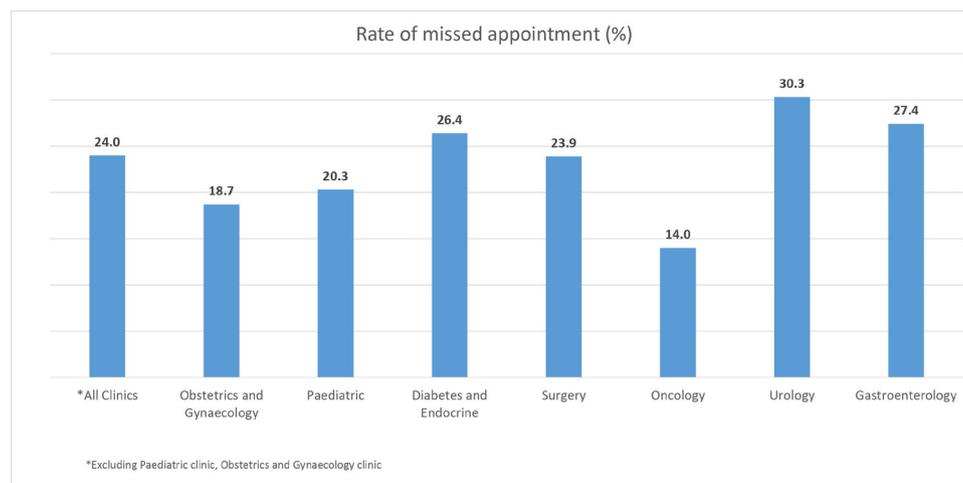


Figure 2 Rate of missed appointment overall and by clinic, showing in the top seven clinics with the highest rate of missed appointments. *Excluding Obstetrics and Gynaecology clinics and the Paediatric clinic.

Table 2 Fully adjusted ORs for the predictors of missed hospital appointment for all clinics combined (except Obstetrics and Gynaecology and Paediatric clinics)

Model	Model (1) N=472882	*Model (2) N=472882
Predictors	†Fully adjusted OR (95% CI)	†Fully adjusted OR (95% CI)
Sex		
Female	Reference	Reference
Male	1.08 (1.06 to 1.10)	1.08 (1.06 to 1.09)
Age category		
19–30 years old	1.15 (1.13 to 1.18)	1.14 (1.12 to 1.17)
31–40 years old	Reference	Reference
41–50 years old	0.91 (0.90 to 0.94)	0.92 (0.90 to 0.94)
51–60 years old	0.89 (0.87 to 0.91)	0.90 (0.88 to 0.92)
61–70 years old	0.97 (0.95 to 1.00)	0.98 (0.96 to 1.00)
71–80 years old	1.17 (1.13 to 1.20)	1.17 (1.14 to 1.21)
81–90 years old	1.34 (1.28 to 1.42)	1.35 (1.28 to 1.42)
>90 years old	1.62 (1.39 to 1.89)	1.60 (1.38 to 1.87)
Appointment day		
Sunday	Reference	Reference
Monday	0.93 (0.91 to 0.95)	0.94 (0.91 to 0.96)
Tuesday	0.88 (0.86 to 0.90)	0.88 (0.86 to 0.90)
Wednesday	0.95 (0.93 to 0.97)	0.95 (0.93 to 0.97)
Thursday	0.84 (0.83 to 0.86)	0.85 (0.84 to 0.87)
Appointment month		
January	Reference	Reference
February	0.95 (0.91 to 0.98)	0.95 (0.91 to 0.98)
March	0.95 (0.92 to 0.99)	0.95 (0.92 to 0.98)
April	1.04 (1.00 to 1.07)	1.03 (1.00 to 1.07)
May	1.12 (1.08 to 1.15)	1.12 (1.08 to 1.15)
June	1.24 (1.20 to 1.29)	1.24 (1.20 to 1.29)
July	1.10 (1.06 to 1.14)	1.11 (1.07 to 1.14)
August	1.08 (1.05 to 1.12)	1.09 (1.05 to 1.13)
September	1.00 (0.97 to 1.04)	1.01 (0.97 to 1.04)
October	1.01 (0.98 to 1.04)	1.02 (0.98 to 1.05)
November	1.10 (1.06 to 1.13)	1.10 (1.07 to 1.14)
December	1.04 (1.01 to 1.08)	1.05 (1.02 to 1.09)
Service cost		
Pay visit and registration fees only	Reference	Reference
Pay all medical service fees	1.36 (1.28 to 1.44)	1.36 (1.28 to 1.44)
‡Under Social Affair coverage	0.62 (0.59 to 0.66)	0.64 (0.60 to 0.68)
Appointment waiting days		
≤30 days	Reference	Reference

Continued

Table 2 Continued

Model	Model (1) N=472882	*Model (2) N=472882
31–60 days	1.45 (1.42 to 1.48)	1.43 (1.40 to 1.47)
61–90 days	1.40 (1.37 to 1.43)	1.40 (1.37 to 1.43)
91–120 days	1.56 (1.52 to 1.60)	1.55 (1.51 to 1.59)
>120 days	1.87 (1.84 to 1.91)	1.85 (1.81 to 1.89)
Appointment year		
2014	Reference	Reference
2015	1.06 (1.04 to 1.09)	1.08 (1.06 to 1.11)
2016	0.99 (0.97 to 1.01)	1.03 (1.00 to 1.05)
2017	1.02 (1.00 to 1.05)	1.09 (1.07 to 1.12)
2018	0.95 (0.93 to 0.97)	1.03 (1.00 to 1.05)
Marital status		
Single	0.91 (0.89 to 0.93)	0.91 (0.89 to 0.93)
Married	Reference	Reference
Divorced	1.15 (1.06 to 1.25)	1.16 (1.06 to 1.26)
Widow	1.10 (1.03 to 1.18)	1.10 (1.03 to 1.17)
Missing	1.15 (1.13 to 1.17)	1.13 (1.11 to 1.15)
Nationality		
Omani	Reference	Reference
Non-Omani	1.02 (0.97 to 1.07)	1.01 (0.96 to 1.06)
*Stratified by appointment group.		
†A fully adjusted OR measures how the change in one predictor affects the odds of a response variable when all other predictors in the model are controlled.		
‡Exempted from all medical service fees.		

appointment. This contradicts the findings from other studies, which reported that patients with low socio-economic status are more likely to miss their hospital

Table 3 Distance between the Royal Hospital and each governorate and fully adjusted OR for missing appointment

Governorate name	Distance to Royal Hospital (km)*	Fully adjusted OR (95% CI)
Muscat	1–90	Reference
South Batina	50–165	1.25 (1.18 to 1.32)
AL Dhakiliya	70–206	1.18 (1.08 to 1.29)
North Batina	114–262	1.08 (1.02 to 1.15)
North Sharqiya	173–290	0.68 (0.66 to 0.70)
South Sharqiya	205–320	0.85 (0.83 to 0.88)
AL Dhahira	245–340	0.84 (0.82 to 0.86)
AL Buriami	285–350	0.97 (0.94 to 1.00)
AL Wusta	365–490	0.82 (0.79 to 0.84)
Musandam	540–620	0.79 (0.76 to 0.82)
Dhofar	800–1120	1.06 (0.97 to 1.17)
*The distance indicates the min–max distance that patients have to travel to reach the hospital.		

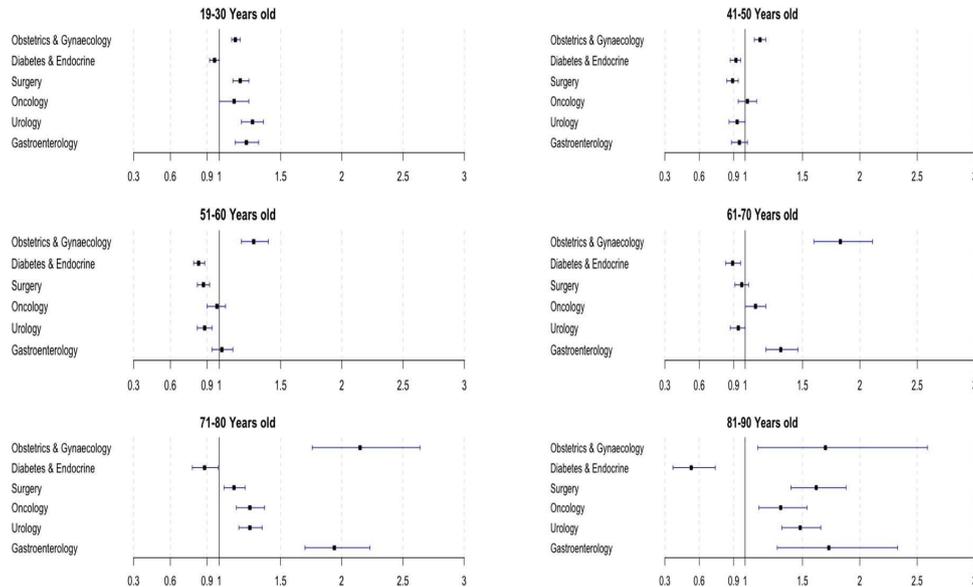


Figure 3 Age category as predictors of missed appointment stratified by clinic. *Reference group: age 31–40 years old.

appointment.^{15 28 29} This may be because they either have no health coverage to pay for their treatment or they have limited coverage that does not cover every health service. However, in Oman, the healthcare service setting is different. All citizens receive free healthcare service with minimum charges only. Omanis with low income receive free services and are exempted from all charges

and fees. As a result, not attending hospital appointment for patients who are under social affair coverage will be more costly for them because they will have to seek health service in private hospitals and pay for the service. On the other hand, patients who have to pay for all their medical services (expatriates only) were more likely to miss their appointment. This might be explained by the fact that since they pay for the health service, they might prefer to go to a private hospital without having to wait for their appointment since in both scenarios they will end up paying for their treatment.

The months of May, June, July and August were the highest for missed appointments. Previous studies support this finding showing that patients tend to miss more appointments in summer compared with the rest of the year because of high temperature.¹⁴ Giunta *et al* also stated that patients tend to miss more appointments during the holiday season. It is probable, with higher temperature of 40°C in May through to August in Oman, that patients are either on holiday or unable to travel in the extreme heat (June, July and August).^{13 30}

Patients who are living in governorates located far away from the hospital are more likely to attend their appointment compared with patients in closer location overall and by clinic. This finding contradicts with the findings from other studies, that long travelling time is associated with high rates of missed appointments.²⁸ This may be explained by the fact that some governorates only provide basic healthcare services, meaning patients have less access to more specialised care (public and private). As most of the referral hospitals providing specialised care are located in the capital city, patients will need to travel to the capital to receive treatment as it is not available locally. As more facilities are available in the capital and surrounding governorates, patients residing here have more available facilities and may choose to attend an

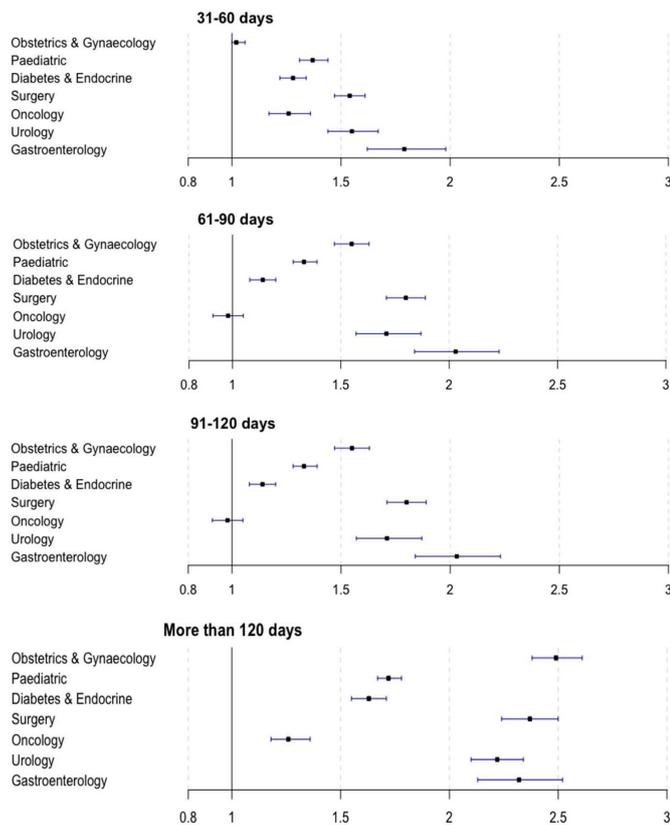


Figure 4 Appointment waiting time (days) as predictors of missed appointment stratified by clinic. *Reference group: ≤30 waiting days.

appointment at an alternative facility, particularly if this reduces their waiting time.

The current analysis also showed that the younger and older patient populations were more likely to miss their appointment. This is consistent with other studies conducted in outpatient clinics that found that younger patients (17–40 years) and older patients (>65) missed more appointments.^{16 31} This could be explained by the fact that younger patients might have more responsibilities with school or work and are unavailable to attend their appointments, whereas older patients may be dependent on family to take them to their appointment and tend to miss their hospital appointments if families are unavailable to do so.

The analysis also showed that appointments scheduled in the beginning of the week (Sunday, Monday) were more likely to be missed compared with appointments scheduled in the end of the week (Thursday). This finding is consistent with findings from previous studies showing that patients missed more appointments scheduled on Monday and Tuesday compared with appointments towards the end of the week, Thursday and Friday.³² This can be explained by the fact that patients might have difficulties getting off work at the start of the week.

The current study has limitations as it included just one tertiary referral hospital in the capital city of Muscat. Although most specialist care is conducted at the Royal Hospital, future work may include other referral hospitals located in the capital city of Muscat to compare the rate of missed appointments within the capital city to see if this varies and if there is driving factors specific to different regions and individual hospitals. Another limitation was that this study just looked at the rate and factors associated with missed hospital appointments without looking at the reasons behind the problem either from the doctors' or the patients' perspectives. Work is currently ongoing to interview patients who missed their hospital appointment and clinical staff to identify the reasons from the patient's and medical team perspectives, respectively. However, the diversity of the departments included in this study, the large sample size and the fact that it is the first attempt to investigate the rate and factors associated with missed hospital appointment in a tertiary Omani hospital are strengths of this study.

CONCLUSIONS

In conclusion, our study showed that age, service cost, waiting days for appointment, governorate (distance from hospital) and month of the appointment had substantive effects on the rate of missed hospital appointments. These predictors also varied between clinics in their effect on the rate of missed appointments. Interventions to reduce the rate of missed hospital appointments should consider these variations between clinics and be tailored to each clinic.

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Contributors AA drafted the ethics application, analysed, interpreted the EHR data and drafted the manuscript. VP oversaw the statistical analyses and reviewed the manuscript. TvS reviewed the ethics application, supervised AA and reviewed the manuscript. All authors read and approved the final manuscript.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study was approved by the Study and Research Centre, Ministry of Health, Sultanate of Oman in 2 May 2019 (proposal ID: MoH/CSR/19/10045).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. The data that support the findings of this study are available from Ministry of Health, Sultanate of Oman, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available.

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REFERENCES

- Mbada CE, Nonvignon J, Ajayi O, *et al*. Impact of missed appointments for out-patient physiotherapy on cost, efficiency, and patients' recovery. *Hong Kong Physiother J* 2013;31:30–5.
- Samuels RC, Ward VL, Melvin P, *et al*. Missed appointments: factors contributing to high No-Show rates in an urban pediatrics primary care clinic. *Clin Pediatr* 2015;54:976–82.
- Mohamed K, Mustafa A, Tahtamouni S, *et al*. A Quality Improvement Project to Reduce the 'No Show' rate in a Paediatric Neurology Clinic. *BMJ Qual Improv Report* 2016;5:u209266.w3789.
- Anisi S, Zarei E, Sabzi M, *et al*. Missed appointments: factors contributing to patient no-show in outpatient hospital clinics in tehran, Iran. *Shiraz E-Med J* 2018;19.
- NHS England. Weblet importer, 2017 <http://www.ersconnect.co.uk/news/5-ways-to-reduce-your-did-not-attend-dna-rates/> [Accessed 26 Nov 2018].
- Giunta DH, Alonso Serena M. Nonattendance rates of scheduled outpatient appointments in a university General Hospital. *Int J Health Plann Manage* 2019;34:1377–85.
- Guzek LM, Gentry SD, Golomb MR. The estimated cost of "no-shows" in an academic pediatric neurology clinic. *Pediatr Neurol* 2015;52:198–201.
- Guzek LM, Fadel WF, Golomb MR. A pilot study of reasons and risk factors for no-shows in a pediatric neurology clinic. *J Child Neurol* 2015;30:1295–9.
- Crutchfield TM, Kistler CE. Getting patients in the door: medical appointment reminder preferences. *Patient Prefer Adherence* 2017;11:141–50.

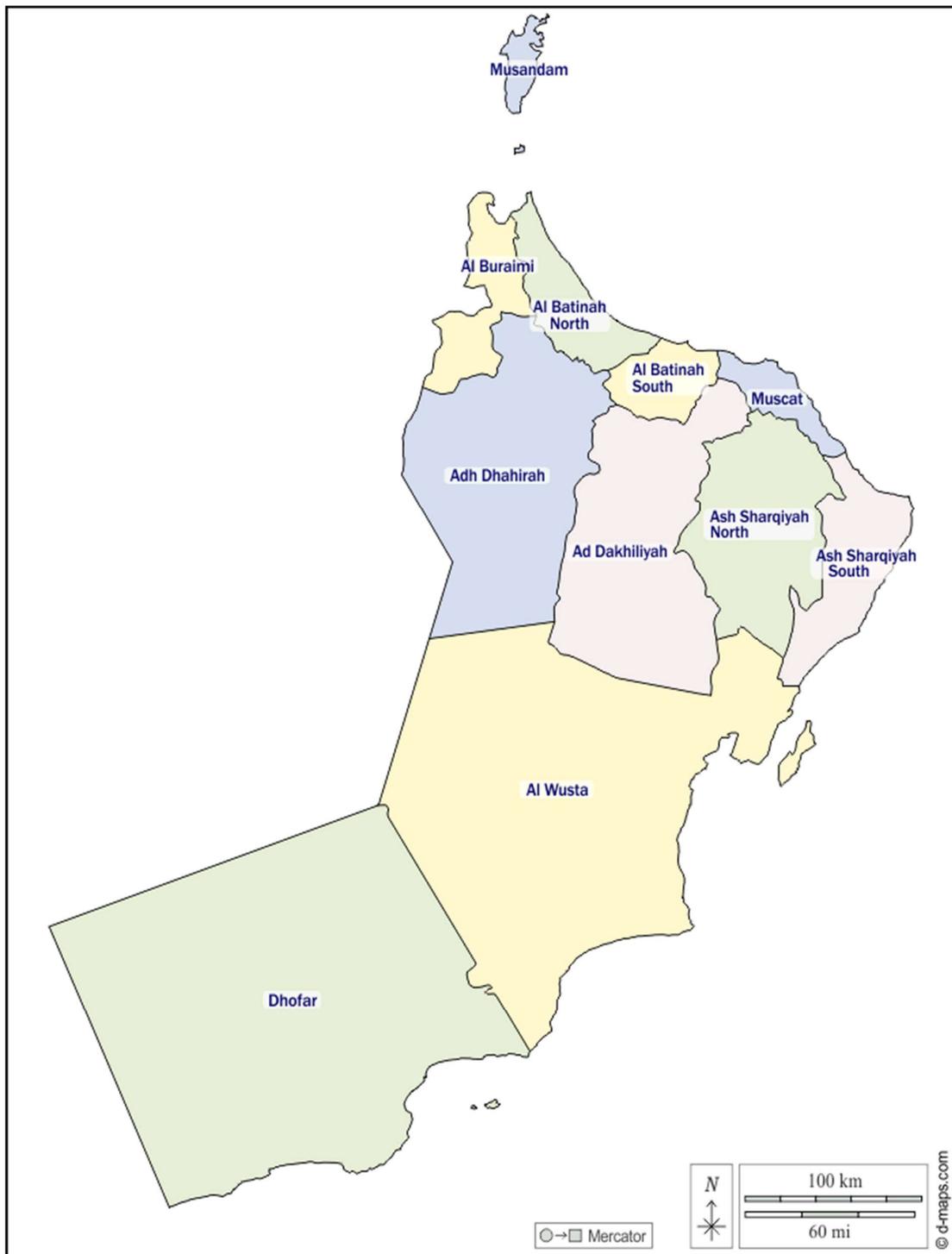
- 10 Magadzire BP, Mathole T, Ward K. Reasons for missed appointments linked to a public-sector intervention targeting patients with stable chronic conditions in South Africa: results from in-depth interviews and a retrospective review of medical records. *BMC Fam Pract* 2017;18:1–10.
- 11 Wilkinson J, Daly M. Reasons for non-attendance: audit findings from a nurse-led clinic. *J Prim Health Care* 2012;4:39–44.
- 12 Frost L, Jenkins LS, Emmink B. Improving access to health care in a rural regional hospital in South Africa: why do patients miss their appointments? *Afr J Prim Health Care Fam Med* 2017;9:1–5.
- 13 Giunta D, Briatore A, Baum A, et al. Factors associated with nonattendance at clinical medicine scheduled outpatient appointments in a university General Hospital. *Patient Prefer Adherence* 2013;7:1163–70.
- 14 Menendez ME, Ring D. Factors associated with non-attendance at a hand surgery appointment. *Hand* 2015;10:221–6.
- 15 Ellis DA, McQueenie R, McConnachie A, et al. Demographic and practice factors predicting repeated non-attendance in primary care: a national retrospective cohort analysis. *Lancet Public Health* 2017;2:e551–9.
- 16 Partin MR, Gravely A, Gellad ZF, et al. Factors associated with missed and Cancelled colonoscopy appointments at Veterans health administration facilities. *Clin Gastroenterol Hepatol* 2016;14:259–67.
- 17 Nancarrow S, Joanne Bradbury CA. Factors associated with non-attendance in a general practice super clinic population in regional Australia: a retrospective cohort study. *AMJ* 2014;33:323–33.
- 18 McLean S, Booth A, Gee M. Appointment reminder systems are effective but not optimal: results of a systematic review and evidence synthesis employing realist principles. *Patient Prefer Adherence* 2016;479.
- 19 Perron NJ, Dao MD, Righini NC. Text-messaging versus telephone reminders to reduce missed appointments in an academic primary care clinic: a randomized controlled trial. *BMC Health Serv Res* 2013.
- 20 Stubbs ND, Geraci SA, Stephenson PL, et al. Methods to reduce outpatient non-attendance. *Am J Med Sci* 2012;344:211–9.
- 21 Finkelstein SR, Liu N, Jani B, et al. Appointment reminder systems and patient preferences: patient technology usage and familiarity with other service providers as predictive variables. *Health Informatics J* 2013;19:79–90.
- 22 Blæhr EE, Væggemose U, Søgaard R. Effectiveness and cost-effectiveness of fining non-attendance at public hospitals: a randomised controlled trial from Danish outpatient clinics. *BMJ Open* 2018;8:19969.
- 23 Bartlett M, Blazer S, Hobson G, et al. The power of digital communications: improving outpatient attendances in South London. *Future Healthc J* 2018;5:43–6.
- 24 Dantas LF, Fleck JL, Cyrino Oliveira FL, et al. No-shows in appointment scheduling – a systematic literature review. *Health Policy* 2018;122:412–21.
- 25 Everitt BS, Hothorn T. *A handbook of statistical analyses using R - an introduction to R*, 2015.
- 26 Torgo L. *Data mining with R*. Chapman and Hall/CRC, 2016.
- 27 McMullen MJ, Netland PA. Lead time for appointment and the no-show rate in an ophthalmology clinic. *Clin Ophthalmol* 2015;9:513–6.
- 28 Moustafa FA, Ramsey L, Huang KE, et al. Factors associated with missed dermatology appointments. *Cutis* 2015;96:E20–3.
- 29 Kruse CS, Krowski N, Rodriguez B, et al. Telehealth and patient satisfaction: a systematic review and narrative analysis. *BMJ Open* 2017;7:e016242.
- 30 Rodríguez Pacheco R, Negro Alvarez JM, Campuzano López FJ, et al. Non-Compliance with appointments amongst patients attending an Allergy clinic, after implementation of an improvement plan. *Allergol Immunopathol* 2007;35:136–44.
- 31 Ratmansky M, Hai N, Schlossberg T, et al. Does pain take holidays? Non-attendance rates at a hospital-based pain clinic are elevated during the Jewish high-holidays. *Isr J Health Policy Res* 2017;6:1–7.
- 32 Ellis DA, Jenkins R. Weekday affects attendance rate for medical appointments: large-scale data analysis and implications. *PLoS One* 2012;7:e51365.

Additional Interpretation:

Our study showed that male patients were more likely to miss their appointment compared to female patients (adjusted OR: 1.08 [95% CI 1.06-1.09]). This finding contradicts with finding from studies done in neighbouring country (Kingdom of Saudi Arabia) showed that female patients were more likely to miss their hospital appointment.^{1,2} This can be explained by the fact that most of our study population were in the working age groups (19-60 years old) which mean that they were more likely to be employed. Similar finding was found in a study conducted in UK showed that there was 33% decrease on the odd ratio of missing hospital appointment for women compared to men.³

Nationality was not a predictor for missing hospital appointment as shown in our study when we looked at the general model (adjusted OR: 1.01[95% CI 0.96-1.06]). However, when we looked at the Obstetrics & Gynaecology clinic, non-Omani patients were 14% (adjusted OR: 1.14 [95% CI 1.05-1.24]) more likely to miss their appointment compared to Omani patients. This could be explained by the fact that non-Omani patients who attend the clinic can be only expatriate patients who either work in the government sector or work in private sector. For expatriate who work in the government sector, some of them have a medical insurance provided to them in addition to their free treatment in the government hospital. So, they have the option to attend the hospital appointment or just seek the treatment in private hospital using their health insurance. Also, for the expatriate patients who do not work in the government sector, they will have to pay for the treatment when they attend the government hospital. So, some of them will obtain medical services from private hospital instead of waiting for the appointment and this can be noticed clearly in the Obstetrics and Gynaecology clinic.

1. Almalki A. Missed appointments at maternal healthcare clinics in primary healthcare centres in Riyadh city: reasons and associated factors. *J Hosp Adm.* 2014;3(4):92-100. doi:10.5430/jha.v3n4p92
2. AlSadhan SA. Frequency of missed and cancelled appointments in King Saud University orthodontic clinic. *King Saud Univ J Dent Sci.* 2013;4(2):77-80. doi:10.1016/j.ksujds.2013.04.001
3. Neal RD, Hussain-Gambles M, Allgar VL, Lawlor DA, Dempsey O. Reasons for and consequences of missed appointments in general practice in the UK: Questionnaire survey and prospective review of medical records. *BMC Fam Pract.* 2005;6:1-6. doi:10.1186/1471-2296-6-47



Supplementary Figure 1: A map of Oman depicting the governorate regions. This image shows the official 11 governorates in the Sultanate of Oman and shows the distance from each governorate to the capital city of Muscat where the Royal Hospital is located. Image downloaded in June 2021 from : https://d-maps.com/carte.php?num_car=245546&lang=en

Supplementary Table 1: Number of appointments missed and attended by decile

Decile	Number of prior appointments	Attend	Missed	Total	% Attended	% Missed
1*	0	137130	37547	174677	78.5	21.5
2	1	86791	32176	118967	73.0	27.0
3	2	62751	21130	83881	74.8	25.2
4	3	47843	15033	62876	76.1	23.9
5	4	37997	10904	48901	77.7	22.3
6	5 to 6	55272	14964	70236	78.7	21.3
7	7 to 9	52357	13559	65916	79.4	20.6
8	10 to 15	56077	13266	69343	80.9	19.1
9	16+	61011	13310	74321	82.1	17.9

*Decile 1 and 2 were merged as they were the same 1 appointment (no prior appointments).

Supplementary Table 2: Baseline characteristics for the study population overall and stratified by attended and missed appointments showing additional variables

Variable	Patients (1) N=174677	Scheduled appointments (2) N=769811	Attended N (%) 597229 (77.7%)	Missed N (%) 171889 (22.3%)
Appointment Month				p value <0.001
January	14770 (8.5)	65615 (8.5)	51486 (78.5)	14129 (21.5)
February	14234 (8.1)	63416 (8.2)	50347 (79.4)	13069 (20.6)
March	15665 (9.0)	69680 (9.1)	55541 (79.7)	14139 (20.3)
April	14720 (8.4)	65927 (8.6)	51734 (78.5)	14193 (21.5)
May	15567 (8.9)	69506 (9.0)	53468 (76.9)	16038 (23.1)
June	12947 (7.4)	56594 (7.4)	42332 (74.8)	14262 (25.2)
July	12177 (7.0)	54711 (7.1)	41802 (76.4)	12909 (23.6)
August	13689 (7.8)	61016 (7.9)	46825 (76.7)	14191 (23.3)
September	13708 (7.8)	60495 (7.9)	47218 (78.1)	13277 (21.9)
October	15589 (8.9)	68002 (8.8)	53032 (78.0)	14970 (22.0)
November	15414 (8.8)	65836 (8.6)	50668 (77.0)	15168 (23.0)
December	16196 (9.3)	68320 (8.9)	52776 (77.2)	15544 (22.8)
Appointment Year				p value <0.001
2014	31319 (17.9)	123627 (16.1)	95959 (77.6)	27668 (22.4)
2015	31119 (17.8)	139336 (18.1)	106327 (76.3)	33009 (23.7)
2016	33215 (19.0)	155211 (20.2)	121165 (78.1)	34046 (21.9)
2017	35770 (20.5)	175806 (22.9)	136277 (77.5)	39529 (22.5)
2018	43254 (24.8)	175138 (22.8)	137501 (78.5)	37637 (21.5)
Marital Status				p value <0.001
Child (<13Years)	37207 (21.3)	136295 (17.7)	109244 (80.2)	27051 (19.8)
Single	256970 (14.7)	116449 (15.1)	89208 (76.6)	27241 (23.4)
Married	82648 (47.3)	406553 (52.9)	316807 (77.9)	89746 (22.1)
Divorced	588 (0.3)	3444 (0.4)	2577 (74.8)	867 (25.2)
Widow	1031 (0.6)	5360 (0.7)	3988 (74.4)	1372 (25.6)
Missing	27506 (15.7)	101017 (13.1)	75405 (74.6)	25612 (25.4)
Nationality				p value <0.001
Omani	164825 (94.4)	729824 (94.9)	568262 (77.9)	161562 (22.1)
Non-Omani	9852 (5.6)	39294 (5.1)	28967 (73.7)	10327 (26.3)

1. One appointment per patient scheduled during the five year period selected at random.
2. All appointments scheduled during the five year period with multiple appointments per patient.

Supplementary Table 3: The study population by clinic, overall and stratified by attended and missed appointments by different medical specialties

Variable	Patients (1)	Scheduled appointments (2)	Attended N (%)	Missed N (%)
	N=174677	N=769118	597229 (77.7%)	171889 (22.3%)
Medical Specialty	p value <0.001			
Acute Medical Admission	741 (0.4)	1810 (0.2)	1044 (57.7)	766 (42.3)
Adolescent Medicine	12 (0.0)	61 (0.0)	45 (73.8)	16 (26.2)
Anaesthesia	2288 (1.3)	10280 (1.3)	8054 (78.3)	2226 (21.7)
Cardiology (Adult Only)	20157 (11.5)	59966 (7.8)	44027 (73.4)	15939 (26.6)
Chest Medicine	3130 (1.8)	18027 (2.3)	12754 (70.7)	5273 (29.3)
Clinical Haematology	2405 (1.4)	17066 (2.2)	13658 (80.0)	3408 (20.0)
Clinical Immunology & Allergy	572 (0.3)	1671 (0.2)	1039 (62.2)	632 (37.8)
Diabetes & Endocrine	8867 (5.1)	84769 (11.0)	62351 (73.6)	22418 (26.4)
Ear Nose Throat	55 (0.0)	170 (0.0)	86 (50.6)	84 (49.4)
Gastroenterology	6616 (3.8)	29277 (3.8)	21250 (72.6)	8027 (27.4)
Genetic Disorders	217 (0.1)	575 (0.1)	347 (60.3)	228 (39.7)
Infectious Diseases	907 (0.5)	6856 (0.9)	5770 (84.2)	1086 (15.8)
Endocrinology	1090 (0.6)	4440 (0.6)	2862 (64.5)	1578 (35.5)
Hyperbaric Oxygen Therapy	21 (0.0)	91 (0.0)	46 (50.5)	45 (49.5)
Nephrology	2113 (1.2)	22637 (2.9)	19652 (86.8)	2985 (13.2)
Neurology	4100 (2.3)	11870 (1.5)	8087 (68.1)	3783 (31.9)
Obstetrics & Gynaecology	32203 (18.4)	127537 (16.6)	103648 (81.3)	23889 (18.7)
Oncology	6014 (3.4)	62041 (8.1)	53326 (86.0)	8715 (14.0)
Paediatric	44918 (25.7)	168699 (21.9)	134401 (79.7)	34298 (20.3)
Rheumatology	3553 (2.0)	18385 (2.4)	14650 (79.7)	3735 (20.3)
Surgery	18739 (10.7)	74762 (9.7)	56903 (76.1)	17859 (23.9)
Urology	15602 (8.9)	46825 (6.1)	32650 (69.7)	14175 (30.3)
[‡] VIP and Hospital staff	357 (0.2)	1303 (0.2)	579 (44.4)	724 (55.6)

1. One appointment per patient scheduled during the five year period selected at random.

2. All appointments scheduled during the five year period with multiple appointments per patient.

[‡]Very important people

Supplementary Table 4: Fully adjusted odds ratios (OR) and 95% confidence intervals (CI) of missing a hospital appointment for the predictors appointment day, month and year stratified by clinic

Fully adjusted OR (95% CI)							
	Diabetes & Endocrine	Surgery	Oncology	Urology	Gastroenterology	Obstetrics & Gynaecology	Paediatric
Appointment Day Reference: Sunday							
Monday	0.94 (0.90-0.98)	1.01 (0.96-1.07)	1.02 (0.94-1.09)	*	0.90 (0.83-0.97)	1.08 (1.03-1.13)	0.95 (0.91-0.98)
Tuesday	0.99 (0.94-1.04)	0.76 (0.72-0.81)	0.91 (0.85-0.97)	0.79 (0.74-0.83)	1.13 (1.00-1.28)	1.09 (1.04-1.15)	0.96 (0.92-0.99)
Wednesday	0.99 (0.94-1.03)	1.06 (1.00-1.12)	0.94 (0.88-1.01)	0.92 (0.87-0.97)	0.92 (0.84-1.01)	1.04 (0.99-1.09)	0.97 (0.93-1.00)
Thursday	0.76 (0.71-0.80)	0.96 (0.91-1.02)	0.89 (0.83-0.97)	0.83 (0.79-0.88)	1.01 (0.93-1.10)	1.12 (1.07-1.18)	0.87 (0.83-0.90)
Appointment Month Reference: January							
February	0.99 (0.91-1.07)	0.98 (0.90-1.07)	0.96 (0.85-1.07)	0.88 (0.80-0.98)	0.92 (0.82-1.04)	0.96 (0.90-1.03)	0.93 (0.87-0.98)
March	0.98 (0.91-1.06)	0.96 (0.88-1.04)	0.96 (0.86-1.08)	0.94 (0.85-1.03)	0.96 (0.85-1.08)	0.88 (0.82-0.94)	0.89 (0.84-0.94)
April	1.05 (0.97-1.13)	1.00 (0.92-1.09)	1.04 (0.93-1.17)	0.97 (0.87-1.07)	0.93 (0.82-1.06)	0.97 (0.90-1.04)	0.92 (0.87-0.98)
May	1.11 (1.03-1.19)	1.16 (1.07-1.26)	1.16 (1.04-1.30)	1.13 (1.03-1.25)	0.97 (0.86-1.09)	1.00 (0.93-1.07)	1.10 (1.04-1.17)
June	1.21 (1.11-1.31)	1.24 (1.14-1.35)	1.23 (1.10-1.38)	1.32 (1.19-1.46)	1.23 (1.09-1.40)	1.17 (1.09-1.25)	1.24 (1.17-1.32)
July	1.05 (0.97-1.13)	1.13 (1.04-1.24)	1.07 (0.95-1.20)	1.13 (1.02-1.25)	1.05 (0.92-1.20)	1.09 (1.01-1.17)	1.10 (1.03-1.17)
August	1.10 (1.02-1.19)	1.12 (1.03-1.22)	1.09 (0.97-1.22)	1.05 (0.95-1.15)	1.06 (0.93-1.20)	1.01 (0.94-1.09)	1.05 (0.99-1.11)
September	1.03 (0.95-1.12)	1.00 (0.91-1.08)	1.11 (0.99-1.25)	0.99 (0.89-1.09)	0.92 (0.81-1.04)	0.93 (0.87-1.00)	1.00 (0.94-1.06)
October	0.99 (0.92-1.07)	1.00 (0.92-1.08)	1.14 (1.02-1.27)	1.05 (0.96-1.16)	0.93 (0.81-1.05)	0.98 (0.92-1.05)	0.96 (0.91-1.02)
November	1.06 (0.99-1.15)	1.14 (1.04-1.24)	1.31 (1.17-1.46)	1.04 (0.94-1.15)	1.04 (0.91-1.18)	1.03 (0.96-1.10)	1.13 (1.07-1.20)
December	0.95 (0.88-1.02)	1.13 (1.04-1.23)	1.18 (1.06-1.32)	0.98 (0.89-1.08)	0.97 (0.85-1.10)	1.03 (0.96-1.10)	1.06 (1.00-1.12)
Appointment Year Reference: 2014							
2015	0.70 (0.65-0.75)	1.11 (1.05-1.18)	1.26 (1.17-1.37)	1.11 (1.03-1.18)	1.17 (1.07-1.27)	1.04 (0.99-1.09)	1.16 (1.12-1.21)
2016	0.98 (0.92-1.05)	1.07 (1.01-1.13)	0.91 (0.84-0.99)	1.00 (0.94-1.07)	1.08 (0.99-1.18)	0.96 (0.91-1.00)	1.02 (0.98-1.07)
2017	0.88 (0.83-0.94)	1.11 (1.05-1.18)	1.26 (1.17-1.37)	1.01 (0.94-1.08)	1.06 (0.97-1.16)	0.93 (0.89-0.97)	1.09 (1.04-1.13)
2018	0.76 (0.72-0.82)	1.04 (0.98-1.10)	1.40 (1.29-1.51)	0.99 (0.92-1.06)	0.82 (0.74-0.91)	0.84 (0.80-0.88)	1.03 (0.99-1.07)

*No Observations recorded on this day.

Supplementary Table 5: Fully adjusted odds ratios (OR) and 95% confidence intervals (CI) of missing a hospital appointment for the predictors age and marital status stratified by clinic

Fully adjusted OR (95% CI)						
	Diabetes & Endocrine	Surgery	Oncology	Urology	Gastroenterology	Obstetrics & Gynaecology
Age Categories Reference: Age 31-40 years old						
19-30	0.96 (0.92-1.00)	1.17 (1.11-1.24)	1.12 (1.00-1.24)	1.27 (1.18-1.36)	1.22 (1.13-1.32)	1.13 (1.10-1.17)
41-50	0.92 (0.87-0.96)	0.89 (0.84-0.94)	1.02 (0.94-1.10)	0.93 (0.86-1.00)	0.95 (0.88-1.02)	1.13 (1.08-1.18)
51-60	0.83 (0.79-0.88)	0.87 (0.82-0.92)	0.98 (0.90-1.05)	0.88 (0.82-0.94)	1.02 (0.94-1.11)	1.28 (1.18-1.40)
61-70	0.89 (0.83-0.96)	0.97 (0.91-1.03)	1.09 (1.00-1.18)	0.94 (0.87-1.00)	1.31 (1.18-1.46)	1.83 (1.60-2.11)
71-80	0.88 (0.78-0.99)	1.12 (1.04-1.21)	1.25 (1.14-1.37)	1.25 (1.16-1.35)	1.94 (1.70-2.23)	2.15 (1.76-2.64)
81-90	0.53 (0.37-0.74)	1.62 (1.40-1.88)	1.31 (1.12-1.54)	1.48 (1.32-1.66)	1.73 (1.28-2.33)	1.70 (1.11-2.59)
>90 Years old	*	2.25 (1.46-3.46)	0.87 (0.53-1.41)	1.77 (1.28-2.44)	2.63 (1.01-6.83)	2.31 (0.97-5.47)
Marital Status Reference: Married						
Single	1.00 (0.96-1.05)	0.83 (0.79-0.88)	1.02 (0.94-1.11)	0.90 (0.85-0.96)	0.95 (0.88-1.02)	1.04 (0.98-1.09)
Divorced	1.18 (0.97-1.44)	1.21 (0.99-1.47)	1.43 (1.08-1.89)	0.88 (0.64-1.21)	0.96 (0.69-1.33)	1.31 (1.03-1.66)
Widow	0.94 (0.80-1.12)	1.18 (1.00-1.39)	1.40 (1.14-1.72)	1.01 (0.76-1.35)	1.12 (0.83-1.52)	1.11 (0.85-1.45)
Missing	1.12 (1.07-1.18)	1.11 (1.06-1.17)	1.03 (0.97-1.09)	1.29 (1.22-1.37)	1.21 (1.12-1.31)	1.40 (1.32-1.47)

*Observations removed due to small numbers. Table excludes results from the Paediatric clinic as it has few observations for the categorisation variable: age category and marital status

Supplementary Table 6: Fully adjusted odds ratios (OR) and 95% confidence intervals (CI) of missing a hospital appointment for the predictors sex, nationality and service cost stratified by clinic

Fully adjusted OR (95% CI)							
	Diabetes & Endocrine	Surgery	Oncology	Urology	Gastroenterology	Obstetrics & Gynaecology	Paediatric
Sex Reference: Female							
Male	0.99 (0.96-1.03)	1.07 (1.03-1.11)	1.20 (1.14-1.26)	0.96 (0.91-1.01)	0.98 (0.93-1.04)	*	1.00 (0.98-1.03)
Nationality Reference: Omani							
Non-Omani	0.94 (0.84-1.05)	1.09 (0.97-1.22)	0.91 (0.77-1.09)	0.93 (0.80-1.09)	1.09 (0.89-1.34)	1.14 (1.05-1.24)	0.92 (0.80-1.05)
Service Cost Reference: Pay registration and visit fees only							
<2 years old [¥]	*	*	*	*	*	*	1.19 (1.15-1.23)
Pay all fees	1.24 (1.07-1.43)	1.32 (1.14-1.53)	1.62 (1.35-1.96)	1.44 (1.19-1.73)	1.30 (1.00-1.67)	1.12 (1.00-1.26)	1.75 (1.51-2.02)
MSA [†]	0.73 (0.63-0.84)	0.65 (0.54-0.79)	0.86 (0.65-1.13)	0.59 (0.49-0.70)	0.57 (0.44-0.74)	0.76 (0.57-1.02)	0.70 (0.65-0.75)

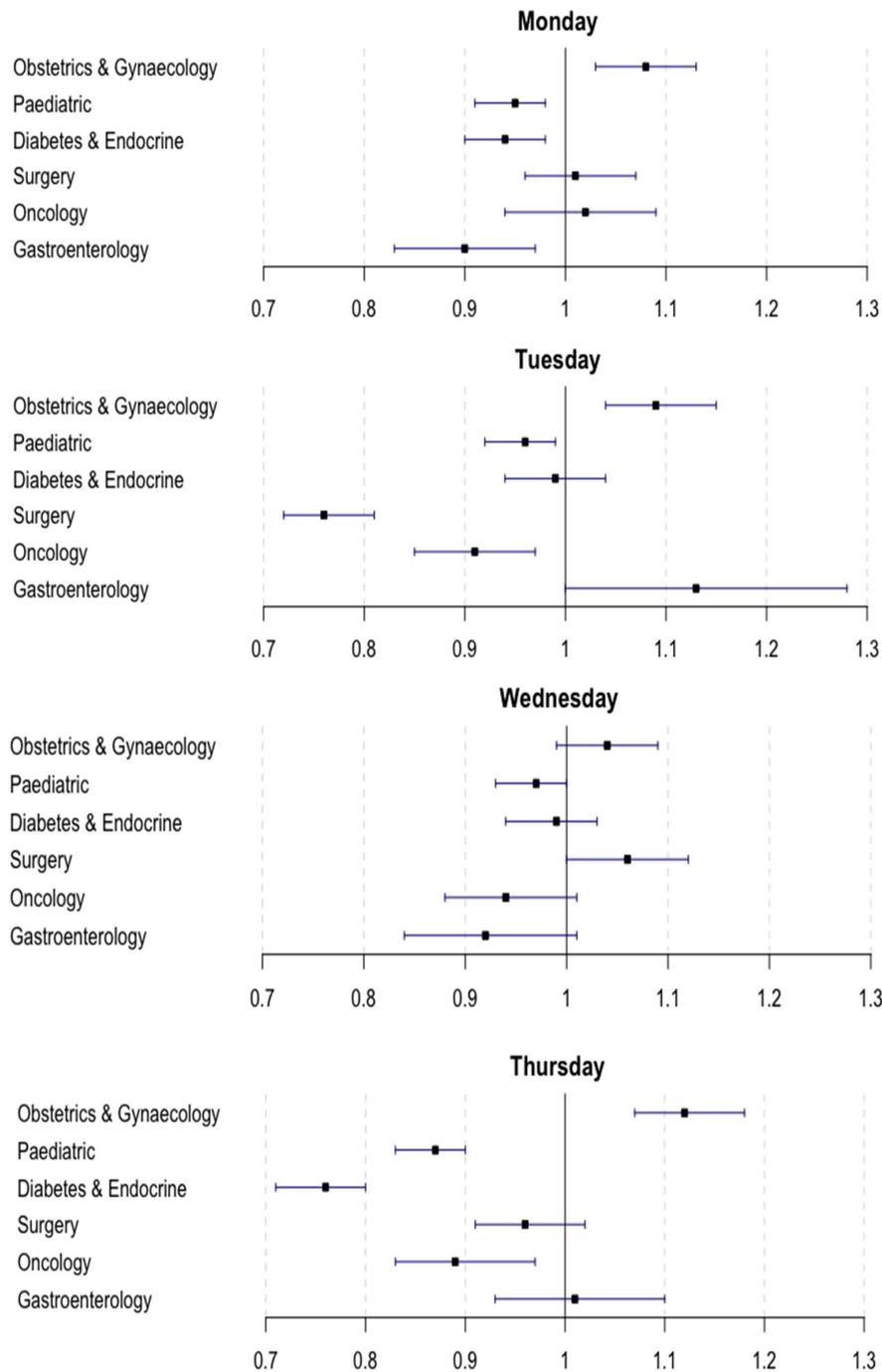
*This clinic does not have observations in this category

¥ Exempted from all medical service fees

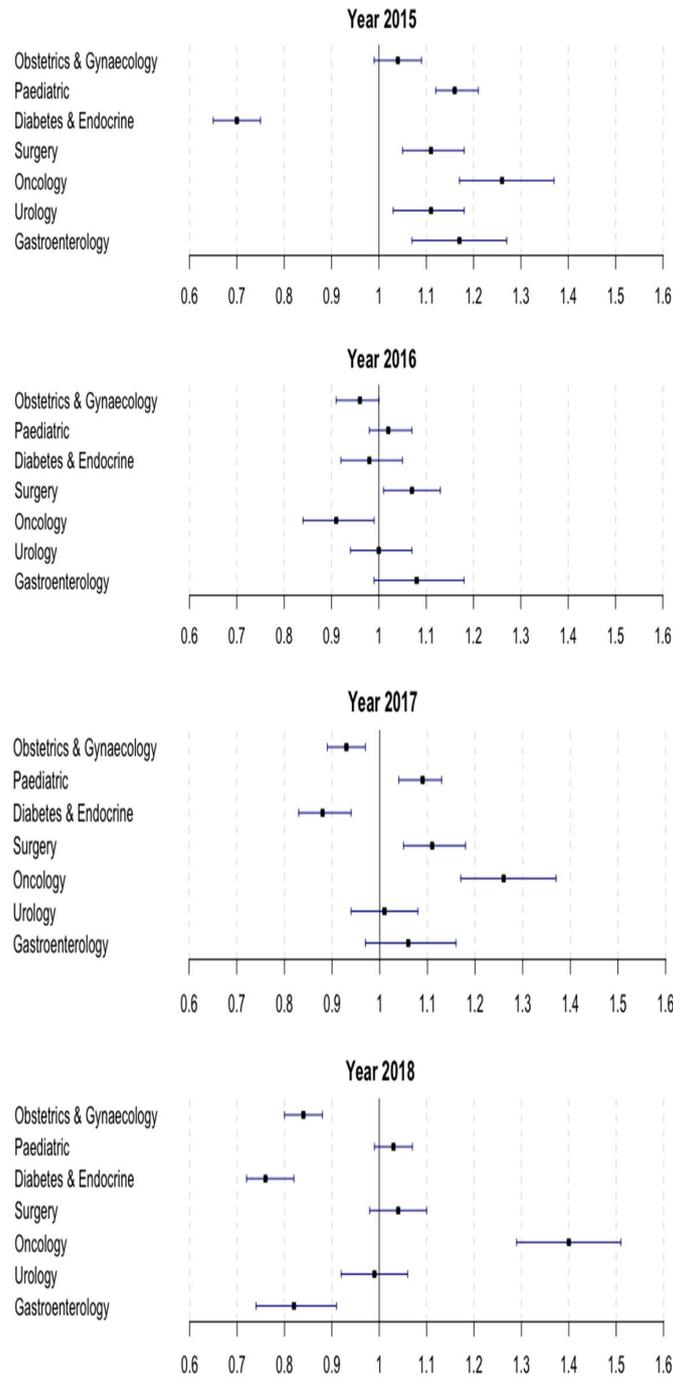
† Under Ministry of social affair coverage (exempted from all medical service cost)

Supplementary Table 7: Fully adjusted odds ratios (OR) and 95% confidence intervals (CI) of missing a hospital appointment for the predictor appointment waiting days stratified by clinic

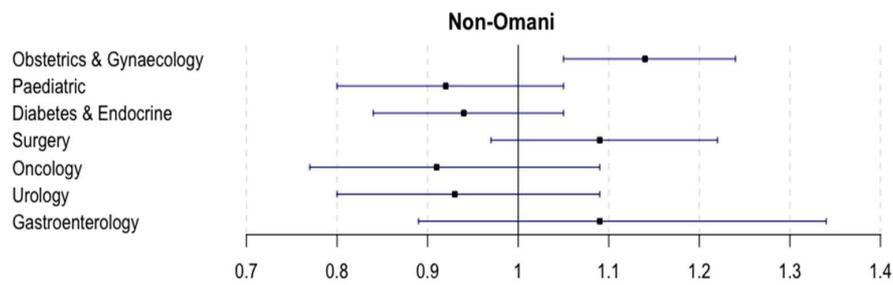
Fully adjusted OR (95% CI)							
	Diabetes & Endocrine	Surgery	Oncology	Urology	Gastroenterology	Obstetrics & Gynaecology	Paediatric
Appointment Waiting days	Reference: Waiting ≤30 Days						
31-60 days	1.28 (1.22-1.34)	1.54 (1.47-1.61)	1.26 (1.17-1.36)	1.55 (1.44-1.67)	1.79 (1.62-1.98)	1.02 (1.00-1.06)	1.37 (1.31-1.44)
61-90 days	1.14 (1.08-1.20)	1.80 (1.71-1.89)	0.98 (0.91-1.05)	1.71 (1.57-1.87)	2.03 (1.84-2.23)	1.55 (1.47-1.63)	1.33 (1.28-1.39)
91-120 days	1.21 (1.14-1.29)	2.32 (2.16-2.49)	1.20 (1.11-1.31)	1.90 (1.75-2.06)	2.31 (2.08-2.56)	2.11 (1.98-2.24)	1.47 (1.41-1.54)
> 120 days	1.63 (1.55-1.71)	2.37 (2.24-2.50)	1.26 (1.18-1.36)	2.22 (2.10-2.34)	2.32 (2.13-2.52)	2.49 (2.38-2.61)	1.72 (1.67-1.78)



Supplementary Figure 2: Fully adjusted odds ratios (OR) and 95% confidence intervals (CI) of missing a hospital appointment for the predictor appointment day stratified by clinic (reference: Sunday)



Supplementary Figure 3: Fully adjusted odds ratios (OR) and 95% confidence intervals (CI) of missing a hospital appointment for the predictor appointment year stratified by clinic (reference: 2014)



Supplementary Figure 4: Fully adjusted odds ratios (OR) and 95% confidence intervals (CI) of missing a hospital appointment for the predictor nationality stratified by clinic (reference: Omani)