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**Missed appointments in an adolescent outpatient clinic: descriptive analyses
of consultations over eight years**

et

**Missed appointments in an outpatient clinic for adolescents, an approach to
predict the risk of missing**

THESE

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Rapport de synthèse:

Missed appointments in an adolescent outpatient clinic: descriptive analyses of consultations over eight years

Missed appointments in an outpatient clinic for adolescents, an approach to predict the risk of missing

Les rendez-vous manqués représentent un problème important, tant du point de vue de la santé des patients que du point de vue économique. Pourtant peu d'études se sont penchées sur le sujet, particulièrement dans une population d'adolescents. Les buts de cette étude étaient de caractériser les adolescents qui sont à risque de manquer ou d'annuler leurs rendez-vous dans une clinique ambulatoire de santé pour adolescents, de comparer les taux des rendez-vous manqués et annulés entre les différents intervenants et d'estimer l'efficacité d'une politique de taxation des rendez-vous manqués non excusés. Finalement, un modèle multi-niveau markovien a été utilisé afin de prédire le risque de manquer un rendez-vous. Ce modèle tient compte du passé de l'adolescent en matière de rendez-vous manqués et d'autres co-variables et permet de grouper les individus ayant un comportement semblable. On peut ensuite prédire pour chaque groupe le risque de manquer ou annuler et les co-variables influençant significativement ce risque.

Entre 1999 et 2006, 32816 rendez-vous fixés pour 3577 patients âgés de 12 à 20 ans ont été analysés.

Le taux de rendez-vous manqués était de 11.8%, alors que 10.9% avaient été annulés. Soixante pour cent des patients n'ont pas manqué un seul de leur rendez-vous et 14% en ont manqué plus de 25%. Nous avons pu mettre en évidence plusieurs variables associées de manière statistiquement significative avec les taux de rendez-vous manqués et d'annulations (genre, âge, heure, jour de la semaine, intervenant thérapeutique).

Le comportement des filles peut être catégorisé en 2 groupes. Le premier groupe inclut les diagnostics psychiatriques et de trouble du comportement alimentaire, le risque de manquer dans ce groupe étant faible et associé au fait d'avoir précédemment manqué un rendez-vous et au délai du rendez-vous. Les autres diagnostics chez les filles sont associés à un second groupe qui montre un risque

plus élevé de manquer un rendez-vous et qui est associé à l'intervenant, au fait d'avoir précédemment manqué ou annulé le dernier rendez-vous et au délai du rendez-vous. Les garçons ont tous globalement un comportement similaire concernant les rendez-vous manqués. Le diagnostic au sein de ce groupe influence le risque de manquer, tout comme le fait d'avoir précédemment manqué ou annulé un rendez-vous, le délai du rendez-vous et l'âge du patient. L'introduction de la politique de taxation des rendez-vous non excusés n'a pas montré de différence significative des taux de rendez-vous manqués, cependant cette mesure a permis une augmentation du taux d'annulations.

En conclusion, les taux de présence des adolescents à leurs rendez-vous sont dépendants de facteurs divers. Et, même si les adolescents sont une population à risque concernant les rendez-vous manqués, la majorité d'entre eux ne manquent aucun de leurs rendez-vous, ceci étant vrai pour les deux sexes. Étudier les rendez-vous manqués et les adolescents qui sont à risque de rater leur rendez-vous est un pas nécessaire vers le contrôle de ce phénomène. Par ailleurs, les moyens de contrôle concernant les rendez-vous manqués devraient cibler les patients ayant déjà manqué un rendez-vous. La taxation des rendez-vous manqués permet d'augmenter les rendez-vous annulés, ce qui a l'avantage de permettre de fixer un nouveau rendez-vous et, de ce fait, d'améliorer la continuité des soins.

Missed appointments in an adolescent outpatient clinic: descriptive analyses of consultations over eight years

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Summary

Question under study: Missed appointments represent an important medical and economical issue. Few studies on the subject are reported in the literature, particularly regarding adolescents. Our aim was to characterize missed and cancelled appointments in a multidisciplinary outpatient clinic for adolescents, to assess the effectiveness of a policy aimed at reducing missed appointments by introducing payment for those missed appointments not cancelled in advance, and to compare the rates between staff and resident physicians.

Methods: A total of 32,816 consultations (representing 3577 patients aged 12–20 years, 82.4% females) between 1999 and 2006 were analysed.

Results: The missed appointment rate was 11.8% whilst another 10.9% were cancellations. Females cancelled more than males (11.3% vs. 8.4%, AOR 1.31, 99% CI 1.08–1.59), but there was no difference for missed appointments (11.7% vs. 12.3%, AOR 0.88, 99% CI 0.71–1.08). April and June to October (vacation months) were associated with more missed appointments. Globally mornings had higher rates of missed appoint-

ments than afternoons (13.6% vs. 11.2%, AOR 1.25, 99% CI 1.11–1.40). There was a slight difference in missed appointment rates between staff physicians and residents (10.4%; 11.8%, AOR 1.20, 99% CI 1.08–1.33). Missed appointment rates before and after the new policy on missed appointments were similar (1999–2003: 11.9%; 2004–2006: 11.6%, AOR 0.96, 99% CI 0.83–1.10). Conversely, cancellation rates increased from 8.4% (1999–2003) to 14.5% (2004–2006) (AOR 1.83, 99% CI 1.63–2.05).

Conclusion: Attendance rates among adolescents show variations depending on vacation and school hours. Being attentive to these factors could help prevent missed appointments. Although having to pay for missed appointments does not increase attendance, it increases cancellations with the advantage that the appointment can be rescheduled.

Key words: adolescent, adolescent health services, adolescent behaviour, continuity of patient care, physician-patient relations

Introduction

Patients missing appointments is a well-known problem among each speciality in medicine, accounting for a substantial part of scheduled appointments. Rates reported in general practices in the United Kingdom range between 4% and 12% [1]. These rates differ within specialities: paediatrics and psychiatry are more affected with reported rates of 31–40% [2, 3]. This failure to attend is a medical problem. Two studies conducted in psychiatry show that patients missing appointments are more likely to be admitted to hospital [3] and to consult in emergency [4]. By missing the consultation, the patient misses the scheduled intervention, be it therapeutic or preventive. Additionally, it is also an economical

problem, accounting for a loss of practice income [5].

Young adults have the highest risk of failing to attend their appointments [1, 6–8], and adolescents also seem to be at high risk [7–9]. Factors, such as a poor psychological condition [6], a low socio-economic status [1] and not having an established provider [10, 11] are associated with missing an appointment. On the other hand suffering from a chronic illness [12, 13] and living close to the healthcare centre [14] are associated with higher attendance. The few studies focusing on adolescents list some further factors: scheduling the first appointment for the adolescents by the parents [15], follow-up appointments (com-

pared to first ones) [16] and consulting for "cosmetic problems" (compared to "non-cosmetic" ones) [17] are associated with less missed appointments. In the literature most reported results do not take cancellations into account. In fact, very few research papers report such data. One study in a family practice clinic showed a 6.9% cancellation rate [5], whilst one in a dermatology clinic indicated a 8.3% rate [18]. To our knowledge, there are no studies specifically analyzing cancellation rates among adolescent patients.

Our adolescent multidisciplinary health care unit exists since 1998 and attempts to meet the youth friendly health services criteria of the World Health Organisation [19]. From this point of view, the rates of non-attendance can be considered as an indicator, among others, of the quality of care. Indeed, intention to keep an appointment [20] and compliance in coming for appointments [21] are associated with satisfaction with health care. After a period of pilot testing, data on attended, missed and cancelled appointments in

our unit have been registered in a computerized database since January 1999.

Using these data we aim: 1) to determine the prevalence of missed and cancelled appointments in our unit and the characteristics of these appointments. We hypothesize that we have lower rates of missed appointments than those reported in the literature due to the special attention given to the quality of care, and 2) As the administration of the university hospital decided that from January 1st, 2004 patients must pay for unexcused missed appointments, we wanted to determine whether such a measure has an impact on the rates of missed appointments. We found no previous study assessing the effects of such a policy. Finally, 3) to assess differences in missed appointment rates between staff and resident physicians. Our hypothesis is that staff physicians show lower rates than residents because they do not rotate and there is consequently a better continuity of care.

Methods

The "multidisciplinary unit for adolescent health" at the University Hospital in Lausanne, Switzerland, is an outpatient clinic. It possesses its own building, where adolescents aged 12–20 years can consult in a place specially adapted to their needs. The permanent staff is a multi-professional team composed of two senior adolescent physicians, a senior gynaecologist, one adolescent medicine chief resident, a psychologist, a nurse, a family planning counsellor and a dietician. Two physician residents (in paediatrics and gynaecology) rotate every six months, while the adolescent medicine resident rotates once a year. Taking advantage of the multidisciplinary approach, patients consulting in our clinic are mostly referred by other health professionals and social services in complex situations. The average time required to receive a first consultation is one to two weeks.

The official hospital policy is that an appointment should be considered as missed if not excused at least 24 hours in advance. However, in our unit we value the fact that an adolescent makes the effort to call. Therefore any cancellation made before the appointment (even if done at the last minute) is coded as a cancellation.

Data of all appointments from 1 January 1999 to 31 December 2006 were used. Each completed consultation includes the patient's (identification number, age, gender, address, diagnosis) and the characteristics of the consultation (date, hour, provider, first or follow-up, with parents present or not, reason for consulting, duration). However, if a patient misses the appointment only the patient's characteristics (without diagnosis), the date of consultation and the intended provider are recorded in the database.

From 1999 to 2006 a total of 35,465 consultations were registered. Of these consultations, 2649 were excluded because they had been provided as consultations to hospitalized patients ($N = 794$), they concerned patients outside the age range (12–20 years) of our unit ($N = 989$), too much data was missing ($N = 63$) or they were adjourned by the scheduled provider ($N = 803$). After

these readjustments we worked with a database of 32,816 consultations (92.5% of all the appointments), which represent 3577 patients (82.4% females). All analyses have been conducted by appointments and not by patients.

In a first step, we calculated the rates of the three types of appointments (missed, cancelled and attended) by year, month, weekday and period (morning or afternoon). Subsequently, we ran two binomial logistic regressions, the first one for missed appointments and the second one for cancelled appointments. In both cases the reference category was attended appointments. Age, gender (reference category: males), year (reference category: 2004), month (reference category: November), weekday (reference category: Tuesday) and period of the day (reference category: afternoon) were used as covariates. Since we used appointment rather than patient, the observations corresponding to a single patient might be correlated, so generalized estimating equations (GEEs) were used to obtain robust estimations. To assess the effect of the policy to charge for missed appointments, we compared rates before and after 1 January 2004. Finally, to verify whether our residents' turnover had any impact on attendance, we compared missed and cancelled appointment rates between residents and staff physicians controlling for age and gender. For these analyses we have excluded the consultations provided by the paramedical staff and have only taken into account those provided by staff or resident physicians ($n = 25,221$ appointments).

All analyses were performed with SPSS 14 & 15 (SPSS Inc, Chicago, Illinois). Our data represent a very large fraction of the total of all consultations taking place in our clinic since 1999. However since the phenomenon of missed appointments is common to all health units specialized in adolescent health, we chose to consider our data as a sample and to perform significance analyses. Considering the large number of consultations, we chose a significance level of $p < .01$ for the analyses in order to avoid a type I error.

Results

From 1999 to 2006, our unit had an overall rate of 11.8% missed appointments and 10.9% cancelled appointments. Overall, females cancelled more than males (11.3% vs. 8.4%, AOR 1.31, 99% CI 1.08–1.59), but there was no difference for missed appointments (11.7% vs. 12.3%, AOR 0.88, 99% CI 0.71–1.08). By year, the rate of missed appointments increased to a peak of 13% in 2002, decreasing thereafter, whilst the cancellation rate more than doubled over the years, from 6.7% in 1999 to 14.9% in 2006. The rate of attended appointments decreased from 1999 (83.5%) to 2004 (74.2%), remaining stable thereafter. By month, the highest missed consultation rates (over 13%) corresponded to July, August and October, while the highest for cancellations was June and December. By weekday, Wednesday showed the highest rates of both missed and cancelled appointments. Finally, missed appointments predominated in the mornings while cancelled rates were slightly higher in the afternoons (table 1).

In the multivariate analysis, missed appointments increased with age, were higher in April and June to October, were higher on any weekday but Thursday and more frequent in the mornings. Females were significantly more likely to cancel appointments and the cancellation rate was significantly lower before 2004 (table 2).

Overall, the effect of the policy to charge for unexcused appointments showed no effect on the missed appointment rates (1999–2003: 11.9%; 2004–2006: 11.6%; AOR 0.96; 99% CI 0.83–1.10), but the cancellation rates increased significantly between 1999–2003 and 2004–2006 (8.4% vs 14.5%; AOR 1.83, 99% CI 1.63–2.05).

There were no significant differences regarding cancellations between staff physicians (10.3%) and resident physicians (11.3%). However missed appointments were slightly higher for residents (11.8% vs. 10.4%), remaining significant after controlling for age and gender (Adjusted Odds Ratio: 1.20; 99% CI: 1.08–1.33).

Table 1
Rates of each type of appointment by year, month, weekday and period of the day.

			Type of consultation		
			Missed	Cancelled	Attended
Year	1999	(n = 3007)	9.8%	6.7%	83.5%
	2000	(n = 3587)	11.7%	8.5%	79.8%
	2001	(n = 4044)	11.9%	7.6%	80.5%
	2002	(n = 4194)	13.0%	8.1%	78.9%
	2003	(n = 4431)	12.5%	10.4%	77.1%
	2004	(n = 4610)	11.7%	14.1%	74.2%
	2005	(n = 4440)	11.8%	14.6%	73.6%
Month	2006	(n = 4503)	11.2%	14.9%	73.9%
	January	(n = 2721)	11.2%	10.4%	78.4%
	February	(n = 2665)	11.2%	11.3%	77.6%
	March	(n = 3152)	10.8%	10.9%	78.3%
	April	(n = 2857)	11.8%	10.3%	77.9%
	May	(n = 3131)	11.1%	10.2%	78.8%
	June	(n = 2985)	12.7%	11.6%	75.7%
	July	(n = 2498)	13.6%	11.1%	75.3%
	August	(n = 1815)	13.9%	11.2%	74.8%
	September	(n = 2550)	12.2%	11.1%	76.8%
	October	(n = 2797)	13.0%	10.7%	76.3%
	November	(n = 3007)	9.6%	10.8%	79.6%
December	(n = 2638)	11.5%	11.6%	76.9%	
Weekday	Monday	(n = 6248)	12.1%	11.4%	76.5%
	Tuesday	(n = 5654)	9.8%	10.5%	79.7%
	Wednesday	(n = 8981)	12.5%	11.5%	76.0%
	Thursday	(n = 5820)	11.5%	11.4%	77.1%
	Friday	(n = 6113)	12.4%	9.4%	78.2%
Period of the day	Morning	(n = 8840)	13.6%	10.7%	75.7%
	Afternoon	(n = 23701)	11.2%	11.1%	77.7%

Discussion

We found a rate of 11.8% for missed appointments and 10.9% for cancellations. While few comparative rates are reported in the literature, our global rate of missed appointments is lower than the 20% found by Sawyer et al. [16], the 38% of Freed et al. [20] and the 18% and 48.5% that Irwin et al. reported respectively for first and for follow-up appointments [15, 22]. Our relatively low rate may be due to the fact that we have always tried to provide quality care and to meet the adolescent friendly health services guidelines [19]. Regarding cancellations, our results are slightly higher than those reported in the literature for the general population [5].

Age is a characteristic of the patient influencing missed appointments. This finding is in agreement with what has been reported in the literature. Young adults are more likely to miss consultations than adolescents [1, 7], and possibly parents of older patients are less implicated in their

adolescents' visits, resulting in more missed appointments.

Interestingly, missed (but not cancelled) appointments are significantly more frequent at times coinciding with school vacation: April (Easter), June to September (summer), and October (when students in our canton have two weeks of autumn vacation). This finding could be explained by the fact that adolescent patients prefer to be on vacation than visiting a health provider and that during vacation it is easier to forget a scheduled appointment.

The high rates of missed appointments during the morning period can be related to the appointment interfering with school. In our canton, afternoons contain mainly lessons that count less in grading marks (physical education, music), which adolescents perhaps allow themselves to miss more readily. These observations match those of Irwin et al. [22], who found "interference with school" as the second cause of missed appointments by adolescents after "forgetting the appointment". Likewise in a study with adolescents consulting in a dental clinic, the most frequent reported reasons for missing were "illness" and "occupied in school" [23]. While we have no hypothesis to explain the differences found between weekdays for missed appointment rates, it is interesting that another Swiss study also reported Tuesday as having lower rates of missed appointments [8], although according to their results the difference is not significant.

While the implementation of the policy of charging for non-cancelled appointments showed no difference in rates of missed appointments before and after its introduction, it is also worth noting that missed appointment rates have remained stable while cancellation rates have increased. We could assume that this is an effect of the new policy on missed appointments. Although the policy is applied in our unit quite laxly with any cancellation before the appointment being accepted, the fact that it is probably not the adolescents themselves who have to pay for it could, at least in part, explain why missed appointments have not decreased. However, it is of interest that cancellations have increased at the expense of missed appointments, because the former allows rescheduling the appointment and the continuity of care can be assured. Moreover we can also note that the rate of attended appointments, which was decreasing, has stabilized since 2004.

In our results, there was only a slight difference between staff and resident physicians for missed appointments. For adults, the period following the turnover and the breach of the relationship was not associated with an increase in missed appointments [24, 25]. Nonetheless having an established provider was associated with fewer missed appointments [26]. Our residents

Table 2
Logistic regressions (n = 32541) for missed and cancelled appointments (reference category: attended appointment) with age, sex, weekday, month, year and period of day as covariates.

	Missed appointment AOR* (99% C.I.)	Cancelled appointment AOR* (99% C.I.)
Age	1.05 (1.01–1.09)	1.01 (0.98–1.04)
Females	0.88 (0.71–1.08)	1.31 (1.08–1.59)
Males	1	1
Monday	1.20 (1.00–1.44)	1.07 (0.91–1.26)
Tuesday	1	1
Wednesday	1.35 (1.15–1.60)	1.08 (0.93–1.25)
Thursday	1.13 (0.94–1.35)	1.05 (0.89–1.23)
Friday	1.20 (1.00–1.44)	0.95 (0.80–1.13)
January	1.19 (0.95–1.49)	0.97 (0.77–1.23)
February	1.20 (0.96–1.51)	1.08 (0.86–1.35)
March	1.14 (0.91–1.43)	1.03 (0.82–1.28)
April	1.28 (1.03–1.59)	0.97 (0.77–1.21)
May	1.19 (0.95–1.49)	0.96 (0.77–1.20)
June	1.40 (1.13–1.74)	1.08 (0.87–1.35)
July	1.48 (1.17–1.86)	1.07 (0.84–1.35)
August	1.54 (1.20–1.97)	1.03 (0.79–1.34)
September	1.32 (1.05–1.65)	1.03 (0.82–1.30)
October	1.43 (1.15–1.77)	1.02 (0.81–1.28)
November	1	1
December	1.24 (1.00–1.56)	1.10 (0.88–1.37)
1999	0.82 (0.64–1.05)	0.45 (0.35–0.58)
2000	1.00 (0.79–1.28)	0.58 (0.46–0.72)
2001	1.00 (0.80–1.26)	0.50 (0.41–0.63)
2002	1.11 (0.90–1.38)	0.54 (0.44–0.67)
2003	1.07 (0.88–1.30)	0.71 (0.59–0.85)
2004	1	1
2005	1.00 (0.81–1.22)	1.03 (0.86–1.24)
2006	0.91 (0.73–1.14)	1.06 (0.89–1.26)
Morning	1.25 (1.11–1.40)	0.91 (0.81–1.03)
Afternoon	1	1

In bold p < .01

* AOR: adjusted odds ratio

only change once or twice a year and adolescents have an established provider during the whole rotation. This change seems to have only a small effect on adolescents' attendance, possibly due to the fact that our patients are able to build a good relationship with their provider. Moreover, different strategies have also been used to ensure the best possible transition. At the end of their rotation residents discuss the issue with their patients and special attention is given to the transfer of information concerning the patients to the next resident. Additionally, at the end of the resident's rotation, staff physicians take care of difficult patients. Nevertheless, the greater experience of the staff physicians in managing patient-provider relationships with adolescents could also play a role.

The main strength of our research is that it is based on a large number of exclusively adolescent consultations during a period of eight years and that it has allowed us to test the effect of a policy aimed at reducing missed appointments that, to our knowledge, had never been tested before. Furthermore, we describe for the first time the cancellation rate in an adolescent population.

Several conclusions that could help prevent missed appointments can be drawn from this study. Firstly, practitioners dealing with adolescents should be aware of the fact that clinic hours

should be scheduled after school, and that, when giving an appointment during school vacation, they should make the patient aware of it. Secondly, older adolescents should be more closely monitored as they are more likely to miss appointments. Thirdly, charging for non-excused appointments has an effect on the cancellation rate. Even though a cancellation (especially at the last minute) is often as negative as a missed appointment, it has the advantage of permitting rescheduling of the appointment. In adolescent patients, assuring continuity of care is worthwhile. Finally, when properly done, discontinuing the patient-provider relationship has only a slight effect on missing appointments, which probably depends on factors other than the change of provider.

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Original article

Missed Appointments in an Outpatient Clinic for Adolescents, an Approach to Predict the Risk of Missing

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Abstract

Purpose: To predict the risk of an adolescent patient to miss an appointment, based on the previous appointments and on the characteristics of the patient and the appointment.

Methods: Two thousand one hundred ninety-three (1873 females) patients aged 12 to 20 years having scheduled at least four appointments were included. We assessed the rate of missed nonexcused appointments of each patient. Second, a Markovian multilevel model was used to predict the risk of defaulting.

Results: Forty-five percent of the patients have not missed even once, and 14% of females and 17% of males have missed >25% of their appointments. Females show two types of behaviors (an abstract concept that groups individuals based on a combination of their appointment-keeping and their recorded type of healthcare need) depending on the diagnosis. Somatic, gynecology, violence, and counseling diagnoses are mostly grouped together. In this group, having already missed and having an appointment with a paramedical provider increases the risk of missing. In the second group (eating disorders and psychiatric diagnoses) having already missed and a longer delay between appointments influence the risk of missing, although the risk is lower for this latter group. Males only show one type of behavior regarding missed appointments. Having missed a previous appointment, being older, having cancelled the next to last appointment and the type of diagnosis explain the risk of missing.

Conclusions: Patients who have already defaulted have a higher risk of defaulting again. Means of control regarding missed appointments should consequently focus on defaulters, to decrease the associated workload. Reminders could be a solution for the follow-up appointments scheduled with a long delay. © 2008 Society for Adolescent Medicine. All rights reserved.

Keywords:

Adolescent health services; Patient compliance; Health service management; Continuity of patient care

Missed appointments are an issue that has health and economical consequences [1–3] and concerns mostly young adults and adolescents [4,5]. Each year 17% of patients of a general practice are reported to default, 66% defaulting, however, only once [5]. Regarding adolescents, and noting that it concerns consultations in dentistry, a study reported that 16.4% of the patients have missed or cancelled 20% or

more of their appointments [6]. A previous study conducted in our outpatient clinic for adolescents showed that 22.7% of the scheduled appointments do not occur (11.8% of all the appointments are missed and 10.9% are cancelled) [7]. There are several risk factors associated to missed appointments: poor psychological condition [8], low socioeconomic status [4], not having an established provider [9,10], suffering from an acute illness [11,12], and living far from the healthcare center [13]. The studies focusing on adolescents also describe risk factors for missed appointments such as the adolescent scheduling the first appointment by himself [14], first appointments (compared to follow-up

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ones) [15], and consulting for well adolescent care or “non-cosmetic” problems (e.g., headache, infection; compared to “cosmetic” ones, e.g., dermatologic, obesity) [16].

Current efforts to reduce missed appointments can be resource intensive and appear not to be all that effective. In our university hospital, the implementation of a policy (since January 1, 2004) for which patients have to pay for unexcused missed appointments did not decrease the rate of missed appointments [7]. In the literature, some other means of control (such as telephone reminders) that allow to decrease missed appointments have been reported [15–18]. By characterizing those youth more at risk for missing appointments, the resources could be targeted to this specific population.

The objective of this study is to predict the risk that an adolescent has of missing an appointment based on the history of the previous appointments and on the characteristics of both the patient and the appointment. We hypothesize that patients who have already defaulted will have a greater probability to miss again, but also that there are factors such as a time elapsed since the last appointment, being older, or certain diagnoses that will increase this risk.

Methods

Our clinic was created in 1998, and since January 1, 1999, data about attended, missed, and cancelled appointments have been registered in a computerized database. For this research we analyzed the data from our database, since January 1, 1999 to December 31, 2006. Our university hospital outpatient clinic for adolescents aged 12 to 20 years old in Lausanne, Switzerland, is multidisciplinary, and consists of 11 staff members: three senior physicians, a chief resident, three residents, and four paramedical providers (psychologist, dietician, family planning counselor, and nurse).

Measures

Over the analyzed period of 8 years (1999–2006), 3577 (2947 females) patients aged 12 to 20 years old and representing a total of 32,816 scheduled appointments have consulted in our clinic. For this analysis, we included all patients with at least four appointments (1873 females and 320 males, respectively 62% and 51% of all patients).

Appointments were coded as missed (if not excused, dependent variable), cancelled (when adolescents called to excuse themselves), and kept. Data registered are ID number, gender, age, diagnosis at each attended appointment (not available for missed/cancelled appointments), reason for consulting, and the consultations’ data (date, provider, intended follow-up). When the diagnosis was not available for an appointment, we considered the diagnosis of the previous attended appointment.

We considered the following covariates: diagnosis (violence, gynecology, somatic, psychiatry, eating disorders [ED], counseling and dummy-code missed appointment [only when

the diagnosis was not available for any of the last three appointments]), age of the patient (12–15, 16–17, 18–20), year of the appointment (as an indicator of pre [1999–2003] and post [2004–2006] implementation of a charge for missed (non-excused) appointments), time elapsed since the previous appointment (<15 days, 15–30, 31–90, >90), cancellation (three dichotomous variables indicating whether each of the three previous appointments was cancelled or not), and type of provider (four dichotomous variables indicating whether the provider for the present appointment and of each of the last three appointments is a physician or a member of the paramedical staff). Patients’ age and diagnoses are reported in Table 1.

Covariates to be used at the hidden and visible levels of the model were chosen through a stepwise procedure. The criterion to discriminate between models was the Bayesian Information Criterion [19].

Analyses

Following preliminary results showing a gender difference in behavior, and also because we have much more female than male patients, all analyses were conducted separately by gender.

To predict the probability of missing, the weight of the history of previous appointments, and their impact, we built a statistical model. The outcome was a dichotomous variable indicating whether each appointment was missed or not. In a preliminary step, we used homogeneous Markov chains to determine the number of past observations of the outcome variable that had to be taken into account to explain the probability of missing the present appointment. If we fixed the number of past events used in the prediction to, for example, k appointments, then all patients with less than $k + 1$ appointments would have been lost for the analysis. Consequently, we chose a maximal dependence order equal to three past consultations, the best arbitrage between the number of available data and the predictive power of the

Table 1
Distribution of the sample

	Females N (column %)	Males N (column %)
Total	1873	320
Age		
12–15	604 (32.2%)	114 (35.6%)
16–17	829 (44.3%)	132 (41.3%)
18–20	440 (23.5%)	74 (23.1%)
Diagnosis ^a		
Violence	59 (3.2%)	12 (3.8%)
Gynecology	702 (37.5%)	0 (0.0%)
Somatic	544 (29.0%)	159 (49.7%)
Psychiatric	192 (10.3%)	113 (35.3%)
Eating disorders	288 (15.4%)	14 (4.4%)
Counseling	88 (4.7%)	22 (6.9%)

^a Patients can have different diagnoses during their follow-up. To have an idea of the repartition of each diagnosis by gender, we took the diagnosis of the first attended appointment for each patient.

resulting model, and we computed models using from zero to three past appointments ($t - 1$, $t - 2$, and $t - 3$) to predict the present one.

First, we assessed for each patient the rate of nonattendance, being the ratio of the missed appointments through all scheduled appointments of the same patient. We then used a Double-Chain Markov Model [20,21] to describe as accurately as possible the complex process of missed appointments. The Double-Chain Markov Model is used to predict hidden or unknown events in the future from previous events and descriptive variables. This is a two-level model with a hidden level used to discriminate between several "general types of behaviors" (called States, an abstract concept that groups individuals based on a combination of their appointment keeping and their recorded type of healthcare need) regarding missed appointments, and a visible level allowing a precise description of the reasons leading to missing or not missing an appointment. This model has been preferred to logistic regression for two reasons: first, preliminary results showed that the probability of missing an appointment was more accurately estimated by a Markov chain than by a logistic regression, the latter being only a rough approximation of the former model. Second, the two-level structure of the Double-Chain Markov Model allows us to classify our patients on the basis of both their probability of missing and their personal characteristics.

The state corresponding to an appointment at time t depends on the value of the state at the time of the previous appointment of the same patient (State $t - 1$), and on covariates (Figure 1). The role of the hidden level is to estimate for each appointment the probability that a patient belongs to each type of behavior, and then to assign the patient to the most likely one. A patient is generally mainly associated to only one of the states, but if his general behavior regarding missed appointments changes during the period of observation, the patient is susceptible to also switch to another state.

To each state corresponds a different model at the visible level. The observed outcome variable Y , indicating whether an appointment was missed or not, is explained by the same variable observed for the last three appointments. In addition, factors that might influence the attendance (covariates) are used to improve the prediction of missing an appointment. A Markovian regression model called the Mixture Transition Distribution model [22,23] is used to link past observations of missed appointments and covariates to the probability of missing the next appointment (Figure 1). This model allows a very precise description of the role and importance of each explanatory factor on the outcome variable.

We used the MARCH v 3.0 package (A&A Berchtold, Switzerland) for the computation of all Markovian models. SPSS 14.0 (SPSS Inc., Chicago, IL) was used for additional computations.

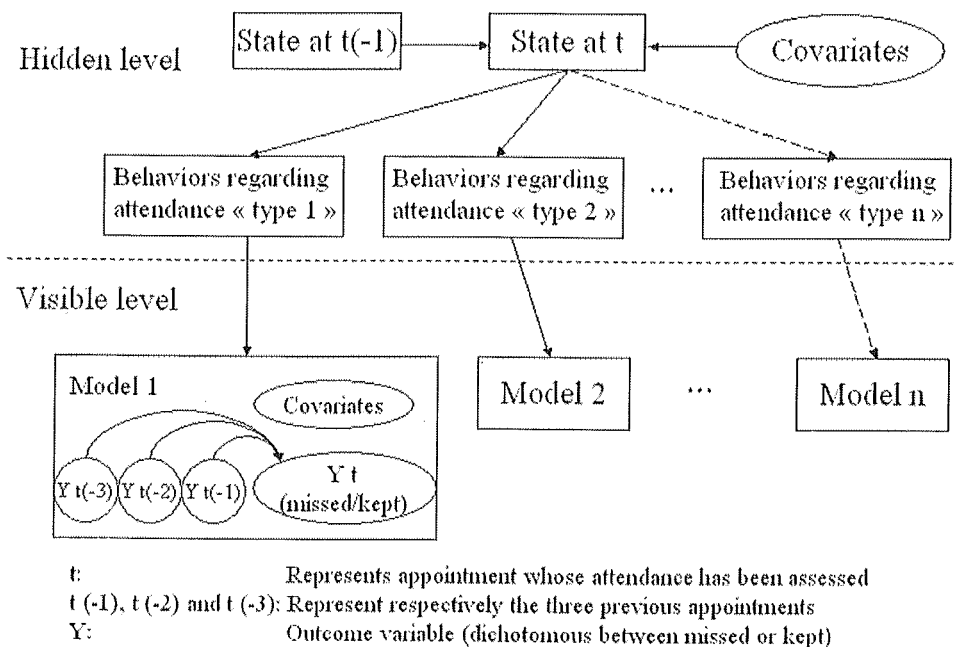


Figure 1. The Double-Chain Markov Model is a two-level probabilistic model with a nonobserved hidden part and a visible level. The hidden level is used to classify data into a number of general types of behaviors regarding missed appointments. Each appointment of a patient is linked to the most probable type of behavior in function of the behavior of the same patient during the previous appointment and of covariates. At the visible level, each type of behavior is then fully described through a Markovian regression-like model using covariates and the fact of having or not missed each of the last three appointments to predict the probability of missing the current appointment.

As our study was a quality improvement initiative, the Ethics Committee at the University of Lausanne did not require the submission of a protocol.

Results

Rate of nonattendance

Forty-five percent of female patients have attended all their appointments, 41.2% have missed up to 25%, and 13.9% have missed more than 25% of them. For males, rates are, respectively, 44.5%, 41.4%, and 15.9%.

Homogeneous Markov chains

For females, the independence model predicting the probability of missing an appointment without using information from previous appointments was clearly rejected, indicating a dependence process between successive appointments. Among models using data from the previous appointments, the best model according to the Bayesian Information Criterion [19] measure was the one using the last three appointments. Similar results were achieved for males.

Double-Chain Markov Model

We used the Double-Chain Markov Model to incorporate covariates into the model and to obtain a more precise explanation of the process leading to missing an appointment. For females, the optimal model has two hidden states representing two different types of general behavior. The state corresponding to an individual rarely changes, and is mostly similar to the state at the previous appointment. Out of the 1873 females, 1022 (55%) have always been in State 1, 833 (44%) in State 2, and only 18 (1%) have changed state once during the observed period, 13 times from State 2 to State 1, and 5 times from State 1 to State 2. These 18

females are characterized by a very large average number of appointments (39.8) compared to both other groups (9.3 for females associated to state 1 only and 11.6 for females associated to group 2 only), all differences being highly significant ($p < .001$). The diagnosis is the only covariate that has a significant influence on the state. Somatic, gynecology, violence, and counseling diagnoses are mostly associated to State 1, whereas psychiatric and ED diagnoses are mostly associated to State 2 (Table 2).

At the visible level, for the model corresponding to state 1 (somatic diagnoses), the risk of missing an appointment is increased by the fact of having already missed one of the three previous appointments, the amount of time elapsed since the last appointment, not having cancelled the last appointment, having an appointment scheduled with a paramedical provider, and having consulted a paramedical provider at the last appointment. The most prominent of these factors is the intended provider (47% of the total explanation).

For State 2, which is mostly associated to ED and psychiatric diagnoses, having missed one of the three previous appointments, a longer delay and having cancelled the next to last appointment are factors explaining the risk of missing an appointment. Having missed any of the three previous appointments is the most prominent factor with, respectively, 30%, 26%, and 31% of the total explanation. Among girls, the probability of missing an appointment is lower for those with a psychiatric diagnosis. Detailed results are reported in Table 3.

For males, preliminary analyses have shown no differences at the hidden level for the general type of behavior; thus, the model is reduced to only one visible regression-like model. The probability of missing an appointment is explained by having missed or cancelled the next to last appointment, having missed the antepenultimate appointment, being older, diagnosis, and time elapsed since last

Table 2
Hidden level of the Double-Chain Markov Models for females

Factor	Modality	Appointment at time t		
		Weight (95% CI) ^a	Nonweighted probability of being in State 1 (95% CI) ^b	Nonweighted probability of being in State 2 (95% CI) ^b
State at time $t (-1)$	1	95% ($\pm 1\%$)	100% ($\pm 1\%$)	0% ($\pm 1\%$)
	2		0% ($\pm 1\%$)	100% ($\pm 1\%$)
Diagnosis	Violence	5% ($\pm 1\%$)	100% ($\pm 37\%$)	0% ($\pm 37\%$)
	Gynecology		92% ($\pm 8\%$)	8% ($\pm 8\%$)
	Somatic problems		71% ($\pm 8\%$)	29% ($\pm 8\%$)
	Psychiatry		24% ($\pm 12\%$)	76% ($\pm 12\%$)
	Eating disorders		0% ($\pm 8\%$)	100% ($\pm 8\%$)
	Counseling		85% ($\pm 22\%$)	15% ($\pm 22\%$)
	Missed/cancelled		100% ($\pm 8\%$)	0% ($\pm 8\%$)

t represents the time of the appointment for which the risk of missing is being assessed; $t (-1)$ is the time of the previous appointment. CI = confidence interval.

^a Percentage of the total explanation attributable to each explanatory factor.

^b Nonweighted probability of belonging to each state related to each modality of explanatory factors.

Table 3
Visible level of the Double-Chain Markov Models for females

Factor	Modality	Model 1			Model 2		
		Weight (95% CI) ^a	Nonweighted probability to miss (95%CI) ^b	Weighted increase in probability to miss (95%CI) ^c	Weight (95% CI) ^a	Nonweighted probability to miss (95%CI) ^b	Weighted increase in probability to miss (95%CI) ^c
Missed at $t(-1)$	No	10% ($\pm 1\%$)	11% ($\pm 3\%$)	Ref	30% ($\pm 1\%$)	0% ($\pm 2\%$)	Ref
	Yes		75% ($\pm 6\%$)	6.4% ($\pm 0.9\%$)		4% ($\pm 14\%$)	1.2% ($\pm 4.8\%$)
Missed at $t(-2)$	No	2% ($\pm 1\%$)	11% ($\pm 3\%$)	Ref	26% ($\pm 1\%$)	0% ($\pm 2\%$)	Ref
	Yes		75% ($\pm 6\%$)	1.3% ($\pm 0.2\%$)		4% ($\pm 14\%$)	1.0% ($\pm 4.2\%$)
Missed at $t(-3)$	No	8% ($\pm 1\%$)	11% ($\pm 3\%$)	Ref	31% ($\pm 1\%$)	0% ($\pm 2\%$)	Ref
	Yes		75% ($\pm 6\%$)	5.1% ($\pm 0.7\%$)		4% ($\pm 14\%$)	1.2% ($\pm 5.0\%$)
Delay	<15 days	12% ($\pm 1\%$)	8% ($\pm 5\%$)	Ref	10% ($\pm 1\%$)	1% ($\pm 9\%$)	Ref
	15-30 days		44% ($\pm 8\%$)	4.3% ($\pm 1.6\%$)		20% ($\pm 13\%$)	1.9% ($\pm 2.2\%$)
	31-90 days		65% ($\pm 7\%$)	6.8% ($\pm 1.4\%$)		36% ($\pm 14\%$)	3.5% ($\pm 2.3\%$)
	>90 days		0% ($\pm 10\%$)	-1.0% ($\pm 1.8\%$)		79% ($\pm 20\%$)	7.8% ($\pm 2.9\%$)
Cancelled at $t(-1)$	No	15% ($\pm 1\%$)	60% ($\pm 3\%$)	Ref	NS	—	—
	Yes		55% ($\pm 9\%$)	-0.8% ($\pm 1.8\%$)		—	—
Cancelled at $t(-2)$	No	NS	—	—	3% ($\pm 1\%$)	46% ($\pm 11\%$)	Ref
	Yes		—	—		83% ($\pm 33\%$)	1.1% ($\pm 1.3\%$)
Designed Provider	Physician	47% ($\pm 1\%$)	6% ($\pm 2\%$)	Ref	NS	—	—
	Paramedical		17% ($\pm 3\%$)	5.2% ($\pm 2.4\%$)		—	—
Provider at $t(-1)$	Physician	6% ($\pm 1\%$)	37% ($\pm 6\%$)	Ref	NS	—	—
	Paramedical		45% ($\pm 9\%$)	0.5% ($\pm 0.9\%$)		—	—

In bold: increases in probability to miss significant at $p < .05$; NS = nonsignificant.

t represents the time of the appointment for which the risk of missing is being assessed; $t(-1)$, $t(-2)$, and $t(-3)$ are the times of the last three previous appointments.

CI = confidence interval.

^a Percentage of the total explanation attributable to each explanatory factor.

^b Nonweighted probability of missing the appointment related to each modality of explanatory factors.

^c Corresponding weighted probability with respect to the reference modality.

appointment. The most important of these factors is having missed the next to last appointment with 39% of the total explanation. Interestingly, having or not missed or cancelled the immediate previous appointment has no effect and has been excluded from the model. Males have globally a higher probability to miss than both female groups. Results for males are reported in Table 4.

Discussion

In our study, the rates of patients having missed more than 25% of their appointments represented 14% of females and 16% of males. Nevertheless, our rate of patients having never missed is lower than those reported in studies with adults [4,5], confirming that adolescents are, with young adults, at greater risk of missing.

However, the fact that our sample only takes into account patients with four or more appointments could partly explain this lower rate. As a referral center, our clinic receives many patients referred by their primary care provider for a specialized evaluation, and the probability of missing is probably lower, because of the specific status of these appointments. In most cases, these patients, who are followed by their provider after assessment, have less than four appointments and were not included in the model.

For females, ED and psychiatric diagnoses are associated to state 2, which has the lowest risk of missing, even if the patients have previously done it. Although we found no study addressing the attendance of patients with ED, owing to this diagnosis is the self-oriented perfectionism [24], which could explain the particular attendance of these adolescents. Contrary to Cashman et al [8], who have shown that the presence of at least one psychological diagnosis is associated with missing an appointment, our patients with a psychiatric diagnosis have a behavior similar to patients with ED and tend to miss less than females with a somatic diagnosis. The fact that we are not a psychiatric clinic is a possible explanation: patients with complex or more severe comorbidities, who could be more subject to miss, are referred to psychiatry.

All males have a similar behavior concerning missed appointments. This could be explained by the fact that ED diagnoses mostly concern females [25,26], and that males less often report a need concerning psychological problems and a willingness to use mental health services [27,28]. Moreover, psychiatric diagnoses are not necessarily similar for both genders. For males, these diagnoses are more frequently linked to substance abuse or dependence, which are probably associated with an increased risk of missing, as demonstrated for drugs and tobacco use [8]. Consequently,

Table 4
Visible level of the Double-Chain Markov Model for males

Factor	Modality	Weight (95%CI) ^a	Nonweighted probability to miss (95%CI) ^b	Weighted increase in probability to miss (95%CI) ^c
Missed at <i>t</i> (-2)	No	39% (±2%)	0% (±3%)	Ref
	Yes		39% (±10%)	15.2% (±5.1%)
Missed at <i>t</i> (-3)	No	17% (±2%)	0% (±3%)	Ref
	Yes		39% (±10%)	6.6% (±2.2%)
Cancelled at <i>t</i> (-2)	No	8% (±2%)	0% (±9%)	Ref
	Yes		50% (±30%)	4.0% (±3.1%)
Age	12-15	13% (±2%)	0% (±12%)	Ref
	16-17		30% (±11%)	3.9% (±3.0%)
	18-20		53% (±12%)	6.9% (±3.1%)
Diagnosis	Violence	18% (±2%)	48% (±41%)	-1.1% (±9.5%)
	Somatic problems		39% (±9%)	-2.7% (±3.8%)
	Psychiatry		34% (±11%)	-3.6% (±4.1%)
	Eating disorders		0% (±26%)	-9.7% (±6.8%)
	Counseling		42% (±29%)	-2.2% (±7.4%)
	Missed/cancelled		54% (±12%)	Ref
Delay	<15 days	5% (±2%)	36% (±17%)	Ref
	15-30 days		53% (±20%)	0.9% (±1.9%)
	31-90 days		21% (±22%)	-0.8% (±2.0%)
	>90 days		0% (±31%)	-1.8% (±2.4%)

In bold: increases in probability to miss significant at $p < .05$.

t represents the time of the appointment for which the risk of missing is being assessed; *t* (-2) and *t* (-3) are respectively the times of the last but one and antepenultimate appointments.

CI = confidence interval.

^a Percentage of the total explanation attributable to each explanatory factor.

^b Probability of missing the present appointment corresponding to each modality of explanatory factors.

^c Corresponding weighted probability with respect to the reference modality.

few males have the diagnoses that are associated by females to the state 2 (mainly ED and depression).

In all cases, one of the most important factors determining the risk of missing is having missed one or several previous appointments. A possible explanation is the lack of direct adverse consequences for the defaulters. Even if in our clinic adolescents should pay for missed appointments since January 1, 2004, a previous study showed that it does not decrease the rate of missed appointments [7]. The fact that the dichotomous variable "year" distinguishing the periods before and after the introduction of a charge for missed appointments is not significant in any of the models in our study seems to corroborate that having to pay for nonexcused appointments has no effect.

On the other hand, having cancelled one previous appointment influences all models, although the increase in the probability to miss is only significant for males. There are probably different types of behaviors concerning cancellations: some patients cancel a long time in advance because they will not be able to attend, whereas others do it at the last minute because they have forgotten the appointment. Moreover, since January 1, 2004, some patients cancel also at the last moment just to avoid having to pay. We are unfortunately not able to distinguish these different behaviors, what limits our possibilities to explain cancellations.

For females with a somatic diagnosis, delays between 15 and 90 days are associated with a higher probability to miss

than shorter delays. When scheduling an appointment with a long delay, adolescents have probably a greater risk of forgetting the appointment, which is a common cause for missing [29,30]. They also have more time to plan other activities, which will possibly be preferred to the scheduled appointment. Reminders, which have been shown to be efficient concerning missed appointment for adolescents [15,18], could possibly be used more specifically for appointments occurring after a determined delay. Moreover, focusing on these "high-risk appointments" could decrease the required workload involved in strategies to diminish missed appointments. Delays greater than 90 days, however, are not associated with an increase in risk of missing in this group. We hypothesize that appointments scheduled after such a delay are most probably taken for a new reason for consultation that, similarly to what has been described in adults [31], adolescents would be less likely to miss. That is not always the case for follow-up appointments, which are probably mostly purposed by the provider, as patients may feel the follow-up appointments more frequently unnecessary than the providers, similarly to what has been reported by Wick et al [32] in a study conducted in general practices.

For females belonging to the state of psychiatric diagnoses, a delay longer than 90 days is associated with an increased risk of missing. These patients have a closer follow-up. Consequently, a longer delay possibly means health improvement and a spacing of the appointments more

than a new reason for consultation. This improvement could explain that they perceive the appointment as more unnecessary. For all patients, stating very clearly the reason for scheduling a follow-up and avoiding unnecessary appointments could probably decrease missed appointments.

The fact that the intended provider is a member of the paramedical staff significantly increases the risk of missing for females with a somatic diagnosis but not for those in the psychiatric model. Our hypothesis is that, as paramedical providers mainly work part time in our clinic, it is probably more difficult to find a convenient time slot for the appointment. Moreover, the fact that health insurances do not always fully cover all our paramedical providers (and consequently patients have to pay) could also be an explanation. It is also possible that the care relationship established between the psychiatric patients and the paramedical providers (who are mainly the psychologist or the dietician), are different than the relationships with the family planning counselor or the nurse who are probably more frequently consulted by females in the somatic state. Furthermore, concerning the family planning counselor, an increase in the risk of missing might partly be because of the fact that the consultation is more an accessory service offered to the patient than a consultation to treat their health issues. Thus, the patient could feel the appointment as unnecessary.

Paramedical providers meet males in a smaller proportion than females. Although a substantial part of all males' diagnoses are psychiatric diagnoses, substance misuse represents a greater proportion than for females. Thus, they probably consult physicians more frequently than females for psychiatric diagnoses. It is also possible that we did not have enough power to show an influence of the provider for males because of the small number of appointments they scheduled with paramedical providers, and also to the smaller number of males included in the model.

The risk of missing an appointment is greater for older males, in concordance with published research indicating that young adults are at greater risk of missing an appointment than adolescents [4,5]. However, the same is not true for females. Although a gender difference has been inconsistently reported regarding missed appointments [3,4,8,33], we found no study comparing the age influence separately by gender and we have no explanation for this finding.

Strengths and limitations

The present study is innovative in the sense that, as far as we know, the prediction of the risk of missing an appointment, taking the patients' background into account, have never been studied. Moreover, taking into account cancellations, which are a form of nonattendance, allows us also to have a more precise model. However, some limitations need to be stressed. First, the diagnosis is not registered for the appointments that have not been attended. Thus, in these cases, we had to rely on the diagnoses of the previous

consultations. Second, fewer males have consulted in our clinic, what limits our statistical power for males and could limit the establishment of different states at the hidden level. Third, because of the structure of our prediction models, patients with less than four appointments were not taken into account. However, we still consider a large proportion of patients over a period of 8 years. Moreover, our approach was able to put into evidence the influence of past appointments, which would not have been possible otherwise. Finally, Markovian models are mostly used when observations are equally spaced in time, what is not the case here, although similar approaches were already successfully used in the past [34].

Conclusions

As reported in the literature, a majority of our adolescent patients of both genders default at least once. Females have two distinguishable behaviors separating somatic from psychiatric diagnoses. Males show a unique behavior, which is similar to the somatic behavior of females. This should be taken into account for the management of missed appointments. Moreover, providers should be aware of the fact that adolescents could feel an appointment unnecessary; thus, they should always explain the reason for scheduling a follow-up appointment and avoid appointments that are not really necessary. As they have the highest risk of missing the next appointment, our efforts should be focused on those who have already defaulted. Therefore, strictly implemented means of control focusing on those at risk for missing appointments could be a solution that would have the advantage of decreasing the workload. Finally, for long delays between consultations, reminders could be an appropriate solution.

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