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Visual Cue to Reduce False No-Show Registration in Riyadh Primary Healthcare: A Randomized Controlled Trial

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Electronic scheduling · No-show · Nudge · Primary healthcare center · Visual cue

Abstract

Introduction: Preliminary field visits to the Saudi Ministry of Health's primary healthcare centers (PHCs) confirmed a proportion of prior reported no-show appointments to be false due to staff registering patient arrivals inappropriately. We sought to investigate whether visual cue reminders would prime the staff to register patients properly. ***Methods:*** A randomized controlled trial was conducted in 2019 involving 35 PHCs in Riyadh, Saudi Arabia. Visual posters were installed in the intervention PHCs wherever patient arrivals were registered. The primary outcome was patient no-show appointments. Staff who registered appointment arrivals were observed and interviewed. Multilevel logistic regression analyzed the change in no-shows across an intervention group and a control group. ***Results:*** The intervention group had lower odds ratio (OR) of no-shows than the control group, although not significantly (OR 0.81, 95% confidence interval [CI] = 0.50–1.31). The period during Ramadan saw fewer no-shows than pre-Ramadan (OR 1.60, 95% CI = 1.55–1.66). Compared to family medicine appointments, no-shows were higher for the smoking cessation clinic (OR 3.95, 95% CI = 3.43–4.54), dental appointments (OR 2.14, 95% CI = 1.97–2.32), and vaccine appointments (OR 1.31, 95% CI = 1.27–1.35). Qualitative analysis shows that PHCs' appointment processing was arbitrary without a unified structure. ***Conclusion:*** The reduction in no-show rates using visual cues was not significant. However, certain confounders, if not addressed prior to intervention implementation, can lead to cognitive overload and burnout, inviting unwanted behavior. Further implications are discussed.

Introduction

Failing to attend scheduled healthcare appointments or not canceling 24 h before disrupts healthcare schedules, lengthens waiting periods, and wastes resources [1]. The British National Health Service (NHS) has estimated

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that 5% of primary healthcare appointments are missed ("no-shows"), costing 216 million pounds in 2019 (equivalent to 1.1 billion Saudi Riyals) [2]. With the emergence of electronic scheduling systems worldwide, Saudi Arabia's Ministry of Health (MoH) introduced *Mawid* – a centralized appointment system that electronically books and manages appointments – aiming to shift dependency on phone and in-person appointment bookings and reduce appointment errors [3, 4]. Mawid enables patients to book appointments directly for the MoH's primary healthcare clinics and track or change their appointments. The system also permits healthcare staff to check in patients as well as manage their appointments. In comparison, Sehatty application, which was launched by the MoH in 2020, is a one-way patient user scheduling app that is gradually transitioning from the backlog of Mawid two-way user system of patients and healthcare staff.

A growing body of literature has elaborated on using subtle environmental prompts to alter people's decisions with regard to making desirable choices. This method draws from the concept of *nudging*, which is meant to influence decisions by addressing cognitive biases that affect behaviors of individuals or groups without altering economic incentives or limiting their options [5, 6]. Nudging has been applied in various evidence-based interventions to reduce no-show rates through cost-effective strategies. One application of nudging is to persuade people to make more optimal decisions by framing options with a visual cue that highlights the desirable behavior's saliency [7, 8]. Visual cues, for instance, posters, are used in various settings to nudge people into desired behaviors and decision-making [9]. Employing visual cues has seen significant success in reducing staff cognitive barriers, focusing their attention on completing tasks, and increasing their work efficiency in healthcare settings [9]. Like other visualization tools, a visual cue guides the attention to a particular piece of information in a visible and clear way [10].

We sought to reduce the high no-show rate by first addressing false no-show appointments using visual cues to prime and promote healthcare staff to record patients' appointments accurately into the Mawid system. We hypothesized that a visual cue would encourage accurate reporting and eventually reduce the false patient no-show rate in the Mawid system, representing instead the actual no-show rates. A randomized controlled trial (RCT) was used to test the efficacy of visual cues on primary healthcare staff. Intervention and control group allocation were performed at the primary healthcare center (PHC) level; staff performance was evaluated at the appointment level within each PHC.

Methods

Preliminary Investigation and Findings

Before applying interventions to combat the high no-show rate, a true understanding of what was happening at the PHC level was necessary. We conducted preliminary investigations through the Mawid Dashboard, phone interviews, and field visits in mid-2019. The Mawid Dashboard showed 30% no-show rates across all PHCs in Saudi. Phone interviews conducted with patients who were registered as no-shows on the dashboard showed that 82% had attended their scheduled appointments. This led us to assume that a large portion of registrations in the Mawid system were false positives – false no-shows. Field visits to PHCs revealed that healthcare staff were having difficulties adopting Mawid on top of other multiple E-Systems. We concluded that healthcare staff appeared to be cognitively overloaded and overwhelmed from the volume of information and tasks they were instructed to manage with the multiple E-Systems. Additionally, the variance of infrastructure and layout between PHCs hindered a uniform process for patient registration. Some PHCs registered patients as they arrived, while others registered them at the end of the working day. Often, patients were falsely reported to have missed their appointment. In other words, these false no-shows were feeding into the high no-show rate on the Mawid dashboard.

Intervention Materials and Procedure

We developed an A4 poster displaying 2 visual cue reminders, one personalized to the healthcare staff and the other to patients. The reminders were primarily designed to address the healthcare staff's cognitive biases, tailored by our preliminary findings. One side of the poster reminds patients to remind healthcare staff to confirm their appointment in the Mawid system. On the other side, designated healthcare staff are reminded to register patient arrivals and communicate the number for technical support. Salient colors (orange, yellow, and red) were used in the poster to draw the staff's attention (online suppl. Fig. 1; for all online suppl. material, see www.karger.com/doi/10.1159/000529006). In some PHCs, gender segregation is typical, such as in PHC villas or apartment buildings rented by the government (online suppl. Fig. 2). We installed gender-customized visual reminders in the relevant sections when needed (online suppl. Fig. 3). The visual cue posters were installed with a transparent acrylic stand or wall frame wherever healthcare staff registered patients' arrivals, whether at the front desk reception area, an old filing room, or an administrative office.

Sample Selection and Randomization

All PHCs ($N = 115$) in Riyadh, Saudi Arabia, were eligible for inclusion in our study trial (Fig. 1). Only 60 PHCs were considered after excluding centers that had fewer than 20 weekly appointments reported in the Mawid system or an impractical no-show rate (0% or 100%) over the past 2 weeks. A simple random sample of 36 PHCs was selected; they were equally allocated into an intervention and a control group, using block randomization to balance groups with a block size of 2 (Fig. 1). Three weeks into the study, a misclassified PHC in the control group was dropped from the analysis.

The trial ran for 11 weeks from April 14 to July 4, 2019, excluding the first week of June, which was a nationwide week off following Eid Al-Fitr, a national holiday. We had two on-site field visits during the trial period. Appointment data were retrieved weekly,

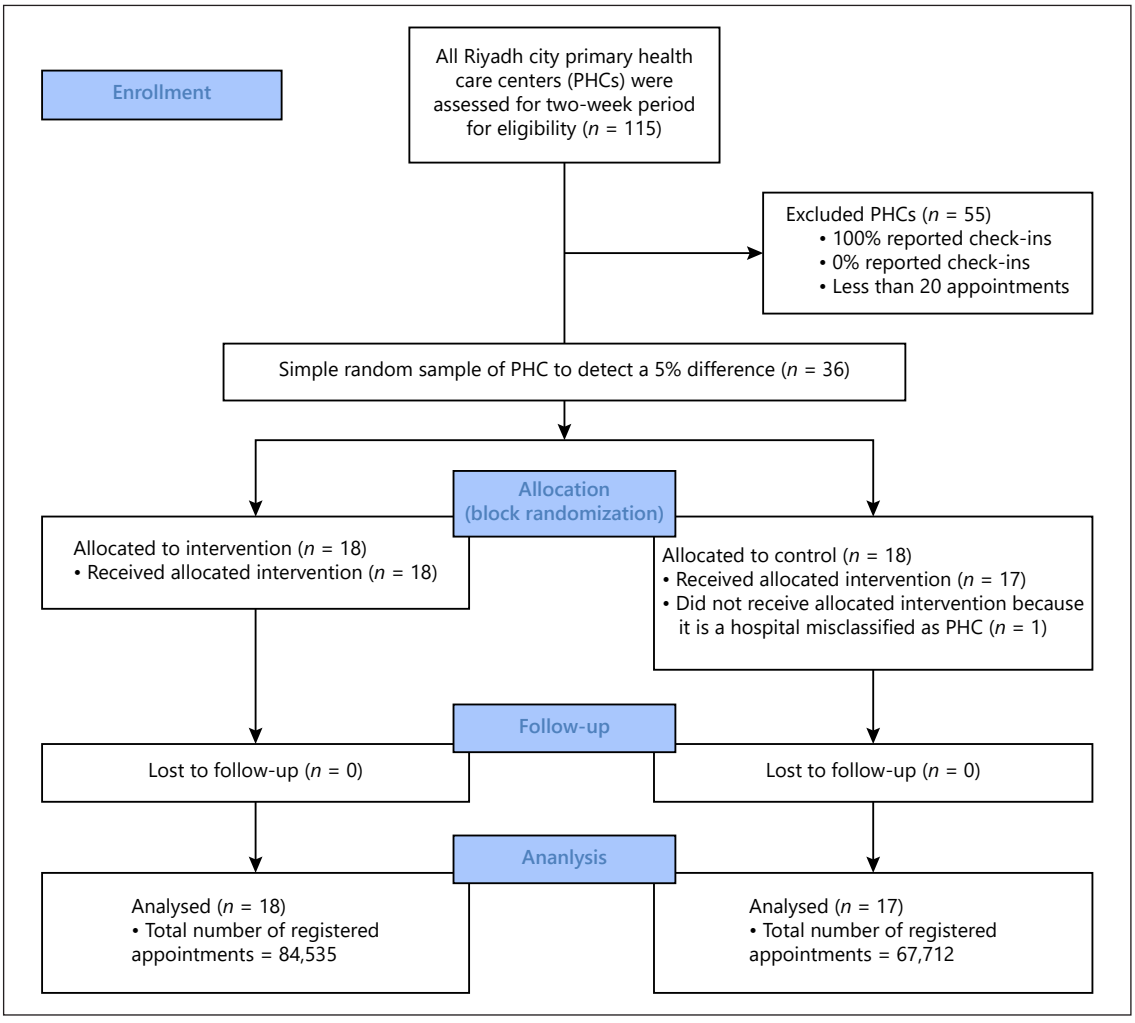

Fig. 1. Randomization of primary healthcare centers (PHCs) distributed in parallel groups.

and we included all patient appointments in each sampled PHC, except those that were rescheduled, canceled, or walk-in patients without an appointment. All identifiable information attached to the appointments was omitted to create a de-identifiable dataset for analysis. Our reporting followed the Consolidated Standards of Reporting Trials (CONSORT) checklist (online suppl. Table 1); however, the trial was not registered. The trial was initially conducted as part of internal quality improvement/quality assurance to enhance the electronic registration of patients at the ministry's PHC centers. Eventually, the authors obtained the approvals and sought to publish the findings to inform policies related to electronic appointment systems and the challenges facing PHC centers.

Outcomes and Confounders

We evaluated the primary outcome using the Mawid system, which electronically recorded, for each appointment, whether the staff checked in a scheduled patient or not, and for the latter, marked it as a "no-show" (binary outcome). The probable assumption is that our intervention would improve accuracy in recording patient appointment arrivals and lower false no-show appointments.

Factors that could influence the processing of appointments were identified, which included the period of the Islamic holy month of Ramadan (before, during, and after), the type of services for which the patient's appointment was made (family medicine, dental, vaccination, smoking cessation clinic, etc.), and the time taken by the Mawid interface to capture patients' walk-in registration (before and after). We further adjusted for the biweekly key performance indicator (KPI) rates of PHCs that had been evaluating their adoption of the Mawid interface system. The adoption level was indicated through colors (green, yellow, and red). PHCs at the green level had an 80–100% adoption rate, yellow had 40–79%, and red had 0–39%. The adoption rate was calculated using the following formula:

$$PHC\ Adoption = \frac{Total\ Number\ of\ PHC\ Appoinmnets\ in\ CAS}{\left(No - Show\right) + \left(Weekly\ Foot\ Visits\right)} \times 100$$

Table 1. Distribution of appointments between control and intervention primary health centers (PHCs) between April 14 and July 4, 2019 (*n* = 152,247)

	Control group (*N* = 17) (*n* = 67,712)		Intervention group (*N* = 18) (*n* = 84,535)	
	frequency, *n*	percent, %	frequency, *n*	percent, %
Seasonality				
Before Ramadan, 4 weeks	22,001	32.5	27,701	32.8
Ramadan, 4 weeks	19,322	28.5	23,220	27.5
After Ramadan, 4 weeks	26,389	39	33,614	39.8
Type of service				
Family medicine	36,856	54.4	47,695	56.4
Vaccine	23,543	34.8	28,532	33.8
Dental	1,401	2.1	1,287	1.5
Dressing	2,553	3.8	1,187	1.4
Pharmacy	33	0.1	1,062	1.3
Smoking cessation	641	1	859	1
Other services	2,685	4	3,913	4.6
App enhancement				
Before update	37,244	55.0	45,910	54.3
After update	30,468	45.0	38,625	45.7
Mawid KPI adoption				
Red	2,226	3.3	9,712	11.5
Yellow	14,551	21.5	17,488	20.7
Green	50,935	75.2	57,335	67.8

N, number of primary healthcare centers; n, number of appointments; KPI, key performance indicator.

Qualitative On-Site Observations and Interviews

Two on-site field visits and a semi-structured interview were conducted with healthcare staff in the PHC intervention group. The first visit occurred during the installation of the intervention (visual cues). The observers went as MOH employees; their aim was to identify (1) the designated staff member (manager, administrator, nurse, physician) who registers patient arrivals on Mawid, (2) the number of installed visual cues, and (3) other surrounding cues in the registration area. For the second visit, mid-trial, observers booked appointments via Mawid. They presented themselves to the PHCs as patients, and the objective was to observe the clarity of the registration process (online suppl. Table 3). They documented the following: (1) Did healthcare staff register your arrival? (2) If not or if you're not sure, how did they process you? (3) Was the registration process clear? Online questionnaires were employed during both visits, using Qualtrics XM Survey software (online suppl. Table 2). Finally, semi-structured interviews were conducted on 11 healthcare staff members separately. The objective was to obtain information on their utilization and opinion regarding the intervention, including suggestions for the E-Systems.

Analysis

Quantitative Analysis

The weekly no-show rate at baseline for the included PHCs was 23.3%, with an average number of appointments of $\mu = 455$ and a population standard deviation of $\sigma = 280$. The intra-class correlation coefficient of the clustering effect within PHCs calculated at baseline was 0.101. To detect a difference of 5 percentage points in the no-show rates between the intervention and control groups at 80% power, the sample size required was 126,610 appointments, adjusting for the PHC clustering effect of appointments. To achieve this sample size of appointments during the 3 months of the trial, we would need 36 PHCs.

We first performed a univariate analysis to describe the distribution of appointments for each experiment arm, by season, type of service, before or after the Mawid update, and PHC classification based on Mawid's KPI adoption. Then, we performed a multivariable logistic regression to estimate the odds ratio (OR) of a patient no-show in the intervention group compared to the control group, adjusting for confounding variables and the clustering effect of observations within PHCs. We reported the adjusted OR of no-shows for other factors as well, with a corresponding 95% confidence interval (95% CI). Cronbach's alpha was set at 0.05, and all statistical analyses were undertaken using Stata/MP 16.1 [11].

Qualitative Analysis

All our analyses regarding open-ended observations and translated interview responses followed inductive approach using grounded theory. Since Mawid is a novel system and is yet to be explored exhaustively, our data drove the analyses instead of preordained theories or frameworks. Triangulation strategies were applied to increase data validity; specifically, we collected data from multiple sites, researchers, and data forms. Additionally, a peer debriefing strategy was used, in which a mix of four researchers with dental, medical, health education, and behavioral analytics background read our data to ensure the correctness of our interpretation.

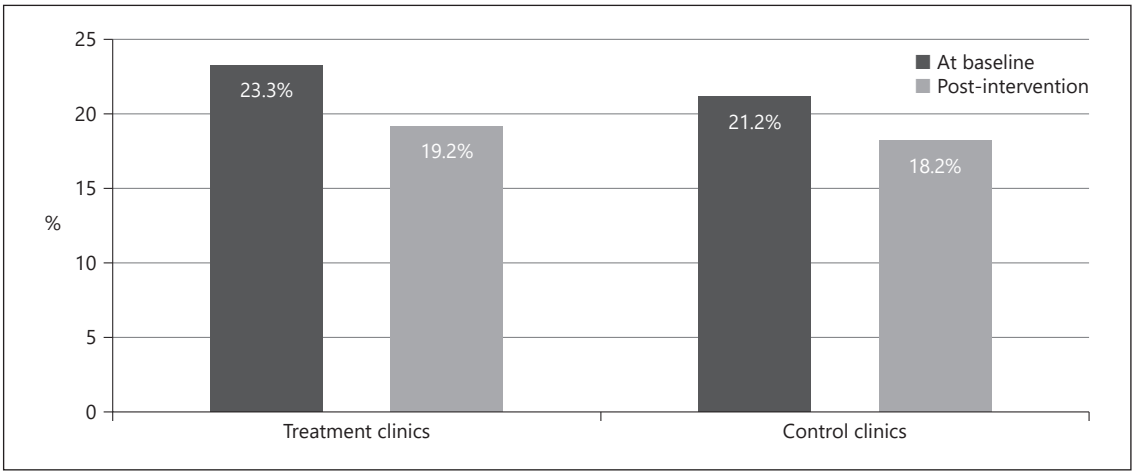

Fig. 2. Unadjusted no-show rate in the intervention and control groups before and after implementation of the intervention.

Results

Quantitative Findings

Overall, the intervention group had more appointments recorded in the system than the control group (Table 1). At baseline, the intervention group had a 23% no-show rate, while the control group had a 21% no-show rate (Fig. 2). There were 152,247 appointments from April 14 to July 4. The number of appointments varied over time (before, during, and after Ramadan), with the highest number of appointments observed after the Ramadan period of 4 weeks between June 9 and July 4. A decrease in appointments was observed during Ramadan, by 12.3% in the control group and 16.2% in the intervention group. Examining the type of service provided in the PHCs, the largest number of appointments were seen in the family medicine clinics (54.4% in the control group and 56.4% in the intervention group), followed by vaccine clinics (34.8% in the control group and 33.8% in the intervention group). Among the 3 KPI categories, most appointments were taken in PHCs in the green zone of Mawid adoption (75.2% of all appointments in the control group and 67.8% of appointments in the intervention group).

During the intervention period, the average unadjusted (crude) no-show rate for the control group decreased by 3 percentage points to 18.24%. Similarly, the intervention group observed a decline in the unadjusted no-show rate by 4 percentage points to 19.2%. The no-show rate in the intervention group was 0.81 times the odds compared to the control PHCs, which translates to an average of 3.7 percentage points lower no-show rate, adjusting for measured confounders (Table 2). The lower no-show rate is consistent with the hypothesis that a visual reminder would improve check-in performance; however, the difference was not statistically significant at conventional levels (95% CI = 0.50, 1.31). The period of Ramadan had 60% higher odds of a no-show rate compared to the period prior (95% CI = 1.55, 166). By type of service, smoking cessation appointments had the highest no-show rate compared to family medicine appointments (OR = 3.95; 95% CI = 3.43, 4.54), followed by dental appointments (OR = 2.14; 95% CI = 1.97, 2.32). On the other hand, dressing appointments had a lower no-show rate than family medicine appointments (OR = 0.04; 95% CI = 0.03, 0.05), followed by appointments scheduled for the PHC pharmacy (OR = 0.13; 95% CI = 0.08, 0.21).

Qualitative On-Site Observational Findings

Clarity of Registration Process

The registration process was not clear in the 13 PHCs that were visited by the observers in the second visit. Five of the observers felt that they were not registered, while 6 were unsure. Observers prompted PHC staff and asked if their registration was verified; 12 PHCs confirmed, while 6 expressed annoyance or avoidance at being questioned. Manual registration on paper happened at 16 different instances, while 5 observers were ushered to the physician without confirming their registration. Other E-system interfaces, like *Wasfaty* (a 2-way pharmaceutical interface between physicians and pharmacies [12]), were prioritized over appointment registration at 4 different instances (Table 3).

Table 2. OR estimation of a no-show rate from 35 randomly sampled primary health centers in Riyadh, Saudi Arabia, between April 14 and July 4

Variables	Adjusted OR of no-show rate (95% CI)	*p* value
Intervention		
Control group	Ref	
Intervention group	0.81 (0.50, 1.31)	0.40
Seasonality		
Before Ramadan	Ref	
Ramadan*	1.60 (1.55, 1.66)	<0.01
After Ramadan/summer vacation	1.01 (0.95, 1.08)	0.72
Type of service		
Family medicine	Ref	
Vaccine*	1.31 (1.27, 1.35)	<0.01
Dental*	2.14 (1.97, 2.32)	<0.01
Dressing clinic*	0.04 (0.03, 0.05)	<0.01
Pharmacy*	0.13 (0.08, 0.21)	<0.01
Smoking*	3.95 (3.43, 4.54)	<0.01
Other services	0.97 (0.91, 1.04)	0.445
App enhancement		
Before update	Ref	
After update*	0.70 (0.66, 0.74)	<0.01
Mawid KPI[3] adoption		
Red (0–39%)	Ref	
Yellow (40–79%)	1.02 (0.96, 1.08)	0.62
Green (80–100%)*	0.84 (0.78, 0.90)	<0.01

Adjusted for the baseline no-show rate, size of the PHC, and variables presented in the table. * Statistically significant at a Cronbach's alpha of 0.05. OR, odds ratio; 95% CI, 95% confidence interval; KPI, key performance indicator.

Visual Cue and Surrounding Observations

The first observational visit indicated all the potential locations of patient registration, whether at a front desk reception area, an enclosed old room for patients' files, or an administrative office. A portion of the sample ($n = 8$) had 2–3 visual cues installed, while the remaining ($n = 10$) had one. A large segment of the sample ($n = 10$) had other surrounding visual cues (posters or flyers) not related to our intervention (Table 3).

Interview Analysis

We used 3 thematic domains: the (1) utilization of cue, (2) aversive effect of the visual cue, and (3) implication for how to improve the appointment scheduling E-system (Table 4).

Visual Cue Utilization

Staff designated to register patients in the Mawid system mentioned utilizing the visual cue to explain to patients how to use Mawid, rather than for its primary purpose. Only a single staff participant stated that the visual cue aided them in registering patient arrivals: "It (the poster) was placed in front of my face, so at first, I remembered (to register arrivals) because of it, then I became used to (it)" (online suppl. Table 4).

Healthcare Staff Opinion of the Visual Cue

Participants did not need to be reminded by a cue: "No (we do not need to be reminded), the center is open 24 h, and there is always someone to register patients, and we never need to be reminded." Some mentioned a lack of clarity: "(the) poster is unclear; (there is) not enough information; patients do not understand what to do," A few comments were made confirming that patients noticed the visual cue: "Yes, they ask about Mawid" and "When they are at my office, I see them reading the visual cue" (online suppl. Table 4).

Implication to Improve the E-System

Some participants believed media campaigns would help increase the awareness and adoption of the Mawid system: "(there should be an) advertisement on Twitter, mentioning the importance of making an appointment." Simplicity was also suggested for visual cues both on the

Table 3. Researchers' response frequency for each questionnaire item for the first and second observational visits

Observational items	1st visit MOH[1]	2nd visit patient[2]
Registration process experience		
Who was the designated staff to register patient arrival via *Mawid*?		
Receptionist	15	7
Not receptionist (administrator, nurse, doctor, etc.)	3	11
Healthcare staff response when asked to register patient arrival in Mawid E-system		
Responded with acceptances	–	12
Responded with annoyances or ignored the question	–	6
Clarity of the appointment registration process[2]		
From your point of view, was the patient registration process clear?		
The process was clear	–	5
The process was not clear	–	13
Are you sure that the staff registered your arrival?		
Yes	–	7
No	–	5
Not sure	–	6
If no or not sure, how did they process you?		
Ushered to the physician without confirmation	–	5
Personal information was written, and not reassuring their arrival was registered into the system		16
Entering information in another system (Wasfaty)	–	4
Patient registered upon request	–	5
Misusing by registering arrival in advance, later in the day	–	3
Visual cue and surrounding observations[1]		
Were there signs/posters other than the visual cue?		
Yes	10	–
No	6	–
No response	2	–
How many locations of visual cues were installed at a PHC?		
One	10	–
2–3	8	–

[1] Researcher's responses during their visits as patients. [2] Researcher's responses during their visits as a Ministry of Health employee. PHC, primary health center.

Table 4. Analytic domains identified through healthcare staff interviews and their descriptions

Participant interviewed	Domains	Description
(*N* = 11)	Visual cue utilization	Elaborate on the utilization of the visual cue, whether for the intended purpose or missed used
	Healthcare staff opinion of the visual cue	Staff's opinion toward the visual cue and the effect on their patients
	Implication to improve the E-system	Future implication to incentives PHC staff to increase the adoption of the Mawid E-system

healthcare and patient's sides: "We should make it simpler for them." Finally, they suggested incentives to increase the motivation of staff registering patient arrivals appropriately: "I suggest providing incentives to administrators who work in the system to motivate them to use it (the system)."

Discussion

We conducted an RCT in Riyadh, Saudi Arabia, to measure the effect of visual cue reminders on healthcare staff registering patient arrivals using Mawid's system. We observed a reduction in the patient no-show rate, although it was not statistically significant. The qualitative data collected during the RCT revealed confounding factors that may have had profound effects on the behavior of healthcare staff, leading to the potentially false no-show appointment rates. Efforts were made to make sure to reduce bias or contamination in the control group. PHCs were randomly assigned to trial arms, and no staff visits were made to the PHCs in the control group to influence their behavior.

The quantitative data revealed the effect of seasonality, particularly during Ramadan, on the number of appointments made and the number of no-shows. During this month, religious activities (e.g., prayers) may have played a role in the 60% higher odds in patient no-shows, especially with regard to late-evening appointments. Riyadh residents also tended to travel to other regions of the country to visit their hometowns or go on pilgrimage to Islamic holy cities (Mecca and Medina).

Although there was an overall reduction in no-show appointments post-intervention, this was not statistically significant. Statistically significant findings came up when type of service was analyzed; the highest no-show rates were in the smoking cessation and dental clinics (OR = 3.95; 95% CI = 3.43, 4.54; OR = 2.14; 95% CI = 1.97, 2.32) compared to the lowest no-show rates in the dressing clinics and pharmacy (OR = 0.04; 95% CI = 0.03, 0.05; OR = 0.13; 95% CI = 0.08, 0.21).

One possible explanation for the higher no-show in dental clinics could be related to fear or bad experiences in previous dental visits, which has been reported to be the third main reason for missing dental appointments in Saudi Arabia [13]. Missed appointment in smoking cessation clinic has been reported to be due to non-adherence to a treatment strategy or low motivation to quit smoking, which leads to abandonment of smoking cessation treatment [14]. On the other hand, no-show for vaccine appointments could be false negative, as patients are usually familiar with the PHC staff who administer the vaccines, so they would head to the vaccination room without checking in at the front desk.

Qualitative data gave insight into factors that may have influenced registration behavior. During the intervention, a new KPI was introduced on a biweekly basis to compare PHCs' adoption of the interface. These reports used color indicators (green, yellow, and red) within percentage ranges to gamify productivity and performances alongside neighboring PHCs.

In any institution or organization, the KPI is an essential method to track and achieve top-down strategy objectives. However, there are underlining drawbacks in employee performance when there are too many KPIs or indicators constructed inadequately, which can lead to perverse incentives to achieve an objective [15]. For instance, during the observations, patient arrivals were registered in advance, later in the day, or dependent on a non-receptionist staff member (a manager, administrator, physician, or nurse) in order to achieve the required indicators.

There is confusion among patients and healthcare staff regarding verifying appointment arrivals due to the lack of a unified registration process. To elucidate, the PHC building variation and infrastructure make it so that registration does not always take place at a front desk. Often it happens in an enclosed old filing room or an administrator's, physician's, or nurse's office (appendices B, C, and E). A significant portion of the intervention group had 2–3 visual cue installments, indicating that there was more than one location where appointment arrivals could be potentially registered.

The qualitative data also revealed that healthcare providers in Saudi PHCs exhibit cognitive overload and burnout from time constraints and organizational and infrastructural barriers. Mandatory E-Systems caused additional workload for the centers, as reflected in the workload distribution right from the receptionist to the physician [16].

There is a gap in the literature that overlooks healthcare staff members' inadequate load regarding mandatory obligations, leading to decision errors and the failure to deliver interventions to the patient. Some PHC staff were aware of the low adoption of Mawid and the low accuracy in registering patient arrivals electronically. They suggested conducting a media campaign and using incentives to enhance employees' performance quality.

Limitations

Potential limitations were related to the time at which the study was performed. PHC appointments may follow a vastly different pattern during certain periods, for example, Ramadan. When collecting data for qualitative analysis, we failed to gather demographic information (age, gender, education, occupation, and years of employment in PHCs) of the healthcare staff. That may have helped explain our outcomes and played a role in the gen-

eralizability of the study's findings. We also did not have a way to measure the extent to which PHCs were affected by KPI reports, which worked to counter the visual cues that were focused on real-time check-ins, and it created an incentive to simply get into the "green zone." A final caveat is that our findings cannot be generalized to other primary healthcare settings. Although clerks in the intervention arm of the trial were not blinded, PHC workers in both arms were not aware it was part of a quality improvement trial. In addition, spillover contamination of the intervention effect was a concern; however, we do not have evidence to believe there was communication between PHCs regarding the installation of the visual cues in the intervention arm. Another highlighting limitation is that there was no control over the scheduling system of patients' appointment; patients might book appointment at different PHCs. There is also a high chance of observation bias from the workers in the intervention arm when they were questioning about visual cues.

Saudi Arabia has invested in enhancing its healthcare system by introducing an exciting series of novel e-health systems to the primary healthcare setting. Despite the good intent with which they were introduced, these E-Systems added to PHCs' existing barriers and created friction around workflow [7, 17]. The multiplicity of the E-Systems that had to be adopted simultaneously hindered the process of accurate real-time appointment check-ins.

Conclusion

This trial sought to explore the effect of visual cues on reminding PHC staff to electronically register patient arrivals properly in the Mawid system and reduce the false patient no-show rate. The trial showed an insignificant effect on reducing the no-show rate. However, it was the specific confounders in the study that helped us understand the limited extent of any intervention placed in the PHC setting. No matter how efficient or profound the intervention design is, if the confounders are not addressed, new interventions can lead to cognitive overload and burnout, both of which invite unwanted behavior.

Future studies should consider several structural and systematic factors related to PHCs. This could potentially lead to better utilization of the MOH's electronic interfaces. Additionally, the work of healthcare providers should be gamified via a unified electronic system [18].

Statement of Ethics

This study protocol was reviewed and approved by the Ministry of Health General Research and Studies Department Institutional Review Board, granting an exemption from requiring written informed consent with approval number 1440–1639581.

Conflict of Interest Statement

Authors declare no conflicts of interest.

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Author Contributions

Muath A. Aldosari conceptualized, supervised, designed, and analyzed the results of the trial. Bader S. Batarfi and Moyser Z. Al-Mullah conceptualized, designed, and executed the trial and contributed significantly to the manuscript writing. Abdulatif A. Binjassas executed and analyzed the trial and wrote portion of the manuscript. Sara T. Alshammari and Sara A. Alsuhaibani cleaned, analyzed, and reported the qualitative portion of the study. May S. BinBaz conceptualized and supervised the design of the trial.

Data Availability Statement

The datasets analyzed during the current study are not publicly accessible on legal grounds, but they are available from the corresponding author on reasonable request. Further inquiries can be directed to the corresponding author.

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