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Problem Definition: Clients and service providers alike often consider one-on-one service delivery to be ideal, assuming – perhaps unquestioningly – that devoting individualized attention best improves client outcomes. In contrast, in shared service delivery, clients are served in batches and the dynamics of group interaction could lead to increased client engagement – which could improve outcomes. However, the loss of privacy and personal connection might undermine engagement. ***Practical Relevance:*** The engagement dynamics in one-on-one and shared delivery models have not been rigorously studied. To the extent that shared delivery may result in comparable or better engagement than one-on-one delivery, service providers in a broad array of contexts may be able to create more value for clients by delivering service in batches. ***Methodology:*** We conducted a randomized controlled trial with 1,000 patients who were undergoing glaucoma treatment over a three-year period at a large eye hospital. Using verbatim and behavioral transcripts from over 20,000 minutes of video recorded during our trial, we examine how shared medical appointments (SMAs) – in which patients are served in batches – impact engagement. ***Results:*** Patients who experienced SMAs asked 33.33% more questions per minute, made 8.63% more non-question comments per minute, and exhibited higher levels of non-verbal engagement across a wide array of measures (attentiveness, positivity, head wobbling or 'talai taḷḷāṭṭam' in Tamil – a South Indian gesture to signal agreement or understanding – eye contact and end-of-appointment happiness), relative to patients who attended one-on-one appointments. ***Managerial Implications:*** These results shed light on the potential for shared service delivery models to increase client engagement and thus enhance service performance.

Key words: client engagement, shared service delivery, shared medical appointments, healthcare operations, behavioral operations

1. Introduction

One-on-one interactions are considered best-in-class in many service settings. We queue for personalized attention at the bank and wait on hold (sometimes for hours) if we run into a technical

support issue with our cable or internet. One-on-one service is private and individualized, so intuitively, it seems like it should result in better service outcomes. However, when outcomes are coproduced, client engagement is required to ensure a high-quality result. If clients are less engaged in one-on-one interactions, share less information about their needs and concerns and absorb less of the service provider's recommendations, one-on-one service delivery may not be optimal.

An alternative approach is shared service delivery, in which clients are served in batches. When clients share similar needs, serving them in groups can increase each client's time with the service provider (albeit with others present), and may lead to higher levels of engagement. On the other hand, shared service delivery may decrease engagement, due to a loss of privacy.

The orthodoxy of expecting one-on-one service is perhaps strongest in healthcare, where the doctor-patient relationship is sacrosanct. As patients, we are accustomed to meeting with our doctors individually, in order to receive treatment that is personalized and confidential. At the same time, however, a significant portion of healthcare costs and healthcare system congestion worldwide is attributable to common chronic diseases (Thorpe et al. 2010). For these ailments, routine follow up one-on-one appointments have traditionally played a crucial role in preventing future clinical events that can entail expensive hospitalizations (Yach et al. 2004). Patients' engagement in their own care is critical to the successful management of chronic diseases (Beaglehole et al. 2008), and engagement in the medical appointment itself is a vital first step in achieving better clinical outcomes (James et al. 2013, Volpp and Mohta 2016, Hibbard 2003).

Against this backdrop, care providers are experimenting with models of care delivery that can enhance engagement in the routine care of chronic diseases. One such model is the shared medical appointment (SMA), in which patients with the same chronic condition meet with the physician in a group, each receiving individualized care in turn, with the other patients in the group present during the interaction. In an SMA, patients can benefit from observing the physician interact with other patients, and from hearing their peers' questions and the physician's responses to them. Patients may also spur one another to engage more deeply. The design of SMAs enables patients to spend more time with the physician, albeit alongside other patients.

Successful adoption of SMAs should depend crucially on whether they increase or dampen patient engagement. We address this question by conducting a randomized controlled trial in the glaucoma clinic of a large eye hospital. With patient consent, we randomly assigned 1,000 patients to receive SMAs (the 'treatment' arm) or traditional one-on-one appointments (the 'control' arm) during four consecutive appointments, scheduled about four months apart. SMAs were designed to have five patients, but due to scheduling constraints had 2-6 (see Online Appendix Table A1 for a breakdown). Patients consented to have each appointment videotaped, which enabled an in-depth analysis of how shared care delivery affected patient engagement.

Our results suggest that despite the relative lack of privacy, patients in SMAs exhibit *higher levels* of both verbal engagement – they spoke 10.14% more times per minute than patients who experienced one-on-one appointments, asking 33.33% more questions per minute and making 8.63% more non-question comments per minute – and non-verbal engagement during their appointments. Also, consistent with the established evidence base on the positive effect of patient engagement on clinically-relevant outcomes (Stewart 1995, Harrington et al. 2004), our related research based on the same trial (which has been shared with the DE and AE) reveals that after engaging in SMAs, patients additionally exhibited 4.59% higher levels of knowledge about their disease, and 2.13% higher compliance to medications. To the extent that shared service delivery may increase client engagement in a setting like healthcare, we argue that shared delivery models hold promise for improving service quality in a broad array of service contexts where client needs and experiences are similar, and client engagement is crucial for a successful outcome.

Although the concept of SMAs may seem provocative in a setting like healthcare, shared service delivery models are not without precedent in other settings. For example, in education, many researchers have explored the relationship between class size and student achievement; although most empirical studies find that reducing class size improves student outcomes (Schanzenbach 2020, American Federation of Teachers 2015), one-on-one service delivery is rarely recommended in education.

Indeed research suggests that bringing people together in a shared service delivery environment can increase engagement, for a variety of reasons. First, the Köhler effect demonstrates that people may become motivated to work harder in groups, as less capable members of the group, motivated by the presence of others, may choose to expend more effort (Köhler 1926, Kerr et al. 2005). Second, engaging in shared service delivery increases operational transparency. With shared delivery, individual clients have better visibility into the engagement of other clients in the service process, how client engagement in the service process affects outcomes, and the service provider's efforts in response to clients' engagement. Prior field research, conducted with a municipal government has shown that when residents were provided with transparency into the otherwise-hidden work of government in response to service requests submitted by themselves and others, they felt more trust in government and more positivity toward themselves for engaging with it, which furthr increased their engagement (Buell et al. 2020). Promoting similar visibility through shared delivery might also increase engagement. Third, successful group interaction rituals can play an important role in promoting a sense of collective happiness and mutual focus of attention (Randall 2004). To the extent that an individual's engagement may be improved through shared service delivery, so too might service quality and long-term cost effectiveness. For example, in healthcare, a growing body of evidence demonstrates that patients who are more actively engaged in their own care tend to be healthier and incur lower long-term costs (James et al. 2013).

1.1. Shared medical appointments

SMAs have been reported to be effective for treating patients with a broad array of chronic conditions (Pastore et al. 2014, Wall-Haas et al. 2012, Sumego and Bronson 2014). Service providers including the Cleveland Clinic and Kaiser Permanente in the US have used SMAs successfully for a variety of chronic conditions. However, despite these high-profile adoptions of this care model, many patients and doctors remain wary of SMAs, concerned that a lack of privacy may prevent information sharing related to sensitive medical issues (Price 2017, Petronio 2002), thus reducing patient engagement and compromising long-run outcomes (Volpp and Mohta 2016). There is also a

worry that interpersonal communication, which can help in strengthening the doctor-patient relationship, may be awkward in a group setting (Taylor et al. 1979, Arora 2003), which could further compromise engagement and outcomes. While there is some evidence in the medical literature – most notably in the context of diabetes – that SMAs can improve medical outcomes, there remains a need for rigorous scientific study of patients' experience in shared delivery contexts (Edelman et al. 2012, 2015).

Evidence on shared service delivery in non-medical settings suggests that SMAs may have the potential to increase patient engagement. For example, it has long been known that support groups such as Alcoholics Anonymous and Weight Watchers are successful in creating an environment in which members share their experiences and help one another attain their goals (Tiebout 1944). SMAs, as an alternative to one-on-one appointments, provide a similar platform for doctor-patient interactions. Patients in SMAs have the potential to learn from the doctor and from fellow patients with different levels of disease. For example, by observing other patients who are in more advanced disease states, a patient may learn firsthand the consequences of not using prescribed medicines, or receive useful information through relevant questions asked by other patients. In this way, SMAs may shift the boundaries of patient and provider roles, with the potential to improve performance (Ramdas et al. 2012).

It is difficult to develop an evidence base for the benefits of the group format of SMAs. Unlike a new drug, which can be developed in a laboratory, care delivery innovations such as shared medical appointments need to be developed and rigorously tested in clinical settings. Building rigorous evidence in the field requires keeping all else equal and is complicated by patient-imposed variability. These inherent challenges have hindered the rigorous trialing of many facets of SMAs in the past (Ramdas and Darzi 2017). With our empirical design, we work to overcome these challenges, presenting the first randomized controlled trial that directly compares the engagement dynamics in one-on-one appointments and SMAs.

1.2. Research setting

We conducted our study in the glaucoma clinic of the Aravind Eye Hospital (Aravind) in Pondicherry, India. During our study period, our site conducted an average of 978 glaucoma appointments per week, which facilitated both subject recruitment efforts, and the assembly of experimental SMAs. Prior to our study, glaucoma and other medical appointments at Aravind had been conducted on a one-on-one basis, which is far and away the norm for medical appointments in India and around the world. Aravind's objective in conducting a trial of shared medical appointments was to increase patients' engagement in their own care.

Glaucoma is an incurable chronic disease that damages the optic nerve and is the second-biggest cause of blindness worldwide. It progresses in a relatively consistent fashion across patients, and patient engagement is crucial for its successful management. Patients typically require an appointment every 3-6 months, during which their ophthalmologist checks their in-eye pressure and vision (Boyd 2003), adjusts the strength of their prescribed drops, and if necessary, suggests surgery. These measures help stem the gradual, almost imperceptible progression of the disease.

2. Methods

2.1. Trial design

We conducted our trial from July 12, 2016 to September 10, 2019, with the help of two ophthalmologists and two study coordinators. The study protocol was approved by the institutional review boards of Aravind and the authors' institutions, and was registered at the Clinical Trials Registry of India (CTRI), a World Health Organization Partner Registry.

Since we were aware of no prior work comparing engagement across SMAs and one-on-one appointments, we were unable to use prior effect sizes as a starting point for a sample size calculation. Comparing the knowledge levels and follow-up rates among patients who experienced pilot SMAs (conducted in May and June 2015) and traditional one-on-one appointments, we proposed a target sample size of $1,000$ patients (500 in each condition), which yielded a power of 90% ($\beta = 0.1$) and confidence for detecting differences between sample means of 99% ($\alpha = 0.01$) (Ahn et al. 2014,

Altman 1980). Per our protocol, we recalculated the sample size using data from the first month of the trial and the target sample size remained unchanged.

Our study inclusion criteria, developed in collaboration with Aravind, are shown in Online Appendix Table A2. Of the 1,034 patients who met the inclusion criteria and were invited to participate, 1,000 accepted and provided informed consent. Patient characteristics were substantively similar among those who joined and those who declined to join our study (Table 1).

Table 1 Summary Statistics

	(1) Participated		(2) Declined to Join Trial		(3) Differences	
	Mean	SD	Mean	SD	Differences	t-Value
Demographic Variables						
Age	62.04	9.34	62.97	9.76	-0.93	(-0.55)
Proportion of Male Patients	0.60	0.49	0.68	0.47	-0.07	(-0.90)
Urban	0.61	0.49	0.68	0.47	-0.06	(-0.78)
Education	2.57	1.21	2.44	1.05	0.13	(0.69)
Medical Variables:						
Proportion of Glaucoma Types						
Primary Open Angle Glaucoma (POAG)	0.74	0.44	0.76	0.43	-0.02	(-0.33)
Primary Angle Closure Disease (PACD)	0.22	0.42	0.21	0.41	0.02	(0.25)
Ocular Hypertension (OHT)	0.01	0.10	0.00	0.00	0.01***	(3.18)
Pseudoexfoliation Glaucoma (PXF Glaucoma)	0.03	0.16	0.03	0.17	-0.00	(-0.11)
Proportion of Comorbidities						
Diabetes	0.37	0.48	0.35	0.49	0.02	(0.24)
Hypertension	0.36	0.48	0.26	0.45	0.10	(1.28)
Cardiac Disease	0.04	0.19	0.06	0.24	-0.02	(-0.53)
Asthma/Chronic Obstructive Pulmonary Disease (COPD)	0.02	0.14	0.00	0.00	0.02***	(4.40)
Other Chronic Diseases	0.01	0.08	0.00	0.00	0.01***	(2.65)
Observations	1000		34		1034	

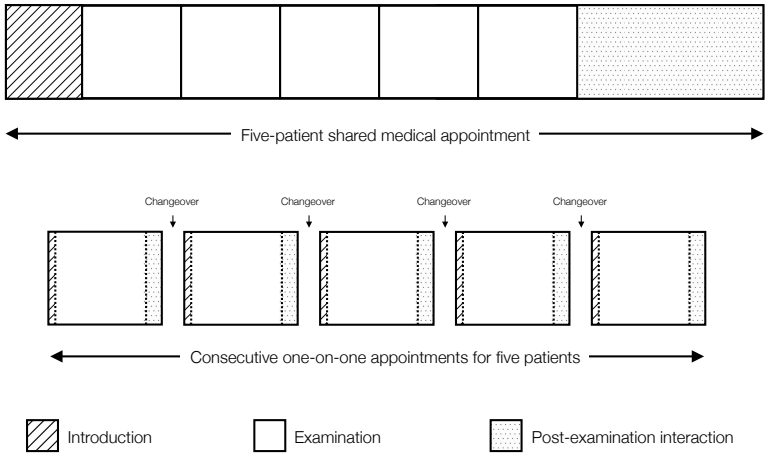
As only 34 out of 1,034 patients declined to join, for some measures there were no cases (and therefore zero variance) in the declining group, resulting, in significant differences across the groups. There were significant differences between both groups in Proportion of Ocular Hypertension, Asthma/Chronic Obstructive Pulmonary Disease (COPD) and Other Chronic Diseases, allowing for differences in variances across groups (all $p<0.001$). The education variable is scaled as: Illiterate (1); Primary School Education (2); Secondary School Education (3); Undergraduate Education (4); Postgraduate Education (5). *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Groups of five patients were randomly assigned to experience either SMAs or one-on-one appointments over the entire course of the trial, based on the output of a random number generator. Each enrolled patient was expected to attend a total of four appointments, each scheduled four months apart.

Groups of patients assigned to SMAs received an SMA on each visit, while patients in groups assigned to one-on-one appointments received consecutive appointments on each visit (see Figure

1). All patients scheduled to be seen as a part of the trial on a given day were seen by the same physician. During their appointments, patients in both arms experienced an eye examination, received recommendations from the doctor, and were given the opportunity to ask questions. Consistent with traditional practice at Aravind, appointments in both arms concluded when all patient questions had been addressed. After each appointment, all patients responded to a survey that included questions designed to assess the quality of their experience, and how much they had learned about glaucoma during the appointment. Patients concluded their visit by scheduling their next appointment with a study coordinator.

Figure 1 Structure of a Five-Patient SMA and Consecutive One-on-One Appointments for Five Patients



The structure of a five-patient shared medical appointment and of consecutive one-on-one appointments for five patients are displayed above. Each appointment included an introduction period, an individual examination for each patient, and a period of time dedicated to answering patients' questions. The schematic is drawn to scale based on the average durations observed during our study for five-patient shared medical appointments (M=18.65 minutes, SD=4.04) and consecutive one-on-one appointments for groups of five patients (M=15.88 minutes, SD=3.54). The delineations among the introduction, examination, and post-examination interaction are drawn to scale based on mean durations for shared medical appointments. The approximated delineations within one-on-one appointments are also represented in the figure, with dotted lines.

One week, three days, and one day before each scheduled follow-up appointment, a study coordinator phoned patients to remind them about their upcoming appointment and to confirm their availability. If the need arose, the coordinator would reschedule the patient, as well as other enrolled patients to fill in gaps. Importantly, we used identical scheduling and reminder procedures for patients in both arms of the trial to ensure consistent experiences across arms beyond the experimental manipulation.

2.2. Data

Measuring client engagement is difficult in any service setting. Our body language, how much we speak, and what we say all signal the extent of our underlying engagement. Although asking people how engaged they were in an interaction can introduce error due to memory lapses and intentional misreporting (Paulhus and Vazire 2007), having a researcher physically present to record engagement can alter behavior, and undermine anonymity. We obtained patient consent to video-record each trial appointment via a camera installed in the ceiling of the examination room. Using more than 20,000 minutes of recorded video, we were able to objectively capture a number of measures of both verbal and non-verbal patient engagement in a nonintrusive way, while maintaining patient anonymity. Our engagement dataset covers 986 patients (493 in each trial arm), resulting in 3,629 observations at the patient-appointment level – we lost 36 observations due to technical errors in videotaping and 335 observations due to patients missing trial appointments or having an unscheduled visit instead of attending their scheduled second, third or fourth trial appointment.

As noted earlier, the stages for both appointment types mirrored one another, except that in SMAs each patient in the group was examined in turn by the doctor. In the introduction stage, the doctor and patient(s) exchanged greetings and seated themselves. During each patient's examination, the doctor asked about the patient's family history and whether family members had undergone glaucoma tests, inspected the patient's eyes, and decided whether to continue or alter the patient's treatment plan. In an SMA, patients were examined in an order that was randomly assigned during the first trial appointment. The assigned examination order was sustained in subsequent appointments unless there was a change in the group composition, due to postponement requests. In the latter cases, the study coordinators determined the patients' examination order, with no input from the patients. After all examinations were completed, the post-examination interaction period ensued. In a one-on-one appointment, the conversation between the patient and physician transitioned to this phase, whereas in SMAs, the physician transitioned the conversation following the last patient examination by asking if anyone in the group had questions. In both arms,

patients were free to ask questions during any stage of the appointment. As in regular practice, the doctors both asked and invited more questions as needed, based on a patient's condition or behavior (e.g. compliance to medication).

Recall that in order to ensure identical scheduling across the trial arms, patients were scheduled to arrive in their assigned groups, for each appointment (see Figure 1). Since SMAs (which served 2 to 6 patients) lasted an average of 14.5 minutes longer than one-on-one appointments (which served a single patient), speaking instances attributable to a patient are incomparable across the two arms. Naturally, patients in groups assigned to one-on-one appointments had no chance to speak up during the appointments of the other patients in their group, nor during changeovers. To overcome this challenge, we divide each patient's speaking instances by the duration of time spent serving that patient's group. By analyzing speaking rates in this way (speaking instances per minute), we normalize time discrepancies across the two arms, facilitating a valid comparison. We use a similar procedure to compute the number of questions per minute and the number of non-question comments per minute contributed by each patient. Questions were identified in the verbatim transcripts as patient speaking instances that ended in a question mark. All other patient speaking instances were identified as non-question comments.

We also captured demographic data for each patient – age, gender, urban/rural residence and education level, as well as medical information, such as glaucoma type and the presence of relevant comorbidities. Summary statistics by trial arm for the demographic and medical information variables, which are provided in Online Appendix Table A3, indicate that random assignment resulted in balance across the treatment and control arms.

Guided by the prior literature on engagement – both in medical appointments and in more general settings – and our own direct observation in the field, we developed five measures of non-verbal engagement: attentiveness, positivity, head wobbling, eye contact, and leaning in. A transcriber who was blind to our hypotheses and research questions viewed each appointment video from start to finish to rate each patient, during each stage of an appointment (introduction, patient

examination and Q&A), on each of these five measures, using a 7-point Likert scale (see Figure 1). Likewise, the attentiveness and positivity of the doctors were also evaluated.

Following prior research, we defined *Attentiveness* as the extent to which the individual (patient or doctor) appeared to be energetic, dedicated, and focused (Seppälä et al. 2009, Bakker et al. 2008). *Positivity* measured the extent to which the individual seemed positive (i.e, satisfied, confident, hopeful) about the proceedings (Heikamp et al. 2014).

Head Wobbling, or 'talai taḷḷāṭṭam' in Tamil, which involves nodding the head from side to side along the coronal plane, is a common gesture among the people of Southern India, including Pondicherry and the adjacent Tamil Nadu region, where study patients came from. It can signal agreement, understanding, or appreciation, depending on the context (Brodsky 1987). Based on our direct observation of this gesture during trial appointments, we included head wobbling as a measure of the extent to which patients exhibited this gesture.

Eye Contact measured the extent of each patient's eye contact with the doctor (and with fellow patients, if in an SMA). Greater eye contact and gaze are known to signal cooperative settings (Bavelas et al. 2002) and facilitate enjoyment, engagement, and learning (Kleinke 1986). *Leaning in* measured the extent to which a patient was leaning forward. Leaning in has been associated with paying attention and responding quickly in an interaction, whereas leaning out has been associated with boredom (D'Mello and Graesser 2009). Finally, we measured *End-of-Appointment Happiness* at each appointment, using a 6-point Likert scale, based on our observation that there was variation on this dimension across patients, as they left their appointments.

As a validity check for these subjective measures of non-verbal engagement, we also asked our transcribers to rate speech, measured as the extent to which a patient spoke with the doctor, (or also with fellow patients, if in an SMA), on a 7-point Likert scale during each appointment stage. The correlation between patients' speech rating across all stages of an appointment and their speaking instances extracted from the verbatim transcripts is 0.438 ($p < 0.000$), suggesting consistency across our subjective and objective verbal measures, and increasing confidence in our measures of non-verbal engagement.

Table 2 provides a model-free preview of our results. On most measures, patients in SMAs exhibited significantly higher levels of verbal and non-verbal engagement than patients in one-on-one appointments. Patients randomly assigned to experience SMAs spoke 10.14% more times per minute than patients who experienced one-on-one appointments, asking 33.33% more questions per minute and making 8.63% more non-question comments per minute.

Table 2 Summary Statistics

	(1) Shared Medical Appointment (SMA)		(2) One-on-One Appointment (1-1)		(3) Differences	
	Mean	SD	Mean	SD	Difference	t-Value
Dependent Variables						
Speaking Instances Per Minute	1.63	0.84	1.48	0.68	0.15***	(5.79)
Questions Per Minute	0.12	0.16	0.09	0.12	0.03***	(7.09)
Non-question Comments Per Minute	1.51	0.76	1.39	0.64	0.11***	(4.94)
Attentiveness	5.83	0.51	5.49	0.80	0.34***	(15.34)
Positivity	4.71	0.89	4.42	0.97	0.29***	(9.39)
Head Wobbling	3.67	0.81	0.06	0.39	3.61***	(170.97)
Eye Contact	6.00	0.08	5.98	0.28	0.02***	(2.95)
Leaning In	3.93	0.88	5.79	0.60	-1.86***	(-74.53)
End-of-Appointment Happiness	4.47	0.70	4.20	0.84	0.27***	(10.41)

*** p<0.01, ** p<0.05, * p<0.1.

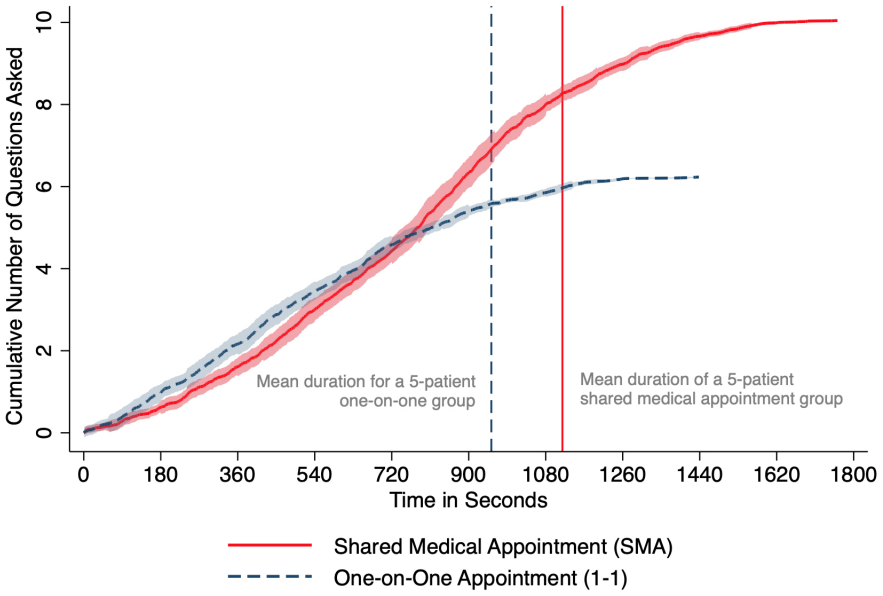
3. Empirical framework and results

3.1. Model Free Evidence

We present model free evidence on how questions arise over time in SMAs and one-on-one appointments. Figure 2 plots the average cumulative number of questions initiated during each second, for five-patient groups randomly assigned to each trial arm. Importantly, this figure facilitates comparability of the extent of information exchange in SMAs and one-on-one appointments by preserving the sequencing and interpatient dynamics that arose from random assignment at the group level (e.g., data from patients examined in the same group are presented together, the sequence of their examinations conducted in each group is preserved, changeover times between patients are represented as they occurred in each group, etc.). As such, the figure provides a model-free, head-to-head comparison of the amount of information exchanged in the two arms of the trial.

Consistent with Figure 1, Figure 2 shows that during our trial, on a "patients served per unit of time basis" basis, SMAs were less productive than one-on-one appointments. Serving five patients

Figure 2 Cumulative Number of Questions Asked by Groups of Five-Patients over Time



The figure above plots the average cumulative number of questions initiated during each second, for five-patient groups randomly assigned to either the shared medical appointments group or to the one-on-one appointments group. The blue dashed curve represents groups assigned to one-on-one appointments, whereas the red solid curve represents groups assigned to shared medical appointments. The shaded area around each curve depicts 95% confidence intervals. The blue vertical dashed line highlights the mean duration for a group of five consecutive one-on-one appointments, whereas the red vertical line highlights mean duration for a five-patient shared medical appointment.

through an SMA took longer on average (M=18.65 minutes, SD=4.04) than serving five patients through consecutive one-on-one appointments (M=15.88 minutes, SD=3.54; $p<0.01$). However, Figure 2 also highlights the reason for this difference: patients in SMAs generated more questions than patients in one-on-one appointments. Since the doctors' stopping rule for each appointment was that the interaction should continue until all questions were answered, SMAs lasted longer on average.

Figure 2 also shows that SMAs resulted in significantly more questions being asked than did one-on-one appointments. The blue curve shows that for groups assigned to one-on-one appointments, in which patients were seen serially, questions accumulated over time at a fairly constant rate in the first 720 seconds. This is intuitive, because the questions arose from five independent appointments, one occurring after the other. In contrast, the red curve shows that questions accumulated in SMAs at an increasing average rate for the first 900 seconds, with the most dramatic acceleration occurring late in the appointment, during the post-examination interaction. Importantly, the red

curve overtakes the blue curve after 765 seconds, after which point, on a "questions asked per unit of time" basis, SMAs were more productive than one-on-one appointments. Consistently, as can be seen in Table 2, patients in SMAs were observed to have more speaking instances per minute, ask more questions per minute and make more comments per minute than patients in one-on-one appointments. Indeed, if the stopping rule for SMAs had been changed so that they ended after 15.88 minutes (the mean duration for one-on-one appointments), SMAs would have been equivalently productive on a "patients served per unit of time basis," but more productive on a "questions asked per unit of time" basis. This is interesting, since it provides early evidence that rather than suppressing engagement, the SMAs in our trial had the effect of amplifying engagement.

Perhaps most importantly, however, Figure 2 dramatically understates the productivity advantages of SMAs on an "information transferred per unit of time" basis. Structurally, the batch process design of SMAs is far more efficient for transferring information than the serial process design of traditional one-on-one appointments. For example, during one-on-one appointments, patients only heard the answers to their own questions (M=1.26 questions, SD=1.67), whereas patients in SMAs heard the answers to every question asked by anyone in their group (M=10.25 questions, SD=7.56; $p<0.01$). Moreover, since patients in SMAs could hear each other's questions, it stands to reason they may have been inspired to ask questions they would not have thought to ask otherwise, and that there may have been fewer redundancies in the questions that they did ask, resulting in more unique information transferred during SMAs. Furthermore, consistent with the difference in non-question comments per minute presented in Table 2, patients in SMAs may have seized the opportunity to share their own experiences with each other, amplifying the number of sources of information in SMAs.

In summary, Figure 2 suggests that although SMAs in this trial were less productive than one-on-one appointments on a "patients served per unit of time" basis, they were more productive on a "questions asked per unit of time" basis, and by extension, on an "information transferred per unit of time" basis. Consistently, in the sections that follow, we will present detailed evidence that not

only did patients in SMAs exhibit higher levels of verbal and non-verbal engagement during our trial, they also learned more from their interactions during their appointments and subsequently became more compliant with their medications – a pattern of near-term results that is consistent with better long-term outcomes over time. We turn next to regression analyses to further examine our questions of interest.

3.2. Effect of SMAs on verbal patient engagement

A common concern expressed by those who are apprehensive about SMAs is that patients may find SMAs to be less confidential, and may be less inclined to ask questions or make comments than in one-on-one appointments.

To corroborate the model free evidence presented above, which indicates otherwise, we use the linear specification below to examine whether and to what extent patients' verbal engagement may differ between SMAs and one-on-one appointments.

$$\begin{aligned} Y_{it} \quad = \quad & \alpha_0 + \alpha_1 SMA_i + \alpha_2 Male_i + \alpha_3 Age_i + \alpha_4 Urban_i \\ & + \alpha_5 Educ_i + \alpha_6 AppointmentNumber_t + \alpha_7 Doctor_t + \upsilon_{it} \end{aligned} \tag{1}$$

where Y_{it} represents four different measures of verbal engagement: speaking instances per minute, questions per minute and non-question comments per minute. $Male$ is a dummy variable for biological sex. $Doctor$ indicates which doctor is involved. Age is the age of patient i at the first trial appointment. $Urban$ is an indicator for whether the patient lives in an urban (rather than rural) area. $Educ$ represents a vector of dummy variables for five different education levels: illiterate, primary school education, secondary school education, undergraduate education, and postgraduate education. $AppointmentNumber_t$ represents a vector of dummy variables that capture whether appointment t was patient i's second, third, or fourth trial appointment, relative to a first-appointment baseline. We note that t could differ for the patients attending a particular appointment, because patients sometimes skipped a trial appointment. As in all primary analyses in this paper, we clustered standard errors at the patient level to account for potential within-patient serial correlation in errors across appointments and heteroskedastic errors across patients.

One might expect that patients whose turn to be examined by the doctor comes later in an SMA may speak less and have fewer unanswered questions when their turn arises, as their questions may have been already asked by patients who were examined earlier. To investigate the contingent effects of patient sequence on the speaking behavior for patients randomly assigned to each trial arm, we use the modified linear specification below.

$$\begin{aligned} Y_{it} \quad = \quad & \delta_0 + \delta_1 SMAPatientSequence_{it} + \delta_2 Male_i + \delta_3 Age_i + \delta_4 Urban_i \\ & + \delta_5 Educ_i + \delta_6 Doctor_t + \delta_7 AppointmentNumber_t + \varsigma_{it} \end{aligned} \tag{2}$$

where, as before, Y_{it} represents speaking instances per minute, questions per minute, or non-question comments per minute.

Here, $SMAPatientSequence_{it}$ is a vector of five dummies that capture whether a patient in an SMA was examined first, second, third, fourth, fifth, or sixth by the doctor. The coefficients of these dummy variables represent, for example, the change in the average number of questions per minute asked by patients sequenced differently in SMAs relative to the base case of patients in one-on-one appointments.

Results are presented in Table 3, below. Column (1) indicates that patients randomly assigned to experience SMAs spoke significantly more often, on a per minute basis, than patients who experienced one-on-one appointments ($\hat{\alpha}$=0.145, p<0.01). Similarly, Columns (3) and (5) demonstrate that the number of questions asked per minute ($\hat{\alpha}$=0.033, p<0.01) and the number of non-question comments per minute ($\hat{\alpha}$=0.113, p<0.01) were significantly higher. Taken together, these results suggest that in aggregate, patients in shared medical appointments may be more verbally engaged than patients who experience one-on-one appointments.

Columns (2), (4), and (6) explore whether the sequence in which patients are seen moderates the relationship between shared delivery and these measures of verbal engagement. Column (2) demonstrates that patients in SMAs exhibited more speaking instances per minute than patients who experienced one-on-one appointments, when randomly assigned to one of the first four sequence positions. Relative to patients in one-on-one appointments, patients whose examinations were

Table 3 Impact of SMAs on Patients' Verbal Engagement

VARIABLES	(1) Speaking Instances Per Minute	(2) Speaking Instances Per Minute	(3) Questions Per Minute	(4) Questions Per Minute	(5) Non-question Comments Per Minute	(6) Non-question Comments Per Minute
Shared Medical Appointment (SMA)	0.145*** (0.031)		0.033*** (0.007)		0.113*** (0.028)	
First Patient		0.180*** (0.049)		0.025** (0.010)		0.156*** (0.045)
Second Patient		0.140*** (0.048)		0.024*** (0.009)		0.117*** (0.044)
Third Patient		0.236*** (0.048)		0.055*** (0.011)		0.182*** (0.043)
Fourth Patient		0.156*** (0.052)		0.046*** (0.010)		0.113** (0.047)
Fifth Patient		-0.024 (0.057)		0.013 (0.011)		-0.037 (0.051)
Sixth Patient		-0.267*** (0.064)		-0.026* (0.014)		-0.241*** (0.060)
Male	0.036 (0.033)	0.034 (0.033)	-0.008 (0.007)	-0.008 (0.007)	0.044 (0.029)	0.042 (0.029)
Age	-0.000 (0.002)	-0.000 (0.002)	0.001*** (0.000)	0.001*** (0.000)	-0.001 (0.001)	-0.001 (0.001)
Urban	0.054* (0.031)	0.055* (0.031)	0.022*** (0.006)	0.022*** (0.006)	0.034 (0.028)	0.034 (0.028)
Constant	1.599*** (0.112)	1.616*** (0.112)	0.057** (0.023)	0.057** (0.023)	1.545*** (0.101)	1.560*** (0.101)
Doctor Name FE	YES	YES	YES	YES	YES	YES
Education Level FE	YES	YES	YES	YES	YES	YES
Appointment Number FE	YES	YES	YES	YES	YES	YES
Observations	3,629	3,629	3,629	3,629	3,629	3,629
R-squared	0.055	0.063	0.043	0.050	0.052	0.059

Robust standard errors clustered at the patient level are in parentheses. All regressions are linear specifications.
*** p<0.01, ** p<0.05, * p<0.1

sequenced first ($\hat{\delta}$=0.180, p< 0.01), second ($\hat{\delta}$=0.140, p<0.01), third ($\hat{\delta}$=0.236, p<0.01), or fourth ($\hat{\delta}$=0.156, p<0.01) exhibited a higher number of speaking instances per minute than patients in one-on-one appointments. Patients sequenced fifth exhibited no significant difference in speaking instances per minute ($\hat{\delta}$=-0.024, p=0.674), whereas patients sequenced sixth in shared medical appointments spoke less ($\hat{\delta}$=-0.267, p<0.01) than patients in one-on-one appointments.

This pattern was generally similar across all measures of verbal engagement. Question asking and sharing of non-question comments were elevated among patients who experienced SMAs, and this effect was driven by those whose examinations were sequenced earlier in their appointments. This observed pattern is consistent with the idea that patients who, by virtue of their randomly-assigned examination sequence position are brought into the conversation sooner, may exhibit a higher degree of verbal engagement throughout the interaction.

In our related research based on the same trial, we observe no systematic effect of sequence on patient knowledge or compliance to medications.

3.3. Effect of SMAs on non-verbal patient engagement

To understand how SMAs impact non-verbal patient engagement, we analyzed the patient examination stage for each patient, which resulted in 2-6 observations per SMA. Since the individual patient examination phase followed the same protocol in both trial arms, it is sensible to directly compare patient engagement during this phase, where any differences observed must be attributable to the presence or absence of other patients.

As described above, our dependent measures of non-verbal engagement were each captured using a Likert scale and the resulting distributions of data violate the proportional-odds assumption that is required for Ordered Logit or Ordered Probit analysis. Consequently, we use Wilcoxon Rank-Sum tests to investigate the effects of shared medical appointments on non-verbal engagement (Beer et al. 2018, Rohatgi 1976, Greene and Hensher 2010).

Table 4 Patients' Non-verbal Engagement in SMAs versus One-on-One Appointments

	SMAs		One-on-One Appts.		z	p-value
	Sample Mean	**Sample Size**	**Sample Mean**	**Sample Size**		
Attentiveness	5.83	1,803	5.49	1,826	-16.797	0.000***
Positivity	4.71	1,803	4.42	1,826	-9.198	0.000***
Head Wobbling	3.67	1,803	0.06	1,826	-55.891	0.000***
Eye Contact	6.00	1,803	5.98	1,826	-3.004	0.003***
Leaning in	3.93	1,803	5.79	1,826	50.404	0.000***
End-of-Appointment Happiness	4.47	1,803	4.20	1,826	-10.095	0.000***

Note: z and p represent the "z score" of the Wilcoxon Rank-Sum (nonparametric) test and the corresponding probability of "z score" for the sum of the ranks within both the treatment or the control groups. *** p<0.01, ** p<0.05, * p<0.1.

The results, in Table 4 above, indicate that attentiveness, positivity, head wobbling, eye contact and end-of-appointment happiness are significantly higher in SMAs than in one-on-one appointments ($p<0.01$). Patients in SMAs were less likely to lean in ($p<0.01$). This observed pattern is

consistent with the idea that a patient may wish to lean back more during their examination in a group setting, so as not to monopolize the conversation, and to appear more willing to share in the presence of others.

We also examined the effect of sequence on all six non-verbal engagement variables – attentiveness, positivity, head wobbling, eye contact, leaning in and end-of-appointment happiness. We find that with only a couple of exceptions – attentiveness and positivity for the sixth patient, and eye contact for the first, fifth and sixth patients – patients in SMAs were more non-verbally engaged than patients in one-on-one appointments – independent of their examination order (See Online Appendix Table A4).

In complementary analyses presented in the Online Appendix, we examined doctors' verbal and nonverbal engagement. We find that doctors speak 4.60% more on average, but they ask 3.56% fewer questions and make 11.22% more non-question comments (see Online Appendix Table A5 and A6). Furthermore, Wilcoxon Rank-Sum tests indicate that the doctors in this trial were significantly less attentive and positive during the introduction and Q&A phases of SMAs, and no more nor less attentive, but more positive, during the examination phase of SMAs (see Online Appendix Table A7). These observed differences in physician affect are consistent with a phenomenon that psychologists call the *many minds* problem. Unlike in dyadic conversations, where turns are allocated effortlessly, managing group interactions is fraught with greater complexity, frustration, and even formality for the speaker, due to differences in the basic mechanics of conversation. Speakers facilitating group conversations face more minds to coordinate with and more minds that judge them (Cooney et al. 2020), factors which could undermine physician affect at the beginning of an SMA and at the onset of open discussion. We do not wish to overinterpret the implications of these results, since there were only two physicians in our trial – in fact we chose not to include physician outcomes as a primary analysis in our study protocol. However, it is worth noting that patients in this trial exhibited increased engagement in the presence of physicians who, at the outset, were observed to be less attentive and less positive.

4. Discussion

Every service provider must decide whether to serve clients individually or in batches. This design choice is so fundamental that it often goes unquestioned. Some services – such as law and accounting – are reflexively practiced through one-on-one delivery models, whereas others – like education and entertainment – are habitually offered through shared delivery models. Re-examining this fundamental aspect of service design may offer the potential for new service delivery innovation (Ramdas et al. 2012).

We conducted such an analysis in healthcare, a domain where one-on-one service delivery has, over time, been the near-universal norm. Although SMAs are known to improve efficiency and patient outcomes (Edelman et al. 2015), they have exhibited slow adoption (Ramdas and Darzi 2017). Doctors and patients alike fear that patients will find SMAs unappealing, due to concerns that a lack of privacy may diminish engagement and hinder efficacy. However, results from our large-scale, multi-stage, randomized controlled trial indicate that, in the context of glaucoma appointments, shared service delivery can significantly improve patients' verbal and non-verbal engagement.

On a minute-by-minute basis, we find that patients in SMAs ask 33.33% more questions, and make 8.63% more non-question comments. Interestingly, in a complementary analysis presented in the online appendix, we observe that doctors speak 4.60% more on average, but the composition of their participation changes. They make 11.22% more non-question comments and ask 3.56% fewer questions. Taken together, SMAs catalyze healthcare interactions that are more directed by the patients themselves, which may, counterintuitively, be better suited to addressing patients' uncertainties, worries and doubts than traditional one-on-one care. Moreover, if one views the transfer of medically-relevant information as the objective of a medical appointment, our results on verbal engagement indicate that SMAs are more productive than traditional one-on-one appointments.

Prior research has shown that when customers are anxious, reducing the barriers for them to ask questions can improve their confidence and satisfaction, inspiring greater trust (Shell and Buell

2020). In a similar light, future research can examine the extent to which SMAs may foster more trusting relationships among patients and providers, in both physical and virtual service delivery settings (Ramdas et al. 2020, Ramdas and Swaminathan 2021).

Our analysis also sheds light on the operational benefits that may arise from designing service models that enable customers to be more helpful in serving one another – leading to more efficacious service encounters in healthcare and beyond. During our trial, our physician partners observed patients in SMAs who became motivated to ask particular questions by hearing the questions and comments of other patients. Consistent with these efficacy benefits, we find that patients are observably more attentive and positive, make more direct eye contact, exhibit more outward signs of understanding, and emote greater levels of end-of-appointment happiness during SMAs than in one-on-one appointments. Moreover, information exchanged in SMAs benefits a broader audience by design. The design of SMAs enables patients to spend more time with the physician, albeit alongside other patients, offering providers more leverage than one-on-one delivery models. Relatedly, SMAs allow providers an efficient way to spend more time with each patient – over 600% more time in our study – a driver of quality and value in customer-intensive services like healthcare (Anand et al. 2011).

Crucially, our evidence suggests that the improved engagement dynamics that arise from shared care delivery may have more far-reaching implications for patients and providers alike. In other research based on the same trial (which has been shared with the DE and AE), we find that SMAs result in 4.59% higher levels of patient knowledge as measured by tests about glaucoma subject matter. Also, considering the serious consequences of poor adherence to medication (Sabaté and Sabaté 2003), we find that patients' noncompliance to medications is 3.03% after engaging in SMAs, compared to 5.05% after engaging in 1-1 appointments, a reduction of 40%.

Of course, it is important to consider our results in context. Our results emanate from a single trial of patients undergoing treatment for glaucoma – a non-contagious condition for which the treatment protocol is highly routinized, and for which there is no stigma attached to being afflicted.

Naturally, the need for privacy and confidentiality is an important factor in determining whether shared medical appointments are appropriate for a particular medical condition (Noffsinger 2009). In addition, if the information a clinician shares with one patient has little relevance for others who share the same medical condition, the value of a shared appointment is diminished. Nonetheless, there are many non-stigmatised medical conditions that have a dominant pattern of progression, for which batched delivery might bring benefits. Many chronic conditions fall into this category, as do temporary conditions like pregnancy.

Although SMAs are not the norm in healthcare, some providers have embraced their use. For example, the Cleveland Clinic has offered SMAs for over two decades. They are now offered in every medical specialty at this provider, and have been associated with improvements in productivity and health outcomes (Bronson and Maxwell 2004). Despite adoption by the Cleveland Clinic, Kaiser Permanente and a few other large providers, SMAs remain largely underexplored, likely due to the lack of rigorous scientific evidence on their benefits (Ramdas and Darzi 2017).

Future research should examine the boundary conditions of SMAs, by validating factors that make shared care delivery more or less appropriate. These factors can be examined from the perspective of patients, care providers, and payors. Relatedly, future research can delve into the contextual and cultural considerations that facilitate or hinder the efficacy of shared delivery. For example, future research could explore how group size affects engagement in shared care delivery models. Moreover, future work can examine whether SMAs may be more efficacious in collectivist cultures, and less efficacious in individualistic cultures.

Our findings that shared service delivery can lead to increased engagement in medical appointments – a context where doctor-patient confidentiality is highly prized – suggest that it may be worth considering their use in other service settings. The need for privacy, confidentiality and information relevance are important considerations for batch delivery in service contexts beyond medical appointments. For example, inspired in part by this research, a start-up called Seven Starling offers shared service delivery among doulas and groups of expectant mothers. Shared service delivery is

also relevant in contexts unrelated to health. LocalGlobe, a London-based venture-capital firm, uses a form of shared delivery to advise groups of startup CEOs, and similarly groups of startup CTOs and other function-based groups that can benefit from shared information. In the legal context, cases filed by different litigants may share the same legal principles. The Indian Supreme Court conducts joint hearings for some such cases, which are referred to as 'connected matters' (Bakshi et al. 2021).

The exploration of shared service delivery models in operations is relatively nascent. There has been recent interest in modelling shared delivery in more transactional services such as shared rides (Lobel and Martin 2020) or bus scheduling (Bertsimas et al. 2019). Future streams of research could investigate how shared delivery models might best be leveraged to optimize client experiences and operating efficiency in customer-intensive, high-value services. One question of interest is what group size is optimal. Naturally both the costs and the benefits of shared delivery will vary with group size. Research could also identify which other consultative service settings, where clients have the potential to benefit from the perspectives and experiences of one another, could be improved by offering shared service delivery – leading to more engaging interactions, and, perhaps, to better long-term outcomes as well.

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Online Appendix

Table A1 Distribution of Number of Patients in an SMA

Number of Patients	Percentage of SMAs
2	0.74%
3	17.44%
4	28.75%
5	43.00%
6	10.07%

Table A2 Sample Selection Criteria

Inclusion Criteria
1.The patient must be a primary glaucoma patient
2. The patient must not have had more than one surgery in one eye in the past
3. The patient must not have undergone a tube/ shunt surgery
4. The patient must not be monocular
5. The patient should not require surgical intervention in the near future
6. The patient must not wish to interact with a specific doctor
7. It is believed that the patient will interact effectively in a group setting
8. The patient should not be a part of any other existing trial
9. The patient should not have any vision threatening condition other than glaucoma

Our study inclusion criteria were developed in collaboration with Aravind. We note that although criterion 7 was specified prior to the trial to exclude patients for whom it was believed that they would not interact effectively in a group setting, no patient was excluded for this reason.

Table A3 Balance Statistics

	(1) Shared Medical Appointment (SMA)		(2) One-on-One Appointment (1-1)		(3) Differences	
	Mean	SD	Mean	SD	Difference	t-Value
Demographic Variables						
Age	61.95	9.16	62.08	9.54	-0.14	(-0.23)
Proportion of Male Patients	0.58	0.49	0.63	0.48	-0.05	(-1.56)
Urban	0.62	0.49	0.61	0.49	0.01	(0.33)
Education	2.55	1.17	2.58	1.24	-0.02	(-0.29)
Medical Variables:						
Proportion of Glaucoma Types						
Primary Open Angle Glaucoma (POAG)	0.73	0.44	0.75	0.43	-0.01	(-0.51)
Primary Angle Closure Disease (PACD)	0.23	0.42	0.22	0.41	0.01	(0.23)
Ocular Hypertension (OHT)	0.01	0.09	0.01	0.10	-0.00	(-0.33)
Pseudoexfoliation Glaucoma (PXF Glaucoma)	0.03	0.18	0.02	0.14	0.01	(1.19)
Proportion of Comorbidities						
Diabetes	0.37	0.48	0.38	0.49	-0.01	(-0.39)
Hypertension	0.35	0.48	0.38	0.48	-0.02	(-0.66)
Cardiac Disease	0.04	0.20	0.03	0.18	0.01	(0.68)
Asthma/Chronic Obstructive Pulmonary Disease (COPD)	0.02	0.15	0.02	0.13	0.01	(0.69)
Other Chronic Diseases	0.00	0.06	0.01	0.10	-0.01	(-1.14)
Observations	493		493		986	

There were no significant differences between the trial groups for any characteristic. The education variable is scaled as: Illiterate (1); Primary School Education (2); Secondary School Education (3); Undergraduate Education (4); Postgraduate Education (5). *** p<0.01, ** p<0.05, * p<0.1.

Table A4 Patients' Non-verbal Engagement by SMA Examination Sequence versus in One-on-One Appts.

	SMAs		One-on-One Appts.		z	p-value
	Sample Mean	Sample Size	Sample Mean	Sample Size		
Attentiveness						
Sequence 1 versus 1-1	5.84	406	5.49	1,826	-9.415	0.000***
Sequence 2 versus 1-1	5.79	405	5.49	1,826	-8.113	0.000***
Sequence 3 versus 1-1	5.83	404	5.49	1,826	-9.227	0.000***
Sequence 4 versus 1-1	5.89	332	5.49	1,826	-9.885	0.000***
Sequence 5 versus 1-1	5.83	215	5.49	1,826	-7.228	0.000***
Sequence 6 versus 1-1	5.63	41	5.49	1,826	-1.602	0.109
Positivity						
Sequence 1 versus 1-1	4.71	406	4.42	1,826	-5.763	0.000***
Sequence 2 versus 1-1	4.73	405	4.42	1,826	-5.960	0.000***
Sequence 3 versus 1-1	4.71	404	4.42	1,826	-5.400	0.000***
Sequence 4 versus 1-1	4.69	332	4.42	1,826	-4.655	0.000***
Sequence 5 versus 1-1	4.70	215	4.42	1,826	-4.225	0.000***
Sequence 6 versus 1-1	4.66	41	4.42	1,826	-1.497	0.135
Head Wobbling						
Sequence 1 versus 1-1	3.69	406	0.06	1,826	-44.584	0.000***
Sequence 2 versus 1-1	3.75	405	0.06	1,826	-44.592	0.000***
Sequence 3 versus 1-1	3.63	404	0.06	1,826	-44.516	0.000***
Sequence 4 versus 1-1	3.69	332	0.06	1,826	-43.353	0.000***
Sequence 5 versus 1-1	3.59	215	0.06	1,826	-40.834	0.000***
Sequence 6 versus 1-1	3.73	41	0.06	1,826	-29.101	0.000***
Eye Contact						
Sequence 1 versus 1-1	5.99	406	5.98	1,826	-0.382	0.702
Sequence 2 versus 1-1	5.99	405	5.98	1,826	-1.724	0.085*
Sequence 3 versus 1-1	5.99	404	5.98	1,826	-1.721	0.085*
Sequence 4 versus 1-1	6.00	332	5.98	1,826	-2.010	0.045**
Sequence 5 versus 1-1	6.00	215	5.98	1,826	-1.618	0.106
Sequence 6 versus 1-1	6.00	41	5.98	1,826	-0.707	0.480
Leaning in						
Sequence 1 versus 1-1	3.91	406	5.79	1,826	35.397	0.000***
Sequence 2 versus 1-1	3.98	405	5.79	1,826	34.897	0.000***
Sequence 3 versus 1-1	3.87	404	5.79	1,826	34.895	0.000***
Sequence 4 versus 1-1	3.90	332	5.79	1,826	32.785	0.000***
Sequence 5 versus 1-1	3.98	215	5.79	1,826	28.649	0.000***
Sequence 6 versus 1-1	3.78	41	5.79	1,826	14.771	0.000***
End-of-Appointment Happiness						
Sequence 1 versus 1-1	4.48	406	4.20	1,826	-6.252	0.000***
Sequence 2 versus 1-1	4.47	405	4.20	1,826	-6.065	0.000***
Sequence 3 versus 1-1	4.48	404	4.20	1,826	-5.951	0.000***
Sequence 4 versus 1-1	4.47	332	4.20	1,826	-5.315	0.000***
Sequence 5 versus 1-1	4.47	215	4.20	1,826	-4.655	0.000***
Sequence 6 versus 1-1	4.46	41	4.20	1,826	-1.821	0.069*

Note: z and p represent the "z score" of the Wilcoxon Rank-Sum (nonparametric) test and the corresponding probability of "z score" for the sum of the ranks within both the treatment and the control groups. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A5 Summary Statistics for Doctors' Verbal Engagement

	(1) Shared Medical Appointment (SMA)		(2) One-on-One Appointment (1-1)		(3) Differences	
	Mean	SD	Mean	SD	Difference	t-Value
Dependent Variables						
Doctor Speaking Instances Per Minute	7.27	1.61	6.95	1.64	0.32***	(2.81)
Doctor Questions Per Minute	2.81	0.63	2.91	0.76	-0.10**	(-2.04)
Doctor Non-question Comments Per Minute	4.56	1.43	4.10	1.30	0.45***	(4.69)

*** p<0.01, ** p<0.05, * p<0.1.

Table A6 Impact of SMAs on Doctors' Verbal Engagement

Variables	(1) Doctor Speaking Instances Per Minute	(2) Doctor Questions Per Minute	(3) Doctor Non-question Comments Per Minute
Shared Medical Appointment (SMA)	0.307***	-0.103**	0.441***
	(0.102)	(0.048)	(0.083)
Constant	8.395***	2.967***	5.571***
	(0.146)	(0.068)	(0.119)
Appointment Number FE	YES	YES	YES
Doctor FE	YES	YES	YES
Observations	809	809	809
R-squared	0.217	0.054	0.272

We note that these results are based on data from the two ophthalmologists who administered this trial, and hence we do not present these as primary analyses in the manuscript. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Above, we present analyses for doctors' verbal engagement during an appointment. Doctors speak more on a minute-by-minute basis, make more non-question comments which include answers and ask fewer questions in shared medical appointments than in one-on-one appointments.

Table A7 Doctors' Non-verbal Engagement in SMAs versus One-on-One Appointments

	SMAs		**One-on-One Appts.**		**z**	**p-value**
	Sample Mean	**Sample Size**	**Sample Mean**	**Sample Size**		
Attentiveness during Introduction	4.69	407	6.00	1,823	20.066	0.000***
Positivity during Introduction	4.61	407	5.18	1,823	-4.909	0.000***
Attentiveness during Patient Examination	6.00	1806	5.99	1,823	0.010	0.992
Positivity during Patient Examination	5.47	1806	5.17	1,823	-10.999	0.000***
Attentiveness during Q&A	5.14	405	6.00	1,823	16.102	0.000***
Positivity during Q&A	4.88	405	5.25	1,823	-2.417	0.016**

Note: z and p represent the "z score" of the Wilcoxon Rank-Sum (nonparametric) test and the corresponding probability of "z score" for the sum of the ranks within both the treatment and the control groups. *** p<0.01, ** p<0.05, * p<0.1.

Above, we present analyses for doctors' non-verbal engagement during different stages of an appointment. Doctors are significantly less attentive and less positive in shared medical appointments both at the start and at the end of the appointment, than in one-on-one appointments.