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Original Article

Impact of Rapid Transition to Telemedicine-Based Delivery on Allergy/Immunology Care During COVID-19

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What is already known about this topic? The use of telemedicine in allergy/immunology has been increasing. However, the effect of a rapid and wide-scale adoption of telemedicine as necessitated by the coronavirus disease 2019 pandemic on allergy/immunology patient access and outcomes remains largely unknown.

What does this article add to our knowledge? Video visits followed by in-person visits dedicated to diagnostic testing facilitated ongoing allergy/immunology care during the pandemic. However, there was decreased access for nonwhite, non−English-speaking, and Medicaid-insured patients and decreased completion of skin testing.

How does this study impact current management guidelines? Screening and appropriate triage of patients at high risk of being unable to complete video visits or return for follow-up testing is needed to ensure that telemedicine does not exacerbate existing health disparities in allergy/immunology care.

BACKGROUND: Coronavirus disease 2019 (COVID-19) necessitated wide-scale adoption of telemedicine (TM) and restriction of in-person care. The impacts on allergy/immunology (A/I) care delivery are still being studied.
OBJECTIVE: To describe the outcomes of rapid transition to TM-based care (video visit followed by in-person visits dedicated to diagnostic and therapeutic procedures when needed) at an academic A/I practice during COVID-19.
METHODS: Demographic data were compared for patients originally scheduled for in-person visits between March 10, 2020, and April 30, 2020, who completed a video visit instead between March 10, 2020, and June 30, 2020, and those who did not. Appointment completion, diagnoses, and drug allergy and skin testing completion were compared for visits between March 10, 2020, and June 30, 2020, and 1 year prior (March 10, 2019−June 30, 2019).
RESULTS: Sixty-nine percent (265 of 382) of patients originally scheduled between March 10, 2020, and April 30, 2020, were able to complete video visits. Patients who completed video visits were more likely to be white (52% vs 33%; $P < .001$), English-speaking (96% vs 89%; $P = .01$), and privately insured (70% vs 54%; $P = .004$). With TM-based care compared with in-person care, there were significant decreases in environmental and food skin testing completion rates (91% and 92% in 2019 vs 60% and 64% in 2020, respectively, $P < .001$). Drug allergy testing completed after internal referral remained low but comparable (51% in 2019 vs 52% in 2020). Transitioning nonprocedural visits to video allowed allergen immunotherapy and biologic injection visits to resume at a volume similar to pre-COVID. No COVID-19 infections resulted from in-clinic exposure.
CONCLUSIONS: Although transitioning to TM-based care allowed continued A/I care delivery, strategies are needed to achieve higher testing completion rates and ensure video visits do not exacerbate existing health disparities. © 2021 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2021;9:2672-9)

Key words: *Telehealth; Telemedicine; Video visit; COVID-19; Health disparity*

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has necessitated a rapid and wide-scale adoption of telemedicine (TM) to allow continued delivery of allergy/immunology (A/I) care.[1] The transition has provided insight into ways that video visits, as well as triage of in-person services and procedures, can be incorporated into A/I care delivery.

Before the COVID-19 pandemic, telehealth use had been increasing in the United States, with more than 15 million Americans receiving some form of remote medical care in 2015.[2] Multiple benefits of TM in A/I have been reported,[3] including expanded access to underserved areas,[4] reduced travel time and cost for patients,[5] and equivalent or even improved asthma outcomes,[6,7] including in school-based programs.[8] However,

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Abbreviations used
A/I- Allergy/immunology
AIT- Allergen immunotherapy
DA- Drug allergy
EHR- Electronic health record
ROS- Review of systems
ST- Skin testing
TM- Telemedicine
VS- Vital signs

TM uptake in A/I had been slow before the COVID-19 pandemic.[1,3] General challenges to effective implementation of TM include equitable access to care across patient populations and adequate reimbursement for TM services.[9] Challenges unique to A/I include ensuring the continued delivery of in-person skin testing (ST), medication and food challenges, allergen immunotherapy, and biologic injections.[10]

We report our clinical experience rapidly transitioning from a primarily in-person to a primarily video visit—based A/I care model in which patients receive face-to-face provider consultation over video visits and are triaged to receive in-person procedure visits on the basis of urgency of clinical need and the in-person visit availability adjusted to the COVID-19 surge level.

Similar TM-based care models have been recommended[11,12] and used by multiple practices,[13-15] and ongoing improvements are needed to ensure that patients can safely receive necessary A/I care. Investigating differences in visit and procedure volume as well as disparities in access to these services will help address 2 of the primary challenges in A/I: the need to incorporate in-person diagnostic and therapeutic procedures into care delivery as well as the unclear acceptability of TM across patient demographics (race/ethnicity, language, sex/gender, and socioeconomic status).[9] This in turn will inform future improvements to increase the effectiveness of TM in A/I care delivery.

METHODS

This was a single-center descriptive study of the processes and outcomes of converting from a primarily in-person to a primarily video visit—driven health care delivery model at a tertiary academic medical center. Real-time video visits are conducted over Zoom, and patient communication is conducted over the telephone as well as a secure patient portal with patient messaging capability (MyChart). The study was approved by the UCSF institutional review board (IRB# 20-30433).

Rapid implementation of TM-based care

In early March, ambulatory clinics at UCSF were asked to minimize in-person visits to reduce the spread of COVID-19. In the Allergy/Immunology clinic, a rapid transition to the TM-based care model was implemented between March 9, 2020, and March 10, 2020, to maintain COVID-19 precautions. Standard work for video visits was developed and implemented. Telephone scripts and MyChart messages were created to standardize prevideo visit communication with patients.

From March 10, 2020, onward, all new patient and follow-up visits were conducted via live video connection between the provider and the patient. Appointments originally scheduled as in-person visits were converted to video visits. Newly scheduled in-person and follow-up provider visits were all scheduled as video visits. Phone visits were conducted when there were technical issues that prevented video visits from being completed.

In the previous in-person model, medical assistants obtained vital signs (VS) and asked patients to fill out a review of systems (ROS) form before the provider visit. Completed ROS forms were given to the provider for review during the in-person visit. In the video visit model, medical assistants called patients 30 minutes before the video visit to ask for VS obtained from a home thermometer and blood pressure monitor, if available, and to review the ROS form with the patient. ROS forms completed over the phone were scanned into the electronic health record (EHR) for the provider to review during the video visit. In both models, providers completed ROS during the visit even if ROS forms were not completed beforehand.

In the in-person model, the clinic offered on-demand ST and dedicated drug allergy (DA) testing visits (see Figure E1 in this article's Online Repository at www.jaci-inpractice.org). In the TM-based model, if ST and/or DA testing was deemed necessary during a video visit, providers would place ST orders and DA testing referrals, and patients were subsequently scheduled for in-person procedure visits after they were resumed on May 11, 2020 (Table I; see Figure E2 in this article's Online Repository at www.jaci-inpractice.org). Patients were also offered the option of specific IgE testing if they were not comfortable coming to the allergy clinic for in-person testing. Spirometry at our institution is performed in the pulmonary clinics and pulmonary function laboratories and was held before being restarted with the addition of preprocedure COVID testing requirements.

On March 16, 2020, San Francisco and 5 other Bay Area counties directed all residents to stay at home except for essential services.[16] In addition to in-person ST and DA testing, allergen immunotherapy (AIT) injections were held at that time until they were resumed as shown in Table I. Schedule availability for ST, DA testing, AIT, and biologic injection visits was continuously adjusted on the basis of COVID-19 surge level.

The overarching goal of the new TM-based model was zero patient, staff, and provider COVID-19 infections occurring from in-clinic exposure and the continued delivery of high-quality, equitable care for patients with acute and chronic A/I conditions.

Data collection

Visit volumes and appointment outcomes were measured using reports generated from EHR data, as well as manual tracking of ST orders and DA referrals. Demographic information, MyChart activation status, encounter information including ROS and patient-reported VS entered by the medical assistants, orders and referrals, and primary *International Classification of Diseases, Tenth Revision* visit diagnoses were collected using reports generated from the EHR. Race and ethnicity were classified on the basis of categories defined in the EHR and selected by patients, who were allowed to choose multiple ethnicities or "other."

The following labels are used to denote specific time frames and patient cohorts throughout the article. "Initial conversion to TM-based care" is used to describe patients originally scheduled for in-person visits between March 10, 2020, and April 30, 2020, who were offered video visits instead. "In-person care" is used to describe patients scheduled for in-person visits between March 10, 2019, and June 30, 2019, and "TM-based care" is used to describe patients scheduled for video visits between March 10, 2020, and June 30, 2020.

Nine months after starting the new TM-based model, A/I providers were asked to rate their agreement/disagreement on a 3-point Likert

TABLE I. Service changes made because of COVID-19

Service	Action taken March 10, 2020	Date in-person procedures resumed
New patient visit	Convert in-person to video visit	Video visit ongoing
Follow-up patient visit	Convert in-person to video visit	Video visit ongoing
Environmental and food ST	Deferred	Resumed May 11, 2020
DA testing	Deferred unless urgently needed for antibiotic or chemotherapy initiation	Resumed May 11, 2020
SLIT Initiation	Video visit monitoring for first dose	Video visit monitoring for first dose ongoing
AIT Initiation	Suspended	Resumed August 1, 2020
AIT Maintenance	Suspended unless patient also on concurrent VIT or biologic injection	Resumed May 18, 2020
VIT Initiation	Suspended	Resumed August 1, 2020
VIT Maintenance	Recommended continuation	—
Biologic therapy	Continued with recommendation to convert to home administration and/or decrease dosing frequency if medically appropriate	—
IgG Replacement therapy	Continued with option to convert to home administration and/or from IV to SC formulation	—

IV, Intravenous; *SC*, subcutaneous; *SLIT*, sublingual immunotherapy; *VIT*, venom immunotherapy.

scale as to whether video visits alone and the TM-based model (video visits followed by in-person procedure visits) adequately provided care for 15 diagnosis categories: adverse drug reaction, anaphylaxis, eosinophilia, venom allergy, asthma, chronic obstructive lung disease, cough, vocal cord dysfunction, urticaria/angioedema, atopic/contact dermatitis, rhinoconjunctivitis and rhinosinusitis, adverse food reactions, eosinophilic esophagitis and gastrointestinal disease, immunodeficiency, and constitutional symptoms.

Statistical analysis

We compared continuous variables (eg, age and driving distance) using Wilcoxon rank-sum test and frequencies using Pearson χ^2 or Fisher exact test depending on sample size. Comparisons were not performed when categories occurred infrequently (<5%). Comparative analyses were performed in STATA/SE (version 16.1, StataCorp, College Station, Tex).

RESULTS

Between March 10, 2020, and June 30, 2020, 1008 video visits were scheduled and 967 were completed. To measure the feasibility of new workflows for pre-visit phone check-in, ROS and patient-reported VS obtained during pre-visit phone check-in were followed monthly (Table II). ROS completion during pre-visit check-in increased over time but did not reach greater than 50% at the end of the 4-month tracking period. Patient-reported height, weight, and pain level were successfully obtained for 90% to 92% of total video visits, whereas patient-reported blood pressure, pulse, and temperature were obtained for only 20% to 27% of total video visits despite pre-visit communication asking patients to obtain these measurements before their video visit. In comparison, a complete set of VS (blood pressure, pulse, temperature, height, weight, pain) was obtained for 97% of in-person visits completed between March 10, 2019, and June 30, 2019.

Impact on visit and allergy testing volumes

Initial conversion to TM-based care. There were 382 visits (250 new and 132 follow-up) originally scheduled between March 10, 2020, and April 30, 2020. Of these, 265 (69%) were completed as video visits, 7 (2%) as phone visits, and 4 (1%) as in-person visits (Table III). Twenty-eight percent (106 of 382) of patients originally scheduled for a visit were not seen, with 22% (82 of 382) who opted to cancel rather than convert to video visit and 6% (24 of 382) who converted to video but no-showed. Completion of video visits was more successful for follow-up visits compared with new patient visits (76.5% vs 65.6%; $P = .035$).

Similarly, the outcomes of rescheduling DA testing visits were reviewed. Of the 42 DA testing visits originally scheduled between March 10, 2020, and April 30, 2020, 98% (41 of 42) were deferred because of COVID-19. One visit was completed to provide results for perioperative planning. When in-person DA testing visits resumed on May 11, 2020, only 44% (17 of 39) of the originally scheduled patients opted to reschedule their appointment and only 31% (12 of 39) completed testing by December 31, 2020.

In-person versus TM-based care. With the new care delivery model, nonprocedural visit volumes remained comparable, and the no-show rate was 6.3% between March 10, 2020, and June 30, 2020, compared with 14.1% between March 10, 2019, and June 30, 2019 (Table IV). DA testing visit volumes also remained comparable, with an average of 3 DA testing visits per week in 2019 and 4 DA testing visits per week after resumption on May 11, 2020. The percentage of patients scheduling and completing DA testing after being referred by their primary A/I provider was similar (51% vs 52%) (Table IV). However, both the proportion of visits resulting in ST orders and the proportion of patients who subsequently completed ST fell with TM-based care, where patients had to schedule a separate in-person ST visit after their video visit (Table IV). This decrease was significant for environmental ST (91% vs 60%; $P < .001$) and food ST (92% vs 64%; $P < .001$) (Table IV).

Impact on patient care and access

The overall number of patients on AIT and venom immunotherapy increased and remained stable, respectively (Table V). Of the 130 patients whose AIT was suspended, 34 chose not to restart after AIT injection visits were resumed. Thus, although the overall number of patients on AIT increased by October 2020, 33% (48 of 146) were new patients who initiated AIT.

TABLE II. ROS and VS obtained during pre–video visit check-in

Check-in element obtained	Total (N = 967)	March 2020 (N = 150)	April 2020 (N = 283)	May 2020 (N = 271)	June 2020 (N = 263)
ROS	211 (22)	17 (11)	12 (4)	67 (25)	115 (44)
Blood pressure	195 (20)	41 (27)	70 (25)	49 (18)	35 (13)
Pulse	198 (20)	39 (26)	77 (27)	47 (17)	35 (13)
Temperature	262 (27)	58 (39)	92 (33)	67 (25)	45 (17)
Height	884 (91)	138 (92)	261 (92)	242 (89)	243 (92)
Weight	870 (90)	138 (92)	259 (92)	236 (87)	237 (90)
Pain score	889 (92)	139 (93)	261 (92)	245 (90)	244 (93)

Data are reported as n (%), the number and percentage of video visits with ROS or VS elements obtained during pre-visit phone check-in out of the total number (N) of video visits completed during each month between March 10, 2020, and June 30, 2020.

TABLE III. Outcomes of initial conversion to TM-based care

Visit outcome	Total (N = 382)	New (N = 250)	Follow-up (N = 132)
Telemedicine visits	272 (71.2)	166 (66.4)	106 (80.3)
Video	265 (69.4)	164 (65.6)	101 (76.5)
Phone	7 (1.8)	2 (0.8)	5 (3.8)
In-person visits*	4 (1.0)	1 (0.4)	3 (2.3)
No visit	106 (27.7)	83 (33.2)	23 (17.4)
Cancelled	82 (21.5)	61 (24.4)	21 (15.9)
No-show	24 (6.3)	22 (8.8)	2 (1.5)

Patients originally scheduled for in-person visits between March 10, 2020, and April 30, 2020, were given the option of keeping the same visit time or rescheduling to another time as a video visit between March 10, 2020, and June 30, 2020. Phone visits were conducted when there were technical issues that prevented video visits from being completed.

*Exceptions were made to provide in-person visits for 1 patient without internet access who required an interpreter, 2 patients who presented to clinic before the stay-at-home order, and 1 patient who had another in-person appointment at the same clinic building.

Patients continued biologic therapy (omalizumab, benralizumab, mepolizumab, reslizumab, dupilumab) with the adjustments shown in Table VI. Of the 54 patients on omalizumab, 36 patients continued at the same frequency ranging from every 2 to 12 weeks and 6 patients decreased frequency to every 6 to 12 weeks. Twelve attempted discontinuation between March 10, 2020, and June 30, 2020, but 2 had to restart because of recurrence of urticaria (1 restarted at home). There was 1 patient who started omalizumab in May 2020.

Six patients started house dust mite sublingual immunotherapy, with 5 patients receiving their first dose over video. These 5 patients were asked to show their treatment epinephrine autoinjector and then demonstrate correct administration steps with a trainer epinephrine autoinjector over video. They were monitored over video for 30 minutes after taking a house dust mite sublingual immunotherapy tablet. No adverse reactions occurred. One patient started house dust mite sublingual immunotherapy in-person because of language barrier.

Patient characteristics

Initial conversion to TM-based care. To evaluate whether the TM-based delivery model created gaps in access for specific patient populations, demographic characteristics were compared for patients who completed a video visit and those with no visit (Table VII). There were no significant differences in age, sex, the proportion of black or Hispanic/Latino patients, the proportion of patients with Medicare insurance, or driving distance to the clinic based on home address zip code. There were significantly more patients who identified as white in the group who successfully completed video visits (52% vs 33%; $P = .001$) and fewer who identified as Asian (14% vs 28%; $P = .001$). Patients who successfully completed video visits were more likely to have private insurance (70% vs 54%; $P = .004$) and less likely to have Medicaid insurance (8% vs 17%; $P = .03$). MyChart activation at time of data collection in 2020 was more common among those who completed a video visit (93% vs 70%; $P < .001$) (Table VII).

Demographic characteristics were also compared between patients whose provider ordered ST between March 10, 2020, and June 30, 2020, and subsequently did (n = 124) or did not (n = 83) complete ST. There were no significant differences in age, sex, race, ethnicity, language, or insurance (data not shown). However, patients who completed ST were more likely to have MyChart activated at time of data collection in 2020 (95% vs 85%; $P = .02$).

Patient-reported reasons for not scheduling or cancelling ST visits included pregnancy (n = 3), scheduling conflict (n = 1), preference for specific IgE testing (n = 3), and desire for visitor to accompany who could not be accommodated because of COVID-19 precautions (n = 2). Six patients needed to cancel their ST appointment because of being on antihistamines, of whom 4 patients rescheduled and completed ST, 1 patient rescheduled but then cancelled again, and 1 patient never rescheduled.

In-person versus TM-based care. Demographics were compared between 856 unique patients who completed 948 in-person nonprocedural visits from March 10, 2019 through June 30, 2019, and 910 unique patients who completed 967 video visits from March 10, 2020 through June 30, 2020. There were no significant differences in age, sex, driving distance, language, or insurance type. There was a significantly higher proportion of patients who self-reported their ethnicity as Hispanic/Latino (12% vs 9%; $P = .02$) or did not declare a specific ethnicity (16% vs 11%; $P = .007$) in 2019 than in 2020 (Table VII).

Demographic factors associated with noncompletion of in-person visits in 2019 were also assessed. Patients who cancelled or no-showed were more likely than those who completed in-person visits to be nonwhite (54% vs 44%; $P = .005$) and insured by Medicaid (21% vs 14%; $P = .014$). There were no

TABLE IV. Visit volume and procedures ordered for in-person (March 10, 2019-June 30, 2019) vs TM-based care (March 10, 2020-June 30, 2020)

Visit volume	In-person care	TM-based care
Nonprocedural visits	1138	1084
Total completed	978	1016
In-person	948	8
Video	30	967
Phone	0	41
No-show, n (%)	160 (14.1)	68 (6.3)
DA testing visits	48	31

Procedures	Scheduled/completed by December 31, 2019	Scheduled/completed by December 31, 2020
Internal DA referrals		
Ordered	65	62
Scheduled*	68% (44 of 65)	65% (40 of 62)
Completed*	51% (33 of 65)	52% (32 of 62)
Environmental ST		
Ordered	28% (271 of 978)	20% (207 of 1016)
Scheduled	NA	70% (145 of 207)
Completed	91% (246 of 271)	60% (125 of 207)
Food ST		
Ordered	10% (99 of 978)	6% (64 of 1016)
Scheduled	NA	75% (48 of 64)
Completed	92% (91 of 99)	64% (41 of 64)

NA, Not applicable.
*Total DA testing visit volume is higher than the number of DA testing visits scheduled/completed from internal referrals because the clinic has processes for direct external referrals to DA testing.

TABLE V. Changes to number of patients on SCIT

	February 2020	March-April 2020	May-July 2020	August-October 2020
AIT total	132	—	106	146
Initiation	—	—	—	48
Maintenance	111	2*	2	65
Build-up	21	—	104	81 (48 new starts)
Discontinued	—	—	26	8
VIT total	7	—	7	7
Maintenance	7	1	1	7
Build-up	—	—	6	0
Discontinued	—	—	0	0

SCIT, Subcutaneous immunotherapy; *VIT*, venom immunotherapy.
Number of patients receiving AIT and VIT before TM-based care (February 2020), during suspension of SCIT (March-April 2020), after resumption of AIT maintenance (May-July 2020), and after resumption of AIT/VIT initiation for new patients (August-October 2020).
*During suspension of SCIT, 2 patients continued to receive AIT maintenance doses at their omalizumab injection visits and 1 patient continued VIT.

significant differences found in age, sex, language preference, or driving distance.

Diagnoses

To evaluate whether there were differences in diagnoses seen in the TM-based delivery model, primary *International Classification of Diseases, Tenth Revision* diagnoses for the same periods in 2019 and 2020 were reviewed and found to be mostly comparable (Table VIII). A greater proportion of patients were seen for immunodeficiency in 2020 than in 2019 (18.1% vs 11.4%; $P < .001$). There was a nonsignificant trend toward fewer patients seen for rhinoconjunctivitis/rhinosinusitis (29.4% vs 32.6%; $P = .13$). The only condition that all 4 A/I providers agreed could be adequately treated by video visit only was urticaria/angioedema. However, all 4 providers agreed that the TM-based delivery model used (video visits followed by in-person procedure visits) was adequate for all major diagnoses seen in the clinic other than vocal cord dysfunction, immunodeficiency, and constitutional symptoms (Table VIII).

Safety

No patients, staff, or providers were infected with COVID-19 from in-clinic exposure during the study period. Two patients developed COVID-19 because of a known exposure outside the clinic.

DISCUSSION

The rapid adoption of video visits to maintain A/I care delivery during the COVID-19 pandemic has provided novel insight into specific benefits and barriers to effective implementation of TM.

Most patients in our clinic were able to convert to video visits at the start of the COVID-19 pandemic. This conversion was more successful for follow-up visits, supporting previous suggestions that TM is more suitable for follow-up visits.[17] The no-show rate was lower with TM-based care, indicating that for patients with digital access, video visits may be easier to complete. Indeed, recent studies have reported high acceptability among A/I patients who completed video visits, with convenience, decreased wait times, and decreased cost and travel time indicated as reasons for greater satisfaction.[14,18] In our clinic, A/I provider responses were favorable that most A/I diagnoses seen could adequately be managed with the new TM-based care model.

Compared with in-person visits completed 1 year earlier, TM-based care allowed a comparable number of patients to be seen for a similar range of visit diagnoses. After conversion to video visits, there were more visits for immunodeficiency diagnoses and a trend toward fewer visits for rhinoconjunctivitis and rhinosinusitis, possibly a reflection of increased concerns about infectious risk during COVID-19 and decreased focus on elective care. Despite the increased visits for immunodeficiency, not all A/I providers agreed that immunodeficiency diagnoses were adequately treated with the TM-based model. Further study is needed to investigate how TM-based care may affect clinical outcomes in immunodeficiency.

Another benefit of converting to the TM model was that it allowed AIT injections to resume at a volume comparable to prepandemic levels while maintaining COVID-19 precautions and limiting the number of people (patients, staff, providers) in clinic at any given time to fewer than 10. Even at the height of the pandemic, patients were able to continue biologic therapies with adjustments made to dose and location, including change to home administration where appropriate. One COVID infection occurred among our 87 patients who continued biologic therapy, in line with a review of previous studies that found that most atopic patients on biologic therapy (omalizumab, mepolizumab, benralizumab, reslizumab, dupilumab) did not

TABLE VI. Changes to biologic therapy made because of COVID-19

Location	Omalizumab (n = 54)	Benralizumab (n = 2)	Mepolizumab (n = 9)	Reslizumab (n = 1)	Dupilumab (n = 32)
Pre-COVID administration location					
Home	—	—	2	—	32
Clinic	52	2	7	—	—
Outside clinic	2				
IC	—	—	—	1	—
Post-COVID administration location					
Home	4	—	6	—	32
Clinic	36	2	2	—	—
Outside clinic	4	—	—	—	—
IC	—	—	—	1*	—
Discontinued	10		1	—	

IC, Infusion center.
Number of patients on biologic therapy and changes made to administration location are shown.
*Home administration arranged, but patient opted to return to IC administration given COVID-19 precautions in place at the IC.

TABLE VII. Patients' demographic characteristics during initial conversion to TM-based care and compared with in-person care

	Initial conversion to TM-based care			In-person vs TM-based care		
Characteristic	Completed video visit (n = 265)	No visit (n = 106)	*P*	March 10, 2019-June 30, 2019 (n = 856)	March 10, 2020-June 30, 2020 (n = 910)	*P*
Age (y), median (IQR)	43 (32-61)	41 (30-62)	.38	43 (32-59)	42 (32-59)	.62
Driving distance* (miles), median (IQR)	4.5 (3.0-20.3)	5.9 (3.6-22.5)	.13	5.4 (3.4-24.4)	5.8 (3.4-22.0)	.79
Female sex	181 (68.3)	72 (67.9)	1.00	572 (66.8)	606 (66.6)	.58
Race/ethnicity			.001			.008
White	138 (52.1)	35 (33.0)	.001	479 (56.0)	470 (51.6)	.07
Black	8 (3.0)	8 (7.5)	.09	39 (4.6)	31 (3.4)	.22
Asian	36 (13.6)	30 (28.3)	.001	159 (18.6)	147 (16.2)	.18
Hispanic/Latino	29 (10.9)	9 (8.5)	.57	73 (8.5)	108 (11.9)	.02
American Indian or Alaska Native	0 (0)	1 (0.9)		1 (0.1)	4 (0.4)	
Multiracial	4 (1.5)	1 (0.9)		9 (1.1)	8 (0.9)	
Other or declined or unknown	50 (18.9)	22 (20.8)	.67	96 (11.2)	142 (15.6)	.007
Primary language						
English	255 (96.2)	94 (88.7)	.01	817 (95.4)	876 (96.3)	.28
Insurance			.001			.30
Medicare†	56 (21.1)	25 (23.6)	.68	164 (19.2)	176 (19.3)	
Medicaid	22 (8.3)	18 (17.0)	.03	123 (14.5)	102 (11.2)	
Private	185 (69.8)	57 (53.8)	.004	563 (65.8)	623 (68.5)	
VA	0 (0)	3 (2.8)		1 (0.1)	2 (0.2)	
Worker's Compensation	1 (0.4)	2 (1.9)		1 (0.1)	5 (0.5)	
Other government‡	0 (0)	1 (0.9)		2 (0.2)	1 (0.1)	
Unknown	1 (0.4)	0 (0)		1 (0.1)	1 (0.1)	
MyChart activated	246 (92.8)	74 (69.8)	<.001	—	—	

IQR, Interquartile range; *VA*, Veterans Affairs.
Demographic characteristics of patients originally scheduled between March 10, 2020, and April 30, 2020, who did or did not successfully complete a video visit, and patients who completed in-person provider visits between March 10, 2019, and June 30, 2019, vs video visits between March 10, 2020, and June 30, 2020, are shown. Data reported as n (%) unless indicated.
*Distances >500 miles were excluded.
†Includes Medicare Advantage and MediGap.
‡GHPP (CA Genetically Handicapped Persons Program) and Department of Corrections.

develop COVID-19.[19] However, because there is no control group, conclusions cannot be made regarding COVID-19 infection risk in these patients.

Nevertheless, there are important barriers to implementation of TM in A/I care. This study provided insight into the discrepancies of TM acceptability across patient demographics. We found that patients who did not successfully transition to video visits were more likely to be nonwhite, insured by Medicaid, and have non-English language preference. Although the first 2 characteristics were also associated with noncompletion of in-person visits in our clinic previously, language preference was a new finding. Similar health disparities have been described in primary care populations[20] and are consistent with previous survey results of A/I patients that found that white patients

TABLE VIII. Primary *ICD-10* diagnoses seen during in-person vs TM-based care, and provider opinions on adequacy of TM-based care

Category	March 10, 2019-June 30, 2019 in-person visits (N = 948)	March 10, 2020-June 30, 2020 video visits (N = 967)	% agreement: "video visits are adequate to treat this condition"	% agreement: "video visits with RTC scheduling for procedures is adequate to treat this condition"
Adverse drug reaction	50 (5.3)	50 (5.2)	50	100
Anaphylaxis	21 (2.2)	18 (1.9)	50	100
Mast cell disease	5 (0.5)	4 (0.4)	—	—
Eosinophilia	9 (0.9)	3 (0.3)	50	100
Venom allergy	2 (0.2)	4 (0.4)	50	100
Pulmonary				
Asthma*	72 (7.6)	75 (7.8)	25	100
Chronic obstructive lung disease†	2 (0.2)	6 (0.6)	25	100
Cough	16 (1.7)	12 (1.2)	25	100
VCD	5 (0.5)	1 (0.1)	50	75
Other	8 (0.8)	14 (1.4)	—	—
Dermatology				
Urticaria/angioedema	145 (15.3)	136 (14.1)	100	100
Atopic/contact dermatitis	18 (1.9)	22 (2.3)	75	100
Other	62 (6.5)	52 (5.4)	—	—
Sinonasal/ocular				
Rhinoconjunctivitis/rhinosinusitis	309 (32.6)	284 (29.4)	50	100
Other	1 (0.1)	1 (0.1)	—	—
Gastrointestinal				
Adverse food reaction	59 (6.2)	50 (5.2)	50	100
EoE/EGID	11 (1.2)	5 (0.5)	50	100
Other	9 (0.9)	16 (1.7)	—	—
Immunodeficiency	108 (11.4)‡	175 (18.1)‡	75	75
Constitutional (fever, lymphadenopathy)	9 (0.9)	7 (0.7)	25	75
Other	27 (2.8)	32 (3.3)	—	—

EGID, Eosinophilic gastrointestinal disorder; *EoE*, eosinophilic esophagitis; *ICD-10*, *International Classification of Diseases, Tenth Revision*; *RTC*, return-to-clinic; *VCD*, vocal cord dysfunction.

Primary *ICD-10* diagnosis categories for patients who received care via in-person appointments between March 10, 2019, and June 30, 2019, and video visits between March 10, 2020, and June 30, 2020. For each diagnosis, we show the percentage of A/I providers (n = 4) who agreed that video visits alone or TM-based care model was adequate for A/I diagnosis categories.

*Includes allergic bronchopulmonary aspergillosis and aspirin-exacerbated respiratory disease.

†Includes bronchiectasis and chronic obstructive pulmonary disease.

‡$P < .001$.

expressed more comfort with TM encounters.[18] Interestingly, we did not find significant differences in age or driving distance in our study, although these are factors associated with TM adoption and perceived advantage of video visits. Our work supports the development of proactive strategies, such as assessment of digital access/literacy, to increase patient comfort level with TM and prevent exacerbation of existing disparities in care.

A major challenge to effective implementation of TM specific to A/I is the need for in-person diagnostic and therapeutic procedures.[9] Loss to follow-up occurred among patients who did not restart AIT and patients who did not reschedule DA testing after the pandemic. Both AIT injections and DA testing resumed at a comparable, if not increased, pace with new patients. In contrast, environmental and food ST completion rates dropped compared with pre-COVID. No significant demographic differences were found other than higher MyChart portal activation among patients who completed ST. MyChart is an important means of after-visit communication and may have helped decrease loss-to-follow-up after the video visit. Additional areas of study include how MyChart use (receipt of after-visit summary, online scheduling, types of messages) may have affected ST completion rates, and further eliciting patients' reasons for not completing ordered ST (concerns about COVID-19 safety or barriers to access unrelated to COVID-19).

There are limitations to our study. This was a single-center study at an academic medical center, and different patterns of TM use may exist at other practices. We used surrogate measures including completion rates of diagnostic and therapeutic procedures, which may have been affected by patients deferring care until after the pandemic. We surveyed a small number of A/I providers about their perception regarding the new TM model. Future studies are needed to investigate clinical outcomes for specific diagnoses, cost implications, and patient satisfaction.

CONCLUSIONS

Our findings highlight both benefits and challenges associated with using TM for A/I care delivery. Implementation of the American Academy of Allergy, Asthma & Immunology guidance allowed continued delivery of A/I care services with zero patient, staff, and provider COVID-19 infections resulting from in-clinic exposure. Benefits included ease of access for patients with

digital literacy, and easier preparation and allocation of clinic resources when all procedures are provided on a scheduled, rather than on-demand, basis. Further study is needed on interventions to decrease barriers to TM acceptance and feasibility in nonwhite, non—English-speaking populations. Our initial findings also suggest that MyChart activation is associated with increased ST completion in a TM-based model, and further study of interventions involving electronic communication may address a primary challenge of TM implementation in A/I. With continued refinement, the expansion of TM and changing regulations may facilitate A/I care delivery even after the COVID-19 pandemic.

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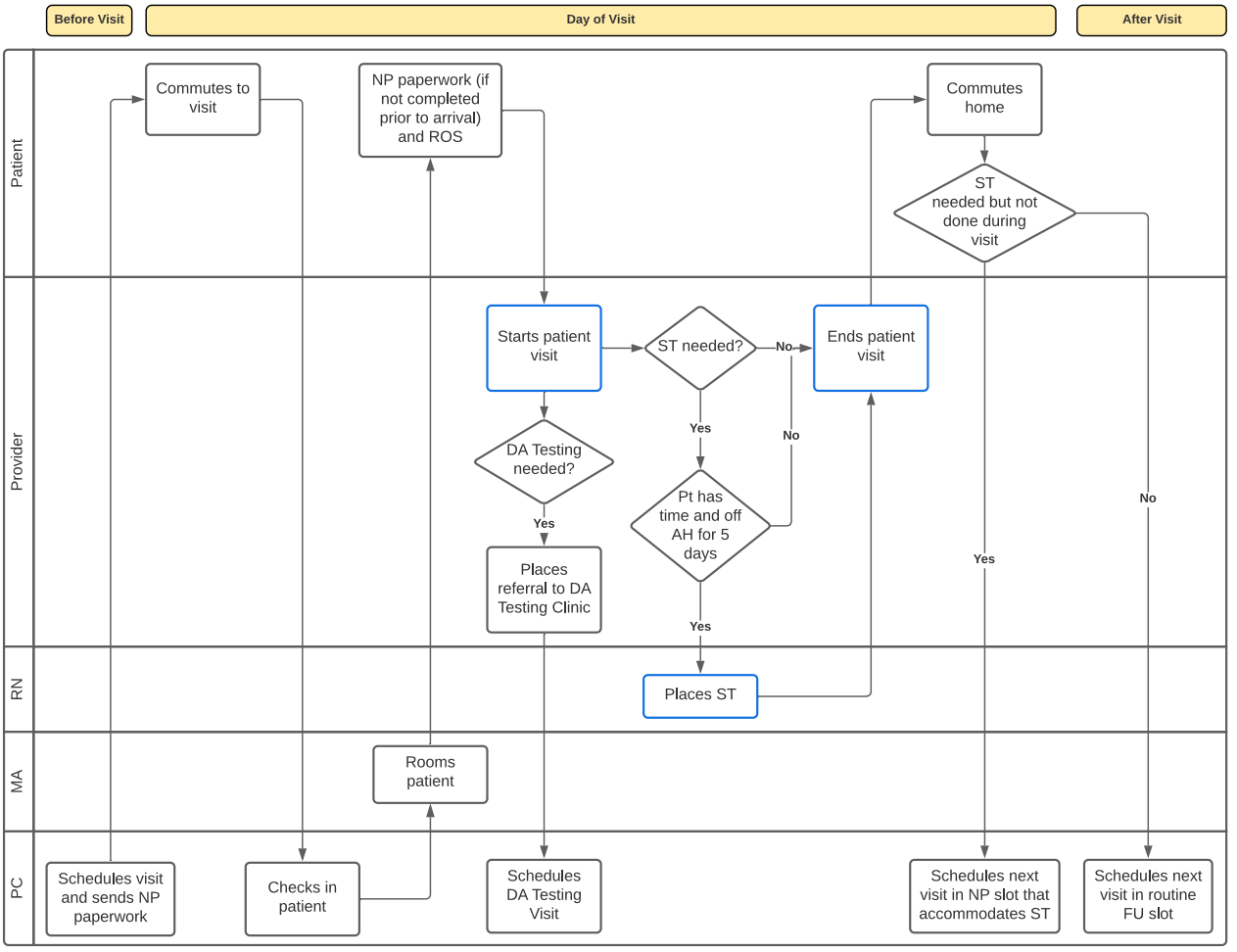

FIGURE E1. Swim lane diagram for in-person provider visits and procedures pre-COVID for patient, provider, and staff. *AH*, Antihistamine; *DA*, drug allergy; *FU*, follow-up; *MA,* medical assistant; *NP*, new patient; *PC*, patient coordinator; *RN*, registered nurse; *ROS*, review of systems; *ST*, skin testing.

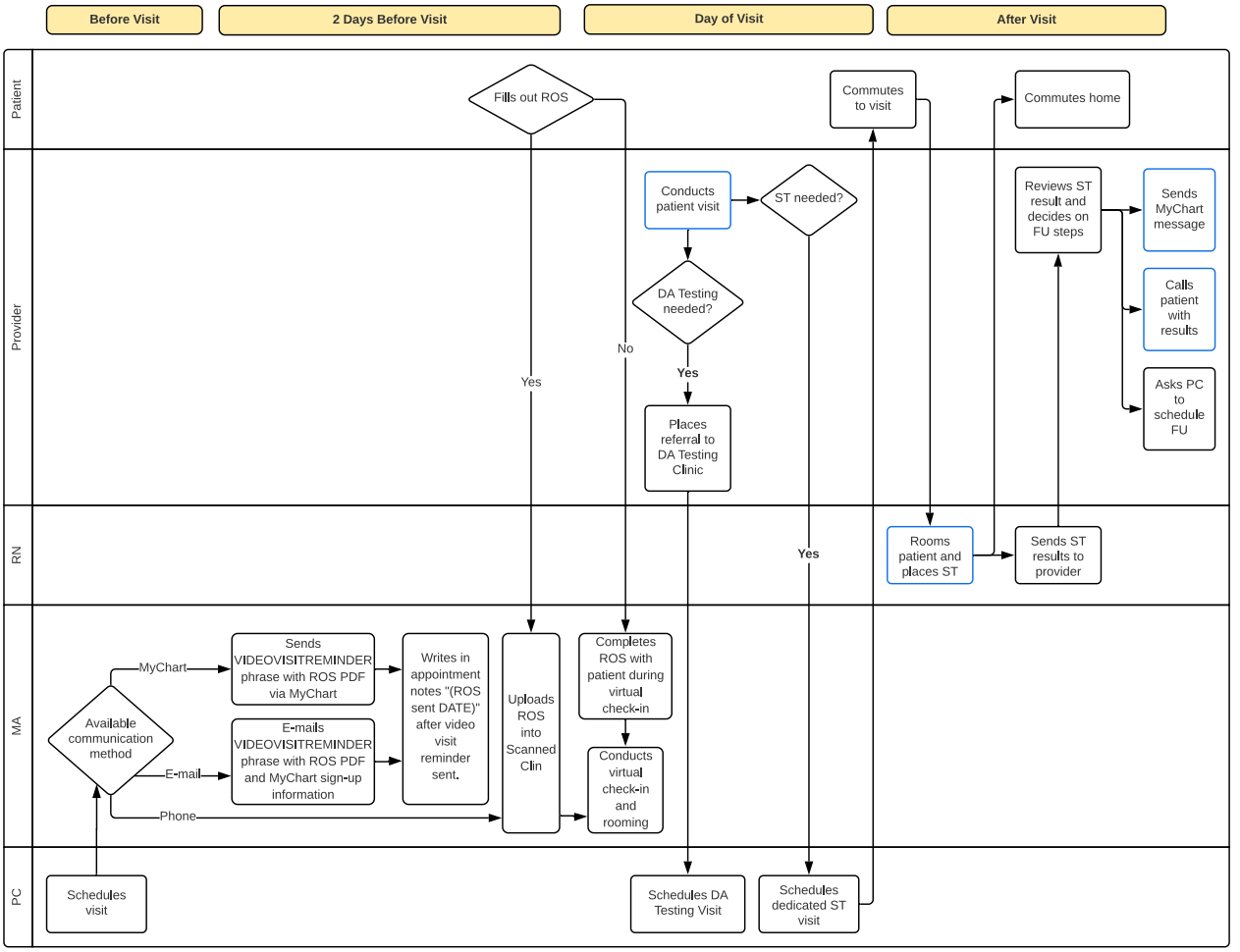

FIGURE E2. Swim lane diagram for video visits and in-person procedure visits post-COVID for patient, provider, and staff. *AH*, Antihistamine; *DA*, drug allergy; *FU*, follow-up; *MA,* medical assistant; *NP*, new patient; *PC*, patient coordinator; *RN*, registered nurse; *ROS*, review of systems; *ST*, skin testing.