Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

MAYO CLINIC

Increased Utilization of Virtual Visits and Electronic Approaches in Clinical Research During the COVID-19 Pandemic and Thereafter

Adil E. Bharucha, MBBS, MD; Cathi T. Rhodes, PMP; Christine M. Boos, BS; Daniel A. Keller, MS; Angela Dispenzieri, MD; and Ryan P. Oldenburg, MBA

Abstract

Objectives: To assess the impact of the COVID-19 pandemic on clinical research and the use of electronic approaches to mitigate this impact.

Methods: We compared the utilization of electronic consenting, remote visits, and remote monitoring by study monitors in all research studies conducted at Mayo Clinic sites (Arizona, Florida, and Minnesota) before and during the COVID-19 pandemic (ie, between May 1, 2019 and December 31, 2020). Participants are consented through a participant-tracking system linked to the electronic health record.

Results: Between May 2019, and December 2020, there were 130,800 new consents across every modality (electronic and paper) to participate in a non-trial (107,176 [82%]) or a clinical trial (23,624 [18%]). New consents declined from 5741 in February 2020 to 913 in April 2020 but increased to 11,864 in November 2020. The mean (standard deviation [SD]) proportion of electronic consent increased from 22 (2%) before to 45 (20%) during the pandemic (P=.001). Mean (SD) remote electronic consenting increased from 0.3 (0.5%) to 29 (21%) (P<.001). The mean (SD) number of patients with virtual visits increased from 3.5 (2.4%) to 172 (135%) (P=.003) per month between pre-COVID (July 2019 to February 2020) and post-COVID (March to December 2020) periods. Virtual visits used telemedicine (68%) or video (32%). Requests for remote monitor access to complete visits increased from 44 (17%) per month between May 2019 and February 2020 to 111 (74%) per month between March and December 2020 (P=.10).

Conclusion: After a sharp early decline, the enrollment of new participants and ongoing study visits recovered during the COVID-19 pandemic. This recovery was accompanied by the increased use of electronic tools.

 ■ Mayo Clin Proc. 2021;96(9):2332-2341

From the Division of Gastroenterology and Hepatology (A.E.B.), Enterprise Application Services (C.M.B., D.A.K.), Division of Hematology (A.D.), and Research Systems Operations (R.P.O.), Mayo Clinic, Rochester, MN; and Research Systems Operations (C.T.R.), Mayo Clinic, Scottsdale, AZ.

Clinical trials are necessary for evaluating and validating the efficacy and safety profile of drugs, devices, and other therapies. Most clinical trial-related activities entail in-person visits to evaluate participants and collect data. The need for in-person visits and other factors increase participant burden, discourage participation, and increase the duration and expense of conducting clinical trials.[1] Indeed, only a minority of patients (only about 8% of cancer patients nationwide) participate in clinical trials.[2]

During the COVID-19 pandemic, the need for social distancing, stay-at-home orders, the influx of COVID-19 infected patients, and the temporary cessation of clinical trials markedly hindered the conduct of clinical trials;[3] initiation of new trials, enrollment of new patients into trials, and assessments in existing patients all declined.[3-5] Initially, all but potentially life-saving treatment trials came to a standstill. On April 21, 2021, there were 1773 suspended clinical trials in ClinicalTrials.gov.[6] Many trials identified the COVID-19 pandemic as the primary

Mayo Clin Proc. ■ September 2021;96(9):2332-2341 ■ https://doi.org/10.1016/j.mayocp.2021.06.022
www.mayoclinicproceedings.org ■

reason for suspension. Based on early trends (ie, in April 2020), it was estimated that clinical-trial accrual for National Cancer Institute-funded studies alone will decrease by approximately 20% to 25% (or approximately 3500 patients) in 2020.[7] Gradually, activities resumed, prompted by the need to meet the ethical obligations to patients and the research process, although adapting to stay-at-home orders. Aligned with US Food and Drug Administration's regulations that allowed for "exceptions where necessary to eliminate apparent immediate hazards to the human subjects" (21 CFR 56.108[a][4]), when feasible, face-to-face visits were replaced with virtual visits.[8] In addition, the US Food and Drug Administration and other agencies provided guidance on measures to mitigate the risk while ensuring compliance with Good Clinical Practice.[8-10] This guidance, which addressed several issues (eg, informed consent, scheduling laboratory tests, and dispensing of study medications), provided the framework for safely continuing research. Institutions and study sponsors implemented several modifications to overcome these challenges.

At Mayo Clinic, before the pandemic, most research studies documented informed consent in person and via hard copy. Likewise, a majority of study visits were conducted in person. The aims of this study were to compare the use of electronic consent, virtual (telemedicine and video) visits, and virtual monitoring of trials by study monitors before and during the COVID-19 pandemic. Anecdotally, we recognize that several institutions have implemented similar measures. However, to our knowledge, there are no data comparing the use of these approaches before and since the pandemic.

METHODS

Environment

Clinical research is a basic tenet at Mayo Clinic. Research is conducted at main campuses in Rochester, Minnesota; Scottsdale and Phoenix, Arizona; and Jacksonville, Florida, and the Mayo Clinic Health System (in Minnesota, Wisconsin, and Iowa). All campuses use an integrated electronic health record (EHR) system (Epic, Verona, Wisconsin) for clinical practice and research. The Mayo Clinic Institutional Review Board (IRB) serves as the IRB of record for more than 95% of studies conducted at Mayo Clinic. For the remainder, an external IRB serves as the IRB of record.

Study Design

This study covered the period from March 1, 2019, to December 31, 2020. Several measures were implemented to mitigate the impact of the COVID-19 pandemic on clinical trials at Mayo Clinic. This study evaluated the effects and the resultant adaptations of the pandemic on the use of electronic consent, remote patient visits, and remote study monitor visits. These metrics were compared before and after the onset of the pandemic and implementation of COVID restrictions on the conduct of research at Mayo Clinic that were initially implemented on March 18, 2020: that is, before stay-at-home orders issued by the state government in Minnesota (March 27, 2020), Arizona (March 31, 2020), and Florida (April 3, 2020). To standardize data analysis across all 3 primary Mayo Clinic sites in Arizona, Florida, and Minnesota with varying stay-at-home orders, the same cutoff date (March 1, 2020) was used to compare pre− and post−COVID-19 data.

Informed Consent

Participants consent to participate in clinical research through the Participant Tracking System (PTrax) application (Mayo Clinic).[11] The consent form is automatically sent into the patient EHR. PTrax enables the study team members the ability to track the status of all participants in real time. The status identifies the stage of participation in the study life cycle. Arranged in chronologic order, the main statuses are enrolled (ie, after informed consent but before screening tests), accrued (ie, after screening tests have been completed), completed (ie, all study-related activities have been completed), and withdrawn. The accrued status is further categorized as active intervention (ie, after the

primary intervention has commenced) and long-term follow-up (ie, after study-related treatments and procedures are completed and patients are under follow-up).

All participants are provided with a hard copy of the consent form. Electronic consent requires a device (eg, tablet) and a conversation, either in the physical presence (ie, for on-site, in-person consent) or remotely (through video or telephone) between the person authorized to obtain consent or assent or Health Insurance Portability and Accountability Act (HIPAA) authorization from the potential participant. Neither the electronic consent nor the remote consent option is routinely granted when studies are approved by the IRB unless the study team requests permission from the IRB to use these options. Once approved, consent forms can be shared electronically with participants. The process is facilitated by integration between PTrax and DocuSign (DocuSign, San Francisco, CA). Participants can consent by clicking the link, reviewing each page, and marking their signatures.

The electronic option, which was introduced in December 2013, has evolved over time. Between December 2013, and August 2019, it was only used to consent participants on site. In August 2019, the IRB approved remote electronic consenting, which is accomplished with an e-mail link also facilitated by DocuSign. An enhancement introduced in April 2021, allows both the participant and the person obtaining consent to electronically sign the consent form. PTrax keeps track of whether participants were consented on site or remotely.

Data Analysis

PTrax was used to compute the number of new participants consented to every research study by hard copy and electronic means. During the COVID-19 pandemic, some participants were reconsented because of a change in study procedures because of the COVID-19 pandemic. Hence, only participants who were initially consented to a study were considered for this analysis. A few participants may participate in 2 or more studies. Therefore, the data are summarized as the number of consents rather than the number of participants. Since the remote electronic consent option was introduced in August 2019, we allowed 2 months (August and September 2019) for study teams to familiarize themselves with the external electronic-consent option. Hence, for this analysis, the pre-COVID period was between October 1, 2019, and February 28, 2020, and the postperiod was between March 1, 2020, and July 31, 2020.

Study Visits

When feasible, some in-person study-related visits were replaced with telephone or video visits after the pandemic began. During video visits, patients connect to their providers or care teams through a HIPAA-compliant video connection enabled through patient-specific online portal to medical services. The metrics for virtual visits were available and analyzed from July 2019, to December 2020. Pre- and during-COVID data were analyzed, respectively, between July 1, 2019, and February 28, 2020, and between March 1, 2020, and December 31, 2020.

Remote Study Monitor Visits

In April 2019, Mayo Clinic implemented the EpicCare Link application (Epic, Verona Wisconsin), which is compliant with 21 CFR Part 11 and allows study monitors to review the EHRs of study participants and verify compliance with the protocol. Study monitors also received access to other relevant documents such as source documentation that is housed in the EHR, via a secure file sharing solution, Microsoft SharePoint (Microsoft Corp, Redmond, WA). We analyzed the number of requests for remote study monitor visits over 10 months before (between May 1, 2019, and February 28, 2020) and 10 months after March 1, 2020 (between March 1, 2020, and December 31, 2020). When these data were analyzed, the number of study and patient records released in the Epic EHR for remote inspection were only available between September and December 2020 because earlier records had been purged from the system.

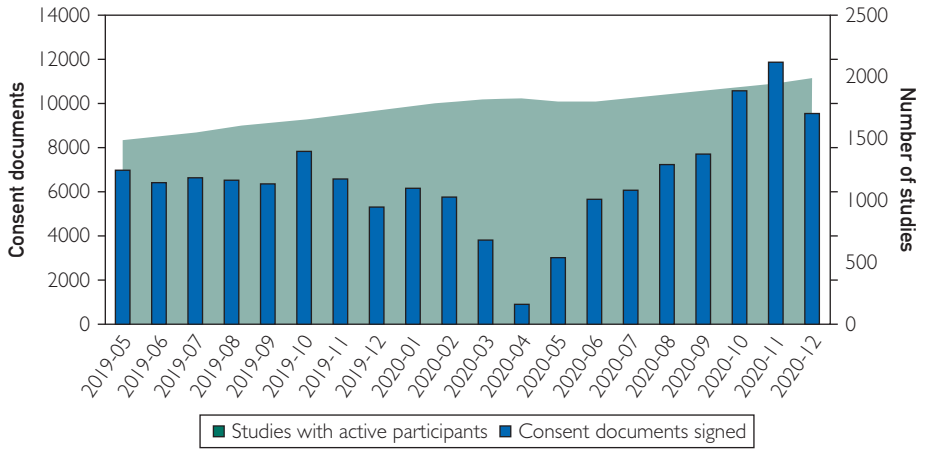

FIGURE 1. Temporal trends in the number of clinical research studies and enrollment of new participants at Mayo Clinic between May 2019, and December 2020.

Statistical Analysis

Data for electronic consent were summarized as the number of consented participants for all studies—non-trials and trials—and the proportions consented on site and remotely. The number of remote participant visits and requests for remote study monitor visits were also analyzed before and during the COVID-19 pandemic. For all variables, pre- vs post-COVID periods were analyzed by evaluating point estimates (eg, just before [February 2020] vs during the pandemic [December 2020]) and by comparing monthly averages with 2-sample *t*-tests. These variables were averaged every month and then across the pre- and during-COVID periods. Data are summarized as mean (SD). Statistical analysis was performed with Microsoft Excel.

RESULTS

At the beginning (May 2019) and end (December 2020) of this study period, there were 1492 and 1995 studies, respectively, with active participants on a research study. The number of studies with active participants increased from an average of 1642 (103) studies during the pre-COVID period (May 2019 to February 2020) to 1869 (68) studies per month ($P<.001$) during the COVID period (March to December 2020) (Figure 1). During this timeframe, 121,691 consent forms were signed for participation in a research study, 101,332 (83%) for a non-trial and 20,359 (17%) for a clinical trial (Figure 1).

Enrollment of New Participants: Overall and Electronic Consent

Between May 2019 and February 2020, the number of new consents signed for all studies, which includes clinical trials and non-trials, was relatively stable, averaging 5878±618 consents per month (Figure 1, Table 1). Coincident with the pandemic, the number of consents declined precipitously to 3483 and 719 per month in March and April 2020 (Table 1). Thereafter, these numbers steadily increased to 11,572 consents per month in November 2020.

Just before the pandemic (February 2020), 1300 of 5248 consents (25%) in all studies were completed electronically (Figure 2, Table 1). In December 2020, the corresponding proportion had increased to 6463 of 9446 consents (68%). Between the pre- (May 2019 to February 2020) and during-COVID periods (March to December 2020), the proportion of patients who were electronically consented increased from 22 (2)% to 45 (20)% ($P=.001$).

Electronic consent took place on site or remotely. In February 2020, 1214 (23%) and 86 (2%) of all 5248 consents were

TABLE 1. Temporal Trends in the Use of Electronic Consent in Research Studies Between 2019 and 2020

Month	All consents (No.)	Electronic consent for all studies[a]		Consents for nontrials[a]			Consents for trials[a]		
		Internal and external, No. (%)	External, No. (%)	Total (No.)	Total electronic, No. (%)	External electronic, No. (%)	Total (No.)	Total electronic, No. (%)	External electronic, No. (%)
May 2019	6319	1211 (19)	0 (0)	5089	1137 (22)	0 (0)	1230	74 (6)	0 (0)
June 2019	5939	1159 (20)	0 (0)	4799	1055 (22)	0 (0)	1140	104 (9)	0 (0)
July 2019	6046	1356 (22)	0 (0)	4909	1219 (25)	0 (0)	1137	137 (12)	0 (0)
August 2019	5832	1330 (23)	5 (0)	4775	1195 (25)	5 (0)	1057	135 (13)	0 (0)
September 2019	5854	1076 (18)	7 (0)	4626	947 (20)	7 (0)	1228	129 (11)	0 (0)
October 2019	7125	1547 (22)	10 (0)	5827	1332 (23)	10 (0)	1298	215 (17)	0 (0)
November 2019	6029	1274 (21)	14 (0)	4925	1113 (23)	14 (0)	1104	161 (15)	0 (0)
December 2019	4805	1212 (25)	23 (0)	3812	1025 (27)	22 (1)	993	187 (19)	0 (0)
January 2020	5586	1315 (24)	43 (1)	4520	1163 (26)	43 (1)	1066	152 (14)	0 (0)
February 2020	5248	1300 (25)	86 (2)	4081	1083 (27)	86 (2)	1167	217 (19)	0 (0)
March 2020	3483	912 (26)	170 (5)	2820	828 (29)	169 (6)	663	84 (13)	0 (0)
April 2020	791	113 (14)	80 (10)	624	102 (16)	72 (12)	167	11 (7)	6 (4)
May 2020	2748	567 (21)	176 (6)	2252	526 (23)	155 (7)	496	41 (8)	18 (4)
June 2020	5261	2134 (41)	1157 (22)	4369	1938 (44)	1078 (25)	892	196 (22)	75 (8)
July 2020	5538	2476 (45)	1421 (26)	4435	2154 (49)	1330 (30)	1103	322 (29)	70 (6)
August 2020	6720	3416 (51)	1526 (23)	5647	3100 (55)	1429 (25)	1073	316 (29)	75 (7)
September 2020	7212	3645 (51)	2432 (34)	5995	3194 (53)	2260 (38)	1217	451 (37)	103 (8)
October 2020	10,137	6205 (61)	4956 (49)	8746	5759 (66)	4821 (55)	1391	446 (32)	105 (8)
November 2020	11,572	8458 (73)	7338 (63)	10498	8036 (77)	7173 (68)	1074	422 (39)	129 (12)
December 2020	9446	6463 (68)	5297 (56)	8583	6210 (72)	5081 (59)	863	253 (29)	159 (18)

[a]All percentages are expressed as a proportion of the total new consents.

executed electronically on site and remotely, respectively (Figure 2, Table 1). In December 2020, the corresponding numbers were 1223 (13%) and 5297 (56%) of 9446 participants. Averaged over the entire pre- (May 2019 to February 2020) and post-COVID epochs (March to December 2020), the proportion of remote electronic consents increased from 0.3 (0.5%) to 29 (21%) ($P<.001$).

Comparison of On-Site vs Remote Electronic Consent in Clinical Trials and Non-Trials

Among participants in a non-trial, the proportion who were electronically consented increased from 24% in the pre-COVID period (October 2019 to February 2020) to 59% in the during-COVID period (March to December 2020) ($P=.001$). Among clinical trial participants, the proportion who were electronically consented nearly doubled from 13% in the pre- (October 2019 to February 2020) to 28% in the during-COVID period (March to December 2020) ($P=.01$). The use of electronic consent increased to a greater extent in non-trials (25 [19]%) than clinical trials (11 [9%]) ($P=.055$). The proportion of participants who were electronically consented remotely increased from 0.4 (0.7%) to 32 (22%) ($P=.0002$) in non-trials and from 0.0 to 8 (5%) in clinical trials ($P<.01$). For remote consent, the pre- and during-COVID periods were between October 2019 and February 2020 and March and July 2020, respectively.

Table 2 categorizes the overall and electronic consent into minimal- and greater than minimal- risk studies. Because Table 2 provides overall counts for the pre- and during-COVID periods, it does not depict

Mayo Clin Proc. ■ September 2021;96(9):2332-2341 ■ https://doi.org/10.1016/j.mayocp.2021.06.022
www.mayoclinicproceedings.org

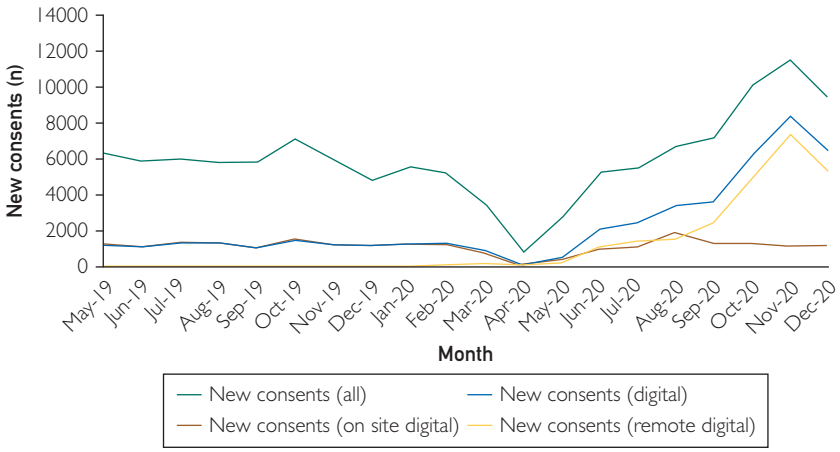

FIGURE 2. Temporal trends in electronic consenting for clinical research studies between May 2019, and December 2020. Digital consents include on-site and remote digital consents. The difference between all and digital new consents represents the number of hard-copy consents.

the initial drop in counts between February and April 2020. However, the statistical analysis compared the per-month counts across pre- and during-COVID periods, each lasting 10 months. Among minimal-risk trials and non-trials, the number of all consents declined, respectively, by 35% (P=.02) and 25% (P=.04). By contrast, among greater than minimal-risk trials, the number of all consents increased by 131% (P=.04). The number and proportion of electronic consents, expressed as a proportion of all consents, increased for all study types except for minimal-risk clinical trials ($P \leq .03$).

In December 2020, 2840 of 4428 (64%) of all consents for minimal risk and 3217 of 4115 (77%) of all consents for greater than minimal-risk non-trials were electronically recorded. However, in that same month, only 54 of 246 (22%) of all consents for minimal risk and 191 of 618 (33%) of all consents for greater than minimal-risk clinical trials were electronically recorded.

Virtual Visits by Study Participants

In July 2019, only 3 patients had virtual research visits. In April 2020, 541 patients had 1 or more virtual research visits; thereafter, the numbers declined to 194 in December 2020 (Figure 2). The number of patients who had virtual visits increased from 3.5±2.4 per month to 172±135 per month between pre-COVID (July 2019 to February 2020) and during-COVID (March to December 2020) epochs (P=.003). A majority (1252 patients or 68%) of these virtual visits used telemedicine capabilities; the remainder were video-enabled visits.

Remote Study Monitor Visits

Between May 2019 and February 2020, 44±17 study monitors requested access for remote monitoring visits (Figure 3). Between March and December 2020, this number increased to 111±74 study monitors per month (P=.10). The numbers varied considerably over time. For example, during the during-COVID period, the number of requests ranged from a low of 58 requests in December 2020 to a peak of 312 requests in August 2020.

DISCUSSION

Although the impact of COVID-19 on clinical trials and the measures taken to mitigate this have been discussed, the data are limited.[3,12] Among geographically diverse sites at a single academic medical center, the number of new patients who were consented to participate in research studies declined by approximately 80% between January and April 2020, which was when

TABLE 2. Comparison of All and Electronic Consents Before and During the COVID-19 Pandemic

	Consents[a]							
	Non-trial		Clinical trial		Non-trial		Clinical trial	
	Minimal risk	Greater than minimal risk	Minimal risk	Greater than minimal risk	Minimal risk	Greater than minimal risk	Minimal risk	Greater than minimal risk
Period	All, No.	All, No.	All, No.	All, No.	Electronic, No. (%)[b]	Electronic, No. (%)[b]	Electronic, No. (%)[b]	Electronic, No. (%)
Pre-COVID	35,532	11,831	3139	8283	8489 (24)	2025 (17)	498 (16)	988 (12)
During COVID	26,691	27,279	2054	6887	11,169 (42)	19,623 (72)	449 (22)	2049 (30)
Change (%)[c]	−25	131	−35	−17	32	869	−10	107
P value[d]	.04	.04	.02	.13	.03	<.0001	.09	.01

[a]Values are 10 month averages each pre- (May 2019 to February 2020) and during-COVID period (March to December 2020).
[b]Expressed as a proportion of all studies in this category.
[c][During−Before]/Before)*100.
[d]Two-sample *t*-test for actual values (all consents) or proportion of electronic (ie, electronic/overall) consents during pre- vs during COVID.

the stay-at-home order was initially implemented in Minnesota. By contrast with minimal-risk studies, which declined before vs during the COVID-19 periods, the number of consents for greater than minimal-risk trials increased over time, probably because the latter trials are more likely to provide therapeutic options for patients. In May 2020, the enrollment of new participants began to increase. By November 2020, the enrollment of new participants was double that in February 2020. This rebound was accompanied—and likely facilitated by—an increase in the proportion of new patients who were electronically consented to participate in the study.

The Mayo Clinic IRB introduced the on-site and remote electronic consent options in January December 2013 and August 2019, respectively. In February 2020, just before the pandemic, only 25% of all new participants were electronically consented to a research study; 24% and 1% of all participants were consented on site and remotely. By December 2020, 68% of all consents were electronically recorded, albeit more so

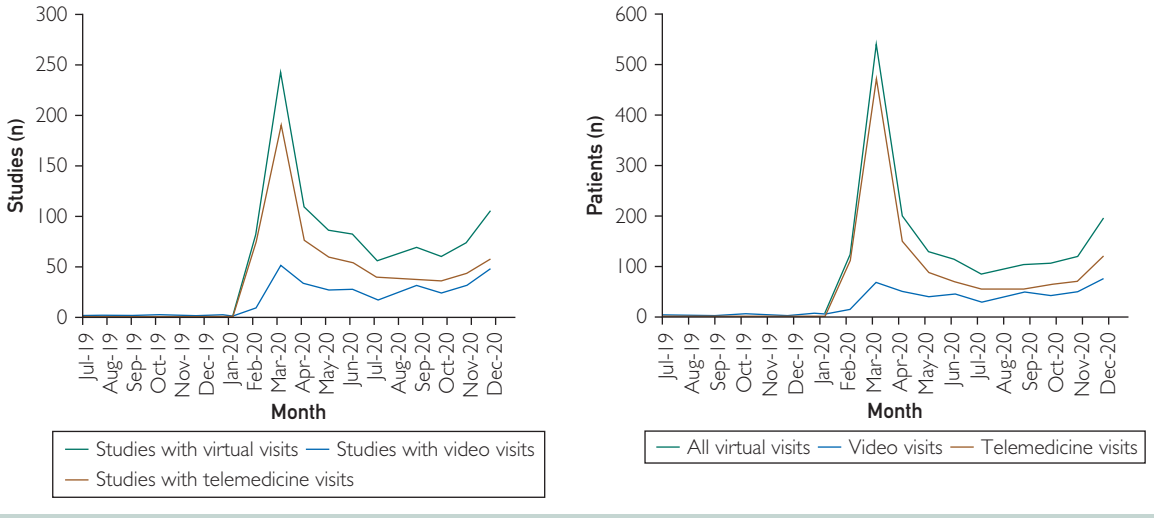

FIGURE 3. Temporal trends in studies (left panel) and participants (right panel) with virtual visits between July 2019 and December 2020. Virtual visits include video and telemedicine visits.

Mayo Clin Proc. ■ September 2021;96(9):2332-2341 ■ https://doi.org/10.1016/j.mayocp.2021.06.022
www.mayoclinicproceedings.org

in non-trials (72%) than in clinical trials (29%). There are 4 possible reasons for the greater use of the electronic consent option in non-trials than in clinical trials. First, compared with clinical trials, a greater proportion of non-trials are minimal-risk studies. The IRB permits nonvulnerable participants to be digitally consented to minimal risk studies by e-mail. A video or telemedicine conversation is optional. By contrast, video or telemedicine consent is generally necessary for greater than minimal-risk studies. For some complex greater than minimal-risk studies, an in-person discussion of the risks and benefits with a hard-copy consent form is preferable. Second, as the screening visit for greater than minimal-risk studies typically includes laboratory tests and other objective assessments, which are typically conducted on site, many studies may opt to consent such participants on site. Third, the person obtaining consent signature field was not uniform among participants. There were differences among sponsors and, depending on the circumstances, in which participants were consented. These differences complicated the workflow and logistics. The April 2021 enhancement to PTrax has simplified the signature process for the person obtaining consent. Finally, it is conceivable that some study teams are not familiar with the remote consent option or have not processed the IRB modifications necessary to enable electronic consent. Indeed, in December 2020, only 22% and 31% of all consents to minimal-risk and greater than minimal-risk clinical trials were electronically recorded. Hence, there is scope to expand the use of electronic consenting in studies. When appropriately implemented, the expansion of electronic consent is 1 of several solutions that might facilitate the inclusion of diverse populations—including those who reside far away from medical centers—in clinical trials.[13]

Aided by guidance from the US Food and Drug Administration and National Cancer Institute, study teams used virtual visits when safe and feasible to continue protocol-related activities and obviate deviations.[8-10] The number of virtual (telemedicine and video) visits increased from 11 per month in February, to a peak of 607 per month in April 2020. Concurrent with the relaxation in stay-at-home orders in Minnesota, Florida, and Arizona, the number of virtual visits declined to 142 per month in November 2020. Research video visits are conducted with a secure video system and must be scheduled on appointment calendars. Hence, the data for research video visits are accurate.

Some applications (eg, electronic consent and remote-study monitoring) that mitigated the impact of the COVID-19 pandemic were even available before the pandemic. The use of video visits, which were introduced 1 week after the pandemic began, rapidly increased thereafter, similar to the rapid growth in video visits for clinical care.[14] Concurrent with the relaxation in stay-at-home guidelines, the number of telemedicine, and—to a lesser extent—video visits has declined since the peak in April 2020, perhaps partly because study teams have strived to adhere to the original study protocol. However, these virtual visits have not reverted to pre—COVID-19 levels, probably because many participants prefer the convenience, reduced expense, and increased safety of virtual visits (ie, they avoid the risk of contracting COVID-19 while traveling to medical centers). By bringing clinical trials closer to patients, virtual visits may enhance access to clinical trials, especially for minority and underserved communities that have been disproportionately affected by the pandemic.[12,15] Even before the pandemic, the financial burden of participating in clinical trials was highest for patients living in low-income areas or enrolled in National Institutes of Health-sponsored trials and phase 1 studies.[16] These barriers discourage patients, particularly patients with low incomes, from participating in clinical trials.[17] Among such patients, equity programs that address the financial burden of trial participation improve participation.[17,18] Sustained over time, the remote electronic consent option and virtual visits will reduce the expense of participating in clinical trials and encourage participation,

especially among minority communities, in trials.[12]

One non-peer–reviewed publication suggested that on-site monitoring comprised 25% to 30% of the overall cost of conducting a clinical trial.[19] The number of study monitors who availed of the remote monitoring option increased during the pandemic. However, this change was not significant. At present, virtually all study monitor visits are conducted remotely. In addition to saving time and travel expenses for study monitors, remote monitoring also saves study staff the expense of chaperoning monitors during visits. In addition to remote monitoring, site-initiation visits are also largely conducted remotely.

In addition to these measures, study teams were provided detailed guidance on measures to facilitate work from home, conducting meetings with an online meeting platform, reporting requirements, scheduling video and telephone appointments, arranging for remote laboratory testing, and shipping medications to patients. Study protocol deviations were documented with an Epic script that had prefilled dropdown options in the patients' EHRs. These and other measures were widely disseminated among study teams. The IRB stipulated that research participants did not have to be reconsented during the pandemic unless the changes to the research are such that the original consent is no longer valid, which would require a modification to be submitted and approved by the IRB. Participants were notified of changes to the research via a letter or other form of communication (e-mail, telephone, virtual meeting). Investigators were not required to report these changes to the IRB unless the form of communication was a permanent change to the consent process.

Limitations

Because some participants—likely few—may have participated in more than 1 study, the counts are summarized as the number of consents rather than the number of participants. The number of telemedicine visits is likely an underestimate because not all such visits are scheduled on appointment calendars. Data for remote monitor visits were limited because the data were purged from the system before we undertook this review.

CONCLUSION

COVID-19 disrupted the status quo in clinical research and provided a catalyst to hasten the adoption of electronic and other solutions for clinical trials. Sustained in the long term, these solutions may foster participation in clinical trials and reduce participant burden, thereby increasing recruitment and retention to trials.

Abbreviations and Acronyms: **EHR,** electronic health record; **HIPAA,** Health Insurance Portability and Accountability Act; **IRB,** Mayo Clinic Institutional Review Board; **PTrax,** Participant Tracking System

Grant Support: This study was supported in part by National Institutes of Health's (NIH) Clinical and Translational Science Awards program Grant UL1TR000135. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

Potential Competing Interests: The authors report no competing interests.

Correspondence: Address to Adil E. Bharucha, MBBS, MD, Division of Gastroenterology and Hepatology, Mayo Clinic, 200 First Street SW, Rochester, MN 55905 (bharucha.adil@mayo.edu).

REFERENCES

1. Inan OT, Tenaerts P, Prindiville SA, et al. Digitizing clinical trials. *Npj Digit Med*. 2020;3:101.
2. Unger JM, Vaidya R, Hershman DL, Minasian LM, Fleury ME. Systematic review and meta-analysis of the magnitude of structural, clinical, and physician and patient barriers to cancer clinical trial participation. *J Natl Cancer Inst*. 2019;111(3):245-255.
3. Tolaney SM, Lydon CA, Li T, et al. The impact of COVID-19 on clinical trial execution at the Dana-Farber Cancer Institute. *J Natl Cancer Inst*. 2020. https://doi.org/10.1093/jnci/dja144. Online ahead of print.
4. Meagher KM, Cummins NW, Bharucha AE, Badley AD, Chlan LL, Wright RS. COVID-19 ethics and research. *Mayo Clin Proc*. 2020;95(6):1119-1123.
5. Rubio-San-Simón A, Andre N, Cefalo MG, et al. Impact of COVID-19 in paediatric early-phase cancer clinical trials in Europe: a report from the Innovative Therapies for Children with Cancer (ITCC) consortium. *Eur J Cancer*. 2020;141:82-91.
6. McDermott MM, Newman AB. Remote research and clinical trial integrity during and after the coronavirus pandemic. *JAMA*. 2021;325(19):1935-1936.
7. Doroshow JH. COVID-19 and cancer clinical trials. *Natl Cancer Inst*. 2020. https://doi.org/10.1093/jnci/djaa162. Online ahead of print.

8. Guidance Document. FDA guidance on conduct of clinical trials of medical products during the COVID-19 pandemic: guidance for industry, investigators, and institutional review boards. Rockville, MD: Food and Drug Administration; FDA-2020-D1106-0002.
9. NIH Staff. *Guidance for NIH-funded clinical trials and human subjects studies affected by COVID-19*. Bethesda, MD: National Institutes of Health; 2020.
10. Mooney M, McCaskill-Stevens W. *Additional guidance regarding alternative procedures for clinical trials supported by the NCI Cancer Therapy Evaluation Program (CTEP) and NCI Community Oncology Research Program (NCORP) affected by the spread of the novel coronavirus: memorandum*. Bethesda, MD: National Institutes of Health; 2020.
11. Watters JT, Pitzen JH, Sanders LJ, et al. Transforming the activation of clinical trials. *Clin Pharmacol Ther*. 2018;103(1):43-46.
12. Doroshow JH, Prindiville S, McCaskill-Stevens W, Mooney M, Loehrer PJ. COVID-19, social justice, and clinical cancer research. *J Natl Cancer Inst*. 2020. https://doi.org/10.1093/jnci/djaa162. Online ahead of print.
13. Lackland DT, Sims-Robinson C. Jones Buie JN, Voeks JH. Impact of COVID-19 on clinical research and inclusion of diverse populations. *Ethn Dis*. 2020;30(3):429-432.
14. Srinivasan M, Asch S, Vilendrer S, et al. Qualitative assessment of rapid system transformation to primary care video visits at an academic medical center. *Ann Intern Med*. 2020;173:527-535.
15. Bharucha AE, Wi CI, Srinivasan SG, et al. Participation of rural patients in clinical trials at a multisite academic medical center [published online July 12, 2021]. *J Clin Transl Sci*. http://doi.org/10.1017/cts.2021.813.
16. Bomo HT, Zhang L, Siegel A, Chang E, Ryan CJ. At what cost to clinical trial enrollment? A retrospective study of patient travel burden in cancer clinical crials. *Oncologist*. 2018;23(10):1242-1249.
17. Nipp RD, Lee H, Powell E, et al. Financial burden of cancer clinical trial participation and the impact of a cancer care equity program. *Oncologist*. 2016;21(4):467-474.
18. Nipp RD, Lee H, Gorton E, et al. Addressing the financial burden of cancer clinical trial participation: longitudinal effects of an equity intervention. *Oncologist*. 2019;24(8):1048-1055.
19. Branch E. Ways to lower costs of clinical trials and how CROs help. *Am Pharm Rev*. April 30, 2016.