ORIGINAL RESEARCH

Capacity of Primary Care to Deliver Telehealth in the United States

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Background: **Because of the Coronavirus disease 2019 (COVID 19) pandemic, many primary care practices have transitioned to telehealth visits to keep patients at home and decrease the transmission of the disease. Yet, little is known about the nationwide capacity for delivering primary care services via telehealth.**

Methods: **Using the 2016 National Ambulatory Medical Survey we estimated the number and proportion of reported visits and services that could be provided via telehealth. We also performed cross-tabulations to calculate the number and proportion of physicians providing telephone visits and e-mail/internet encounters.**

Results: **Of the total visits (nearly 400 million) to primary care physicians, 42% were amenable to telehealth and 73% of the total services rendered could be delivered through telehealth modalities. Of the primary care physicians, 44% provided telephone consults and 19% provided e-consults.**

Discussion: **This study underscores how and where primary care services could be delivered. It provides the first estimates of the capacity of primary care to provide telehealth services for COVID-19 related illness, and for several other acute and chronic medical conditions. It also highlights the fact that, as of 2016, most outpatient telehealth visits were done via telephone.**

Conclusions: **This study provides an estimate of the primary care capacity to deliver telehealth and can guide practices and payers as care delivery models change in a post-COVID 19 environment. (J Am Board Fam Med 2021;34:S48–S54.)**

Keywords: **Child Health, COVID-19, Family Medicine, Mental Health, Pandemics, Primary Care Physicians, Primary Health Care, Rural Health, Social Determinants of Health, Telemedicine**

Background

The Coronavirus disease 2019 (COVID 19) pandemic has rapidly and dramatically changed the delivery of primary care in the short term, shifting many visits from traditional face-to-face encounters to telehealth only encounters. This shift has many clinicians, payers and policy makers questioning the feasibility of telehealth long-term. Despite limited incorporation before March 2020, a number of essential primary care services may be delivered by the spectrum of telehealth modalities.[1] For instance, many studies indicate the feasibility of using telehealth modalities to provide examinations and screenings, mental and behavioral health counseling, health education, and preventive care.[2–6] Other studies suggest some primary care services

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Author contributions: All authors collectively and independently are responsible for the content and made substantial contributions to this paper. Specifically, Anuradha Jetty, Yalda Jabbarpour, and John Westfall designed and developed the study concept. Matthew Westfall conducted the literature review and helped in drafting the introduction section. Douglas Kamerow, John Westfall, Yalda Jabbarpour and Anuradha Jetty examined all the services available in the NAMCS data and classified them into telehealth amenable and non-telehealth amenable. Anuradha Jetty analyzed the data, interpreted results, and drafted the results and methods sections. Yalda Jabbarpour drafted the discussion section and concluding remarks. Stephen Petterson interpreted the results, reviewed the manuscript for intellectual and critical content. Douglas Kamerow and John Westfall reviewed the manuscript for intellectual and critical content.

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may be effectively provided via telehealth.[7–10] A limited number of studies indicate telehealth may be comparatively effective vs traditional face-to-face care and may also save money.[11–17]

The slow uptake of telehealth before the COVID-19 pandemic had many causes, from poor reimbursement to lack of infrastructure to burdensome rules and regulations to patient and provider preferences. The need to slow the spread of COVID-19 and keep patients at home has resulted in rapid changes in care delivery followed by significant changes in payment and regulation that have supported a rapid transition to telehealth.[18]

Despite current transitions to telehealth-based practice and evidence that many primary care services may be effectively delivered via telehealth, little is known about the nationwide capacity for delivering primary care services via telehealth. The purpose of this study was to analyze the primary care capacity to deliver services and clinical care through telehealth mechanisms. We explored this topic using the National Ambulatory Medical Survey 2016 (NAMCS) data.

We used 2 approaches to explore telehealth: (1) a broader definition of telehealth visit that includes patient-physician encounters that are telephone or internet/e-mail consults, and (2) a visit where provision of at least 1 service requires physical presence of a physician was defined as not amenable to telehealth. All those visits that did not require physical presence of a physician were termed as amenable to telehealth.

Study Data and Methods

Data Sources

NAMCS is an annual survey administered by the Division of Health Statistics, National Center for Health Statistics. Data are collected using a national multistage probability sample of visits to non-federally employed physicians. The sampling frame for the NAMCS 2016 was derived from databases maintained by the American Medical Association (AMA) or the American Osteopathic Association (AOA) though membership in these organizations is not required for listing. The patient-physician encounter in an office-based setting is the primary sampling unit. Each physician is assigned a 1-week reporting period; the physician reports data on all the ambulatory care visits that may have occurred during that period. We used the 2016 NAMCS data to explore the telehealth capacity of primary care physicians. The response rate was 39.3% for physicians who provided data for at least 1 encounter.

The main data collection includes computer-assisted automated tools accessible through the Web portal or a laptop computer provided by the data collection staff. Two forms, the Patient Record Form and the Physician Induction Interview Form, are used to record the data. The Physician Induction Interview Form is used to collect information about the characteristics of the physician practices. The Patient Record Forms are used to measure data on socio-demographic characteristics, expected source of payment, the reason for visit, diagnosis for the current visit, continuity of care information, existing chronic conditions, diagnostic and screening tests ordered or provided in the office, procedures, medication therapy, types of providers seen, and provision of preventive health education during the targeted study period. Either the physician or their staff report the data or the Census field representative abstracts the data from the medical charts. The survey methodology including sampling design, data instruments, and data collection procedures are described in detail elsewhere.[19] All the services provided by the physician were divided into categories: (1) examinations/screening, (2) lab tests, (3) imaging, (4) procedures, (5) treatment, and (6) health education/counseling (complete list of services found at https://www.cdc.gov/nchs/data/ahcd/2016_namcs_prf_sample_card.pdf).[20]

Methods

We used 2 approaches to quantify the telehealth capacity of the primary care physicians: (1) examine distribution of e-consults and telephone consults and (2) all the encounters amenable to telehealth in a primary care office-based setting. Primary care specialty included general practice, family practice, internal medicine, and pediatrics.

We used the following question to calculate the proportion of physicians providing the following types of visits *"During the last typical week of practice, did you make encounters of the following types with patients: (1) telephone consults, (2) internet/e-mail encounters with patients, (3) nursing home visits, (4) home visits, and (5) hospital visits. Each of these options was recorded as '1' if the physician answered "yes," '0' and if they answered "no." Blank, unknown, and refused answers were set to missing.

Table 1. Distribution of Patient-Physician Encounters by Patient Characteristics and Telehealth Amenability

Characteristics		n	Telehealth Amenable Yes (Weighted %)	Telehealth Amenable No (Weighted %)	*P* Value
Age, y	0 to 17	1699	39.1	61.9	.02
	18 to 34	1739	42.0	58.0	
	35 to 44	1154	37.1	62.9	
	45 to 54	1628	33.8	66.2	
	55 to 64	2140	33.2	66.8	
	65p	4320	29.8	71.2	
Sex	Male	5567	35.3	64.7	.91
	Female	7113	35.1	64.9	
Race/ethnicity	White, Non-Hispanic	9231	36.7	63.3	.24
	Black, Non-Hispanic	1142	29.8	61.2	
	Other, Non-Hispanic	603	30.4	69.6	
	Hispanic	1704	33.8	66.2	
Insurance coverage	Private	10,553	35.1	64.9	.56
	Public	5233	33.0	67.0	
Chronic conditions	Asthma	782	30.5	69.5	.064
	Diabetes	887	31.9	68.1	.30
	Hypertension	3567	31.0	69.0	.021
	Hyperlipidemia	2004	35.9	64.1	.77
	Depression	1100	44.9	55.1	<.001
	Coronary Artery Disease	804	24.7	75.3	.010
	Number of Chronic Conditions	2303	2.1	2.4	<.001

Source: Author's analysis of the 2016 National Survey of Ambulatory Medical Care Survey weighted by patient weight (n = 12,680, equivalent to 850,695,621 patient-physician encounters).

To determine which services were amenable to delivery through telehealth, we first conducted an environmental scan of peer-reviewed telehealth literature and created a list of services amenable to telehealth. This list was then shared with a group of primary care physicians who either had use telehealth in the past or were currently using video-enabled or telephone only telehealth during the COVID pandemic. (See Appendix Table 1 & Table 2) Each of the services was recoded as a dichotomous measure (0/1). The patient-physician encounters where the physical presence of the physician was required to conduct at least 1 service were deemed as not amenable to telehealth and were coded as '0'. All the encounters where the physical presence of the physician was not required were considered amenable to telehealth and coded as '1'.

Table 2. Proportion of Patient-Physician Encounters Amenable to Telehealth

Telehealth Amenable Encounters	All Physicians		Primary Care Physicians	
	n	%	n	%
Yes	299,347,453	35	165,333,984	42
No	551,348,168	65	228,884,017	58
Total	850,695,621	100	394,218,001	100

Source: Author's Analysis of the 2016 National Survey of Ambulatory Medical Care Survey weighted by patient weight.
*Telehealth amenable encounter was coded as '0' when at least one of the services required physical presence of the physician and '1' if physical presence was not required.

We calculated the total number and percentage of physicians and visits in the study sample. We used univariate statistics to examine the number and proportion of physicians who provided e-consults and telephone consults. We also calculated the number and proportion of patient-physician encounters that were amenable to telehealth. Distribution of patient socio-demographic characteristics by telehealth capacity was also examined. We also looked at the distribution of practice characteristics of the physician sample. All data were weighted to obtain nationally representative estimates of the patient-physician interactions and physicians using patient and physician

weights. We used survey variables to account for the complex NAMCS survey designs.

The current study was approved by the Institution Review Board, American Academy of Family Medicine.

Results

There were 677 physicians (weighted n = 330,605) in the 2016 and 13,615 patient-physician encounters (weighted n = 883,725,178) in the NAMCS 2016. Of the total physicians 41% were primary care and 59% subspecialists. Greater proportion of physician practices were in MSA than non-MSA (unweighted 93.4% vs 6.6%), were owned by physicians or physician group (unweighted 74.7%) and located in the South (40.2%) (Appendix Table 3).

Nearly 30% of visits in patients 65 years and older were telehealth amenable compared with 42% in patients aged 18 to 34 years. (Table 1) A third of the patient-physician encounters related to hypertension (31% vs 69.0%, $P < .021$) and almost a quarter of the visits to coronary artery disease (24.7% vs 75.3%, $P < .010$) were amenable to telehealth. About 45% of the visits for depression were amenable to telehealth (44.9% vs 55.1%, $P < .001$).

Among all physicians in the 2016 analysis sample, 44% reported making a telehealth encounter, 16% made e-consults and 42% telephone consults. (Figure 1) Of the primary care physicians in the 2016 sample, 47% made any telehealth encounter, 19% provided e-consults, and 44% provided telephone consults. In total, of the 850 million patient-physician office-based encounters (all specialties), 35% were amenable to telehealth using the guidelines outlined above. Among all the patient-physician interactions in ambulatory primary care settings (n = 394 million), 42% were amenable to telehealth. (Table 2). Of all the office-based visits, 70% of services rendered at the visit were telehealth amenable (Table 3), as were 73% of services provided by primary care physicians.

Table 3. Proportion of Services Amenable to Telehealth

	All Office-Based Visits		Primary Care Visits	
Telehealth Amenable Services	n	%	n	%
Yes	208,347,001	70	120,922,770	73
No	91,000,452	30	44,411,214	27
Total	299,347,453		165,333,984	

Source: Author's analysis of the 2016 National Survey of Ambulatory Medical Care Survey weighted by patient weight.
*Telehealth amenable services means all services rendered at a given visit can be delivered via telehealth.

Discussion

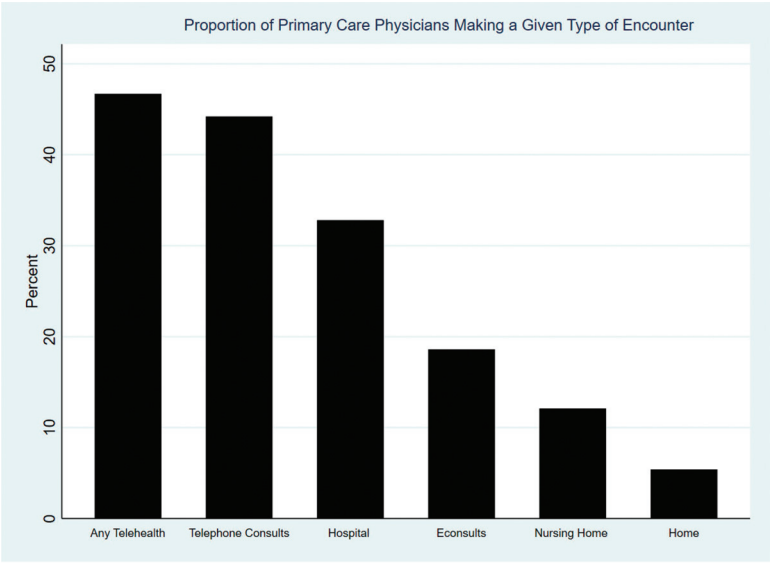
This study estimates the capacity of primary care to provide telehealth services for COVID-19 related illness, and several other acute and chronic medical conditions.

By our estimates, before COVID-19, 41% of physicians and 47% of primary care physicians report using some sort of telehealth in their office, with telephone encounters being the most frequently cited type of telehealth visit. While many primary care physicians report the capacity to provide telehealth, few of the visits coded in NAMCS were delivered via telehealth. We found that a number of services provided (73%) and a smaller but significant number of encounters (42%) could have been delivered via telehealth.

The predominant form of telehealth provided in our sample was via telephone. This makes sense given that the telephone is available in 100% of practices and nearly 100% of patient homes.[21] Yet, telephone only visits are reimbursable by some payers, they are currently reimbursed at a fraction of the rate of video visits. This has grave financial implications for practices without the infrastructure to support video visits or those that serve patient populations without access to broadband, smartphones or computers.

There is substantial evidence that medically underserved populations, particularly in rural communities, have a lower likelihood of having access to the technology needed to sustain video virtual visits.[22] Previous studies cited multitude of reasons for demographic disparities in telehealth use including mistrust in use of technology for obtaining care, poor health or technology literacy in seeking health care.[23,24] A Kaiser Permanente survey demonstrated fewer older and minority patients owned digital devices and had lower ability or were less willing to use internet or email.[25] Likewise our study also shows patients aged 65 or more and those with chronic conditions less likely to engage in telehealth, which underscores the importance of patient education and training in promoting the use of telehealth services in these subpopulations.

Figure 1. Proportion of primary care physicians making a given type of encounter (weighted) (NAMCS 2016).



Source: Author's analysis of the 2016 National Ambulatory Medical Survey (N=132,500) weighted by physician weights

Without either a change to value-based payments or much higher reimbursement rates for telephone visits, we may end up disproportionately adversely affecting practices that support patients with the highest medical and social needs.

This study highlights the need to understand how and where primary care might be delivered. With the advances in virtual care available through telephone, smart phone, desk top cameras, and text, e-mail, and patient portals it is essential to understand the benefits and risks to these care options. While synchronous communication via in-person, face-to-face encounters has been the dominant model, other opportunities for communication have been developed, but under deployed. Meaningful medical encounters may be provided by other synchronous communication through video and audio-only methods. Asynchronous communication may also be a robust method for delivering primary care. Symptom review, feedback, prescription refills, chronic disease management, education, and counseling may all be done via e-mail, text, and other asynchronous methods. It is crucial to provide funding to all forms of quality patient interaction and service provision. The COVID-19 pandemic has led to a realization that some important elements of primary care can be delivered by a patient's local primary care clinician using a host of virtual telehealth methods.

The activities included as amenable to telehealth are a group of general activities included in the NAMCS data collection. As such, they are not specific, diagnosis-related, and do not include a variety of other clinical activities that might be conducted by telehealth. Because NAMCS includes just a small set of general activities, not every encounter with a specific service would be amenable to a virtual visit. For example, while there is evidence that many dermatologic conditions can be amenable to telehealth,[10] not all dermatologic conditions could be fully managed without a skin scraping or direct treatment. While some visits would not require a patient to be physically in the office, the visit may necessitate the patient travel to another site for lab or imaging. This could be a virtual visit combined with a potential need for lab tests, therefore amenable to telehealth. Emerging digital devices such as home blood pressure machines, home spirometers, and pulse oximetry may provide additional care that can be provided without an in-person visit. However, many of these newer devices are not widely available and represent an area of research and evaluation. We recognize that our estimates may be conservative given the lack of a standard definition of telehealth. Nevertheless, these data provide an important glimpse into the potential to expand telehealth for many common acute and chronic conditions.

Study Limitations

NAMCS is a survey of physicians and is therefore subject to bias of the respondents, although, this bias is minimized by a sophisticated data collection process that allows for validation from multiple sources. In addition, we are estimating telehealth capacity by calculating the number of visits that are amenable to telehealth. We are not commenting on the quality of these visits if done via telehealth or in person. Although there is room for more research on the quality of telehealth visits, much of the current research shows that for those visits that are amenable to telehealth, little to no difference in outcomes between visits done in person via telehealth.[10–13,26]

Physicians who participated in the survey but did not see any patients by telehealth during the reporting period and those who refused to participate in the survey were excluded from the public use data. Therefore, estimates for physicians derived from the encounter data may vary slightly from all office-based physicians. For some items the nonresponse bias exceeded 5%, although NAMCS adjusted for nonresponse bias. Finally, the decision to include a service as potentially amenable to telehealth was made by a small group of primary care physicians supported by peer-reviewed literature. While there may be some disagreement among physicians and patients as to what services can be delivered via telehealth, based on NAMCS data collection methods, the list of services assigned as telehealth amenable is a reasonable approximation of the medical services that might be delivered via telehealth.

Since our study is based on 2016 NAMCS data, it does not include CMS changes in telehealth reimbursement and state legislations made in 2019 that impact telehealth adoption rates among physicians, limiting generalizability of our study findings.

Conclusions

The current study estimates the telehealth capacity in the United States using a nationally representative data source. We found that 35% of all visits and 42% of primary care visits are amenable to any kind of telehealth. Our estimates are higher than the 14% ambulatory telehealth visits reported by Mehrotra et al. during early weeks of COVID-19 pandemic in the US.[27] However, authors Mehrotra postulate that 40% of all the patient visits could be done via telehealth, which is comparable to our study estimates.[28] Before the COVID-19 pandemic, it would be hard to imagine that nearly half of all visits to a primary care office could be done virtually. Yet, in a matter of weeks, health care providers nationwide have completely redesigned their practices using telehealth to sustain care capacity while maintaining social distancing and protecting patients and providers. This rapid transformation will undoubtedly change how we deliver care in the post-COVID-19 era. And although telehealth will likely not be provided at pandemic-era levels, it is likely to be provided more frequently than before. Successful practice transformation in the coming months may highlight areas in which primary care can more fully integrate telehealth modalities in the future. Whether paid for through traditional fee-for-service payment models or expanded prospective payment models, telehealth services may be a substantial component of primary care now and in the future. Our estimates of the telehealth capacity in the outpatient primary care setting may be by practices as they plan how they will deliver care by payers as they make payment model decisions in the post-COVID-19 environment.

To see this article online, please go to: http://jabfm.org/content/34/Supplement/S48.full.

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Appendix 1. Classification of Services Amenable to Telehealth

Physical Presence required (Telehealth Capacity = 1)

Examination/Screening	Lab Tests	Imaging	Treatments	Health Education/ Counseling
Alcohol misuse screening	Basic Metabolic Panel	Any Image		
Depression screening	CBC	Bone Mineral density		Alcohol abuse counseling
Domestic violence screening	Chlamydia Test	CT Scan		Asthma education
Substance abuse screening	Comprehensive metabolic panel (CBP)	Echocardiogram		Asthma action plan given to patient
Skin	Creatinine/Renal Function Panel	Other Ultrasound	Mental health counseling, excluding psychotherapy	Diabetes education
	Culture, blood	Mammography		Diet/Nutrition
	Culture, throat	MRI		Exercise
	Culture, urine	Radiograph	Psychotherapy	Family planning/ Contraception
	Culture, other	Other Imaging		Growth/development
	Glucose, serum			Injury prevention
	Gonorrhea test			STD prevention
	HbA1c (Glycohemoglobin)			Stress management
	Hepatitis testing/panel			Substance abuse counseling
	HIV test			Tobacco use/Exposure
	HPV DNA test			Weight reduction
	Lipid profile/panel			Other services
	Liver enzymes/Hepatic function panel			
	Pregnancy/HCG test			
	PSA			
	Rapid Strep test			
	TSH/Thyroid			
	Urine analysis/Urine dip stick			
	Vitamin D test			
	Cholesterol			
	Triglycerides			
	Fasting blood glucose			

Physical Presence required (Telehealth Capacity = 0)

Examination/ Screening	Procedures	Lab Tests	Treatments
Breast Exam	Audiometry	Pap test	Cast/splint/wrap
Foot Exam	Biopsy provided		Complementary and alternative medicine (CAM)

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Physical Presence required (Telehealth Capacity = 0)

Examination/ Screening	Procedures	Lab Tests	Treatments
Neurologic	Cardiac stress test		Durable medical equipment
Pelvic	Colonoscopy		Home health care
Rectal	Cryosurgery(cryotherapy)/destruction of tissue		
Retinal	EKG/ECG		Occupational therapy
	Electroencephalogram (EEG)		Physical therapy
	Electromyogram (EMG)		
	Excision of tissue provided		Radiation therapy
	Fetal monitoring		Wound care
	Peak flow		
	Sigmoidoscopy provided		
	Spirometry		
	Tonometry		
	Tuberculosis skin testing (PPD)		
	Upper gastrointestinal endoscopy/EGD provided		

CBC, Complete blood count; HPV, human papillomavirus; HCG, human chorionic gonadotrophin; HIV, human immunodeficiency virus; TSH, thyroid-stimulating hormone; MRI, magnetic resonance imaging; STD, sexually transmitted disease; EKG/ECG, electrocardiogram; PPD, purified protein derivative (TB test); EGD, esophagogastroduodenoscopy.

Appendix 2. Literature Support for Services Amenable to Telehealth (Telehealth Capacity = 1)

Service		Relevant Literature				
		Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
General						Bashshur RL, Howell JD, Krupinski EA, Harms KM, Bashshur N, Doarn CR. The Empirical Foundations of Telemedicine Interventions in Primary Care. *Telemed J E Health*. 2016;22(5):342 to 375. doi:10.1089/tmj.2016.0045 Tuckson RV, Edmunds M, Hodgkins ML. Telehealth. New England Journal of Medicine. 2017;377(16):1585 to 1592. doi:10.1056/NEJMsr1503323 Totten AM, Womack DM, Eden KB. Telehealth: mapping the evidence for patient outcomes from systematic reviews. Technical brief no. 26. Rockville, MD: Agency for Healthcare Research and Quality, June 2016
Examination/ Screening						
	Alcohol misuse screening	Tofighi B, Abrantes A, Stein MD. The Role of Technology-Based Interventions for Substance Use Disorders in Primary Care: A Review of the Literature. *Med Clin North Am*. 2018;102(4):715 to 731. doi:10.1016/j.mcna.2018.02.011 Molfenter T, Brown R, O'Neill A, Kopetsky E, Toy A. Use of Telemedicine in Addiction Treatment: Current Practices and Organizational Implementation				

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Service	Relevant Literature				
	Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
	Characteristics. *Int J Telemed Appl*. 2018;2018:3932643. Published 2018 Mar 11. doi:10.1155/2018/3932643				
	Ríos-Bedoya CF, Hay C. Feasibility of using text messaging for unhealthy behaviors screening in a clinical setting: a case study on adolescent hazardous alcohol use. *J Am Med Inform Assoc*. 2013;20(2):373 to 376. doi:10.1136/amiajnl-2011-000688				
Depression screening	Wang K, Varma DS, Prosperi M. A systematic review of the effectiveness of mobile apps for monitoring and management of mental health symptoms or disorders. J Psychiatr Res. 2018;107:73 to 78. doi:10.1016/j.jpsychires.2018.10.006	Kingston D, Austin MP, Veldhuyzen van Zanten S, et al. Pregnant Women's Views on the Feasibility and Acceptability of Web-Based Mental Health E-Screening versus Paper-Based Screening: A Randomized Controlled Trial. *J Med Internet Res*. 2017;19(4):e88. Published 2017 Apr 7. doi:10.2196/jmir.6866			
	Abd-Alrazaq AA, Alajlani M, Alalwan AA, Bewick BM, Gardner P, Household M. An overview of the features of chatbots in mental health: A scoping review. Int J Med Inform. 2019;132:103978. doi:10.1016/j.ijmedinf.2019.103978				
Domestic violence screening	Bacchus LJ, Bullock L, Sharps P, et al. Infusing Technology Into Perinatal Home Visitation in the United States	Constantino RE, Braxter B, Ren D, et al. Comparing Online with Face-to-Face HELPP Intervention in			

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Service	Relevant Literature				
	Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
	for Women Experiencing Intimate Partner Violence: Exploring the Interpretive Flexibility of an mHealth Intervention. *J Med Internet Res*. 2016;18(11):e302. Published 2016 Nov 17. doi:10.2196/jmir.6251	Women Experiencing Intimate Partner Violence. *Issues in Mental Health Nursing*. 2015;36 (6):430 to 438. doi:10.3109/ 01612840.2014.991049.			
	Hassija C, Gray MJ. The Effectiveness and Feasibility of Videoconferencing Technology to Provide Evidence-Based Treatment to Rural Domestic Violence and Sexual Assault Populations. *Telemedicine and e-Health*. 2011;17(4):309 to 315. doi:10.1089/ tmj.2010.0147.				
Substance abuse screening	Molfenter T, Brown R, O'Neill A, Kopetsky E, Toy A. Use of Telemedicine in Addiction Treatment: Current Practices and Organizational Implementation Characteristics. *Int J Telemed Appl*. 2018;2018:3932643. Published 2018 Mar 11. doi:10.1155/2018/3932643		McKellar J, Wagner T, Harris A, Oehlert M, Buckley S, Moos R. One-year outcomes of telephone case monitoring for patients with substance use disorder. *Addict Behav*. 2012;37 (10):1069 to 1074. doi:10.1016/j. addbeh.2012.03.009		
Skin		Lee KJ, Finnane A, Soyer HP. Recent trends in teledermatology and teledermoscopy. Dermatol Pract Concept. 2018;8 (3):214 to 223. Published 2018 Jul 31. doi:10.5826/ dpc.0803a13			
		Trettel A, Eissing L, Augustin M. Telemedicine in dermatology: findings			

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Service		Relevant Literature				
		Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
			and experiences worldwide - a systematic literature review. Journal of the European Academy of Dermatology and Venereology. 2017;32 (2):215 to 224. doi:10.1111/jdv.14341.			
Lab Tests		***Telehealth delivery of lab test results is common practice				
Imaging		***Telehealth delivery of imaging results is common practice				
Treatments						
	Mental health counseling/	Psychotherapy	Goetter EM, Blackburn AM, Bui E, Laifer LM, Simon N. Veterans Prospective Attitudes About Mental Health Treatment Using Telehealth. *Journal of Psychosocial Nursing and Mental Health Services*. 2019;57(9):38 to 43. doi:10.3928/02793695 to 20190531-02.	Barrera TL, Cummings JP, Armento M, et al. Telephone-Delivered Cognitive-Behavioral Therapy for Older, Rural Veterans with Depression and Anxiety in Home-Based Primary Care. *Clinical Gerontologist*. 2016;40(2):114 to 123. doi:10.1080/ 07317115.2016.1254133.	Kalapatapu RK, Ho J, Cai X, Vinogradov S, Batki SL, Mohr DC. Cognitive-behavioral therapy in depressed primary care patients with co-occurring problematic alcohol use: effect of telephone-administered versus face-to-face treatment-a secondary analysis. *J Psychoactive Drugs*. 2014;46(2):85 to 92. doi:10.1080/ 02791072. 2013.876521	Egede LE, Dismuke CE, Walker RJ, Acierno R, Frueh BC. Cost-Effectiveness of Behavioral Activation for Depression in Older Adult Veterans. The Journal of Clinical Psychiatry. 2018;79 (5). doi:10.4088/ jcp.17m11888.
		Massoudi B, Holvast F, Bockting CL, Burger H, Blanker MH. The effectiveness and cost-effectiveness of e-health interventions for depression and anxiety in primary care: A		Mohr DC, Ho J, Duffecy J, et al. Effect of telephone-administered vs face-to-face cognitive behavioral therapy on adherence to therapy and depression outcomes among	Watzke B, Haller E, Steinmann M, et al. Effectiveness and cost-effectiveness of telephone-based cognitive-behavioral	

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Service	Relevant Literature				
	Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
	systematic review and meta-analysis. Journal of Affective Disorders. 2019;245:728 to 743. doi:10.1016/j.jad.2018.11.050.		primary care patients: a randomized trial. *JAMA*. 2012;307(21):2278 to 2285. doi:10.1001/jama.2012.5588	therapy in primary care: study protocol of TIDe - telephone intervention for depression. BMC Psychiatry. 2017;17(1):263. Published 2017 Jul 19. doi:10.1186/s12888-017-1429-5	
	Barrera TL, Cummings JP, Armento M, et al. Telephone-Delivered Cognitive-Behavioral Therapy for Older, Rural Veterans with Depression and Anxiety in Home-Based Primary Care. *Clinical Gerontologist*. 2016;40(2):114 to 123. doi:10.1080/07317115.2016.1254133.		Morriss R, Patel S, Malins S, et al. Clinical and economic outcomes of remotely delivered cognitive behavior therapy versus treatment as usual for repeat unscheduled care users with severe health anxiety: a multicenter randomized controlled trial. *BMC Med*. 2019;17(1):16. Published 2019 Jan 23. doi:10.1186/s12916-019-1253-5	Morriss R, Patel S, Malins S, et al. Clinical and economic outcomes of remotely delivered cognitive behavior therapy versus treatment as usual for repeat unscheduled care users with severe health anxiety: a multicenter randomized controlled trial. BMC Med. 2019;17(1):16. Published 2019 Jan 23. doi:10.1186/s12916-019-1253-5	
			Egede LE, Dismuke CE, Walker RJ, Acierno R, Frueh BC. Cost-Effectiveness of Behavioral Activation for Depression in Older Adult Veterans. *The Journal of Clinical Psychiatry*. 2018;79(5). doi:10.4088/jcp.17m11888.		
			Kirkness CJ, Cain KC, Becker KJ, et al. Randomized trial of telephone versus in-person delivery of a brief psychosocial		

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Service		Relevant Literature				
		Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
				intervention in post-stroke depression. *BMC Res Notes*. 2017;10(1):500. Published 2017 Oct 10. doi:10.1186/s13104-017-2819-year Kivelitz L, Kriston L, Christalle E, et al. Effectiveness of telephone-based aftercare case management for adult patients with unipolar depression compared to usual care: A randomized controlled trial. *PLoS One*. 2017;12(10):e0186967. Published 2017 Oct 27. doi:10.1371/journal.pone.0186967		
Health education/ Counseling						
	Alcohol abuse counseling	Gustafson DH, McTavish FM, Chih MY, et al. A smartphone application to support recovery from alcoholism: a randomized clinical trial. *JAMA Psychiatry*. 2014;71(5):566 to 572. doi:10.1001/jamapsychiatry.2013.4642	Kalapatapu RK, Ho J, Cai X, Vinogradov S, Batki SL, Mohr DC. Cognitive-behavioral therapy in depressed primary care patients with co-occurring problematic alcohol use: effect of telephone-administered versus face-to-face treatment-a secondary analysis. J Psychoactive Drugs. 2014;46(2):85 to 92. doi:10.1080/02791072.2013.876521			
	Asthma education/ action plan		Locke ER, Thomas RM, Woo DM, et al. Using Video Telehealth to Facilitate Inhaler Training in Rural Patients with Obstructive Lung	Pinnock H, McKenzie L, Price D, Sheikh A. Cost-effectiveness of telephone or surgery asthma reviews: economic analysis of a randomized controlled trial. *Br*	Pinnock H, McKenzie L, Price D, Sheikh A. Cost-effectiveness of telephone or surgery asthma reviews: economic analysis of a	

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Service	Relevant Literature				
	Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
		Disease. *Telemed J E Health*. 2019;25(3):230 to 236. doi:10.1089/tmj.2017.0330	*J Gen Pract*. 2005;55(511):119 to 124.	randomized controlled trial. Br J Gen Pract. 2005;55(511):119 to 124.	
			Pinnock H, Adlem L, Gaskin S, Harris J, Snellgrove C, Sheikh A. Accessibility, clinical effectiveness, and practice costs of providing a telephone option for routine asthma reviews: phase IV controlled implementation study. *Br J Gen Pract*. 2007;57(542):714 to 722.	Pinnock H, Adlem L, Gaskin S, Harris J, Snellgrove C, Sheikh A. Accessibility, clinical effectiveness, and practice costs of providing a telephone option for routine asthma reviews: phase IV controlled implementation study. Br J Gen Pract. 2007;57(542):714 to 722.	
			Portnoy JM, Waller M, De Lurgio S, Dinakar C. Telemedicine is as effective as in-person visits for patients with asthma. *Ann Allergy Asthma Immunol*. 2016;117(3):241 to 245. doi:10.1016/j.anai.2016.07.012		
Diabetes education	Debon R, Coleone JD, Bellei EA, Marchi ACBD. Mobile health applications for chronic diseases: A systematic review of features for lifestyle improvement. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*. 2019;13(4):2507 to 2512. doi:10.1016/j.dsx.2019.07.016. So CF, Chung JW. Telehealth for diabetes self-management in primary healthcare: A	Izquierdo R, Lagua CT, Meyer S, et al. Telemedicine Intervention Effects on Waist Circumference and Body Mass Index in the IDEATel Project. *Diabetes Technology & Therapeutics*. 2010;12(3):213 to 220. doi:10.1089/dia.2009.0102.	Sood A, Watts SA, Johnson JK, Hirth S, Aron DC. Telemedicine consultation for patients with diabetes mellitus: a cluster randomized controlled trial. *J Telemed Telecare*. 2018;24(6):385 to 391. doi:10.1177/1357633 × 17704346		

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Service	Relevant Literature				
	Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
	systematic review and meta-analysis. *Journal of Telemedicine and Telecare*. 2017;24(5):356 to 364. doi:10.1177/1357633 × 17700552.				
Diet/ Nutrition	Olson CA, McSwain S.D., Curfman AL, Chuo J. The Current Pediatric Telehealth Landscape. Pediatrics. 2018;141(3). doi:10.1542/ peds.2017 to 2334	van Doorn-van Atten MN, Haveman-Nies A, Pilichowski P, Roca R, de Vries JHM, de Groot CPGM. Telemonitoring to improve nutritional status in community-dwelling elderly: design and methods for process and effect evaluation of a non-randomized controlled trial. *BMC Geriatr*. 2018;18(1):284. Published 2018 Nov 16. doi:10.1186/s12877-018-0973-2	Eakin E, Reeves M, Lawler S, et al. Telephone counseling for physical activity and diet in primary care patients. *Am J Prev Med*. 2009;36(2):142 to 149. doi:10.1016/j. amepre.2008.09.042		
			Goode AD, Reeves MM, Eakin EG. Telephone-delivered interventions for physical activity and dietary behavior change: an updated systematic review. *Am J Prev Med*. 2012;42(1):81 to 88. doi:10.1016/j. amepre.2011.08.025		
Exercise			Eakin E, Reeves M, Lawler S, et al. Telephone counseling for physical activity and diet in primary care patients. *Am J Prev Med*. 2009;36(2):142 to 149. doi:10.1016/j. amepre.2008.09.042		
			Goode AD, Reeves MM, Eakin EG. Telephone-delivered interventions for physical		

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Service	Relevant Literature				
	Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
			activity and dietary behavior change: an updated systematic review. *Am J Prev Med*. 2012;42(1):81 to 88. doi:10.1016/j.amepre.2011.08.025		
Family planning/	Contraception	Lengle KL, Mangone ER, Parcesepe AM, Agarwal S, Ippoliti NB. Mobile Phone Interventions for Adolescent Sexual and Reproductive Health: A Systematic Review. *Pediatrics*. 2016;138(3). doi:10.1542/peds.2016-0884.			
	Martinez KA, Rastogi R, Lipold L, Rothberg MB. Response to requests for contraception in one direct-to-consumer telemedicine service. Contraception. February 2020. doi:10.1016/j.contraception.2020.01.017				
Growth/ development		Telemedicine in America 2017: Parents Use of Virtual Visits. Nemours Children's Health System; 2017. https://www.nemours.org/content/dam/nemours/wwwv2/filebox/mediaroom/telehealth-survey-executive-summary-final.pdf. Accessed April 9, 2020.			

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Service	Relevant Literature				
	Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
Injury prevention		Gielen AC, Bishai DM, Omaki E, et al. Results of an RCT in Two Pediatric Emergency Departments to Evaluate the Efficacy of an m-Health Educational App on Car Seat Use. American Journal of Preventive Medicine. 2018;54(6):746 to 755. doi:10.1016/j.amepre.2018.01.042.			
Sexually transmitted disease prevention	Cordova D, Mendoza Lua F, Muñoz-Velázquez J, et al. A multilevel mHealth drug abuse and STI/HIV preventive intervention for clinic settings in the United States: A feasibility and acceptability study. *PLoS One*. 2019;14(8):e0221508. Published 2019 Aug 22. doi:10.1371/journal.pone.0221508 Muessig KE, Nekkanti M, Bauermeister J, Bull S, Hightow-Weidman LB. A systematic review of recent smartphone, Internet and Web 2.0 interventions to address the HIV continuum of care. *Curr HIV/AIDS Rep*. 2015;12(1):173 to 190. doi:10.1007/s11904-014-0239-3 Prado G, Estrada Y, Rojas LM, et al. Rationale and design for eHealth Familias Unidas Primary Care: A drug use, sexual risk behavior, and STI preventive intervention for		Horberg MA, Blank JG, Rubenstein KB, et al. Impact of Alternative Encounter Types on HIV Viral Suppression Rates in an Integrated Health System. *AIDS Patient Care STDS*. 2018;32(11):425 to 431. doi:10.1089/apc.2018.0079		Touger R, Wood BR. A Review of Telehealth Innovations for HIV Pre-Exposure Prophylaxis (PrEP). *Current HIV/AIDS Reports*. 2019;16(1):113 to 119. doi:10.1007/s11904-019-00430-z.

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Service	Relevant Literature				
	Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
	hispanic youth in pediatric primary care clinics. Contemp Clin Trials. 2019;76:64 to 71. doi:10.1016/j.cct.2018.11.005				
Stress	management	Hoerster KD, Jakupcak M, Stephenson KR, et al. A pilot trial of telephone-based collaborative care management for PTSD among Iraq/Afghanistan war veterans. *Telemed J E Health*. 2015;21(1):42 to 47. doi:10.1089/tmj.2013.0337			
	Possemato K, Bishop TM, Willis MA, Lantinga LJ. Healthcare Utilization and Symptom Variation Among Veterans Using Behavioral Telehealth Center Services. *The Journal of Behavioral Health Services & Research*. 2013;40(4):416 to 426. doi:10.1007/s11414-013-9338-year.				
Substance abuse counseling		Kalapatapu RK, Ho J, Cai X, Vinogradov S, Batki SL, Mohr DC. Cognitive-behavioral therapy in depressed primary care patients with co-occurring problematic alcohol use: effect of telephone-administered versus face-to-face treatment-a secondary analysis. *J Psychoactive Drugs*. 2014;46(2):85 to 92. doi:10.1080/02791072.2013.876521	Shepard DS, Daley MC, Neuman MJ, Blaakman AP, McKay JR. Telephone-based continuing care counseling in substance abuse treatment: Economic analysis of a randomized trial. *Drug Alcohol Depend*. 2016;159:109 to 116. doi:10.1016/j.drugalcdep.2015.11.034	Shepard DS, Daley MC, Neuman MJ, Blaakman AP, McKay JR. Telephone-based continuing care counseling in substance abuse treatment: Economic analysis of a randomized trial. Drug Alcohol Depend. 2016;159:109 to 116. doi:10.1016/j.drugalcdep.2015.11.034	

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Service		Relevant Literature				
		Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
	Tobacco use/ Exposure	E. Lichtenstein, R.E. Glasgow, H.A. Lando, D.J. Ossip-Klein, S.M. Boles, Telephone counseling for smoking cessation: rationales and meta-analytic review of evidence, Health Education Research, Volume 11, Issue 2, June 1996, Pages 243 to 257, https://doi.org/10.1093/her/11.2.243	Richter KP, Shireman TI, Ellerbeck EF, et al. Comparative and cost effectiveness of telemedicine versus telephone counseling for smoking cessation [published correction appears in J Med Internet Res. 2015;17(6):e124. Catley, Delwyn [Added]]. *J Med Internet Res*. 2015;17(5):e113. Published 2015 May 8. doi:10.2196/jmir.3975			Stead LF, Hartmann-Boyce J, Perera R, Lancaster T. Telephone counseling for smoking cessation. *Cochrane Database of Systematic Reviews*. December 2013. doi:10.1002/14651858.cd002850.pub3
		Kruse G, Park ER, Shahid NN, Abroms L, Haberer JE, Rigotti NA. Combining Real-Time Ratings With Qualitative Interviews to Develop a Smoking Cessation Text Messaging Program for Primary Care Patients. *JMIR Mhealth Uhealth*. 2019;7(3):e11498. Published 2019 Mar 26. doi:10.2196/11498				Matkin W, Ordóñez-Mena JM, Hartmann-Boyce J. Telephone counseling for smoking cessation. Cochrane Database of Systematic Reviews. February 2019. doi:10.1002/14651858.cd002850.pub4.
		Buller DB, Borland R, Bettinghaus EP, Shane JH, Zimmerman DE. Randomized trial of a smartphone mobile application compared to text messaging to support smoking cessation. *Telemed J E Health*. 2014;20(3):206 to 214. doi:10.1089/tmj.2013.0169				
	Weight reduction	Smith E, Bradbury K, Scott L, Steele M, Little P, Yardley L. Providing online weight management in Primary Care: a mixed methods process	Davis AM, James RL, Boles RE, Goetz JR, Belmont J, Malone B. The use of TeleMedicine in the treatment of pediatric	Davis AM, Sampilo M, Gallagher KS, Landrum Y, Malone B. Treating rural pediatric obesity through telemedicine: outcomes from a		

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Service	Relevant Literature				
	Feasible/Supplementary	Effective	Comparatively Effective	Cost Effective	Overview
	evaluation of healthcare practitioners' experiences of using and supporting patients using POWeR. *Implement Sci*. 2017;12(1):69. Published 2017 May 25. doi:10.1186/s13012-017-0596-6	obesity: feasibility and acceptability. *Matern Child Nutr*. 2011;7(1):71 to 79. doi:10.1111/j.1740 to 8709.2010.00248.x	small randomized controlled trial. *J Pediatr Psychol*. 2013;38 (9):932 to 943. doi:10.1093/ jpepsy/jst005		
		Batsis JA, Pletcher SN, Stahl JE. Telemedicine and primary care obesity management in rural areas - innovative approach for older adults?. *BMC Geriatr*. 2017;17(1):6. Published 2017 Jan 5. doi:10.1186/s12877-016-0396-x	Appel LJ, Clark JM, Yeh HC, et al. Comparative effectiveness of weight-loss interventions in clinical practice. *N Engl J Med*. 2011;365(21):1959 to 1968. doi:10.1056/NEJMoa1108660		
		Izquierdo R, Lagua CT, Meyer S, et al. Telemedicine intervention effects on waist circumference and body mass index in the IDEATel project. *Diabetes Technol Ther*. 2010;12 (3):213 to 220. doi:10.1089/dia.2009.0102			

Appendix 3. Distribution of Patient-Physician Encounters by Physician Practice Characteristics (NAMCS 2016)

		Unweighted		Weighted	
		n	%	n	%
Metropolitan Statistical Area	MSA	623	93.4	306508	92.7
	Non-MSA	54	6.6	24097	7.3
Region of practice location					
	Northeast	142	25.4	66666	20.2
	Midwest	146	17.9	70946	21.5
	South	255	40.2	108595	32.9
	West	134	16.5	84398	25.5
Practice Ownership					
	Physician or physician group	519	74.7	242,058	73.2
	Medical/academic health center; Community health center	61	10.5	33,115	10.0
	Insurance company, health plan, or HMO;	62	9.2	38,109	11.5
	Unknown	35	5.7	17323	5.3
		677	100.0	330,605	100.0

Source: Author's Analysis of the 2016 National Survey of Ambulatory Medical Care Survey weighted by physician weight. (n = 677 equivalent to 330,605 nationally representative sample of physicians).
MSA, Metropolitan statistical area; HMO, Health maintenance organization.