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The Roles of Technology, Provider Interaction, and Therapeutic Modality on the Efficacy of iCBT to Treat Depression Following the COVID-19 Pandemic

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Abstract

The COVID-19 pandemic accelerated the adoption of telehealth, including internet-based cognitive behavioral therapy (iCBT) to treat depression. This review evaluates the efficacy of iCBT among technological platforms, patient-provider interactions delivering care and iCBT modalities in improving depression symptoms. A narrative review was conducted using PRISMA guidelines, focused on RCTs conducted post-2020. Twenty-one studies met inclusion criteria and were categorized by delivery technology (website, app, VR), interaction type (self-guided, therapist-guided, feedback-based), and modality (iCBT, internet mindfulness-based CBT, transdiagnostic iCBT). Contrary to common perception, iCBT was only weakly associated with depression symptom improvement, though certain combinations of study design demonstrated better outcomes, such as those delivered on websites or mobile apps, self or therapist-guided interactions, or standard iCBT treatment modalities. Study limitations were high heterogeneity, small sample sizes, and underrepresented or unproven technologies like VR. Findings suggest that iCBT is a viable treatment for depression, but its efficacy depends on design factors. Future research should explore optimal configurations and compare iCBT directly to in-person CBT to refine effective and quality teletherapy practices.

Introduction

Major depressive disorder (MDD) is one of the most common and costly illnesses in the world [1]. It has a variety of causes and manifestations, though medication and psychotherapy are effective treatments in reducing and preventing symptoms [2]. Cognitive behavioral therapy (CBT) helps patients cultivate awareness of dysfunctional thoughts and then change behavioral responses accordingly [3]. While effective in treating depression, CBT encounters barriers to delivery such as distance, provider availability, and fear of stigma. Teletherapy services can overcome these barriers and allow for internet CBT (iCBT) to be delivered to larger populations. In the wake of COVID-19, telehealth services expanded greatly due to public policy and subsequent developments have affected care [4, 5, 6]. This review will examine the roles of technology, provider interaction, and therapeutic modality on the efficacy of iCBT to treat depression since the beginning of the pandemic.

Background

Depression

Depression is one of the most common illnesses in the United States [1]. In 2018, 17.5 million Americans were diagnosed with MDD and added an annual economic burden of \$326.2 million, primarily due to workplace costs such as lost work hours, medical expense, and suicide risk management [7]. Controlling symptoms with medication and therapy can reduce the disorder's impact on society and the individual [2].

Depression does not always have a clear cause, but arises from a mix of biological, environmental, social and genetic factors. Pharmacological treatments target neurotransmitters such as serotonin and norepinephrine, but these treatments are not on size fits all and often require trial-and-error to find the right medicine. Traumatic life events can increase the likelihood of depression. Life conditions, socioeconomic status, and negative social interactions also contribute to depression [1]. The most consistent indicator of depression risk is heredity, with twin studies indicating a 37% heritability rate and a two- to threefold increased risk among first-degree relatives [1]. Psychiatric comorbidity and secondary effects of other illnesses further complicate causality.

Symptoms of depression are often comorbid other mental health diagnoses. Affective disorders like bipolar disorder, seasonal affective disorder, and dysthymia have depressive components [8]. Anxiety, panic disorder, OCD, and PTSD can also be intertwined with depression. Psychotic disorders like schizophrenia frequently show depressive symptoms, and major depression itself may present with psychotic features [8].

Beyond psychiatry, depression may occur secondary to biological illnesses. Cancer, for instance, involves treatment side effects, economic burdens, and existential distress [9]. Hemodialysis is known for high depression comorbidity due to treatment burden [7]. Hormonal conditions like hypothyroidism, as well as life events such as pregnancy, are also common triggers [10].

Due to its varied causes, depression lacks a predictable duration. Some patients experience lifelong episodic depression without identifiable triggers, sometimes treatment-resistant. Depression with seasonal affective disorder tends to follow annual cycles, while perinatal depression may resolve postpartum. Given the diverse manifestations of depression, identification and treatment can be particularly challenging.

Diagnosis and Treatment

There are no diagnostic tests for depression. Diagnosis is based on patient history and presentation. Self-report measures derived from DSM-V criteria such as the Patient Health Questionnaire (PHQ-9) and Beck Depression Inventory (BDI) are used to diagnose depression for clinical and research purposes [1, 2]. Given the subjective nature of diagnosis, providers can miss signs and misinterpret symptoms of depression [11].

While no laboratory tests or imaging studies can diagnose depression, many of these measures can screen for underlying biological conditions that present as depression. Conditions like hypothyroidism can cause symptoms of depression, but can be resolved with alternative treatment. Depression has no biological markers that can diagnose, or even indicate the best treatment, and therefore subjective methods are necessary [12].

Depression is treated with medication and/or therapy. These can be used together or separately, but a combination is considered ideal to achieve remission [2]. Treatment and response are dependent on the patient.

Medications can be administered by providers, but must be monitored carefully because patients do not respond the same to different drugs. Due to the complexity of depression without objective tests, providers use professional experience and "trial and error" to treat depression [12]. Psychopharmaceuticals are administered, titrated and often changed to find the right package for the patient. This process can be time consuming and frustrating, because many medications used to treat depression, such as selective serotonin reuptake inhibitors (SSRIs), require time to reach therapeutic levels in the bloodstream. But in lieu of other methods to determine optimal treatments, it is the only way to find the right medicines to treat depression.

Along with medication, psychotherapy has a crucial role in the treatment of depression. It offers individuals insight into their thought and emotions, offering tools to develop effective coping strategies. Numerous studies have explored and demonstrated the effectiveness of psychotherapy in the treatment of depression [2]. Success of treatment depends on factors such as the severity of symptoms, patient circumstances and buy-in, and patient-therapist relationship [2].

Therapy provides a safe, supportive environment to help patients address emotional distress, negative cognition and maladaptive behaviors [3]. In therapy patients can find root causes for their depression or ways to cope with the illness. Sessions can be done individually or in groups, as well as in private practice, specialized clinics, and remotely.

Cognitive Behavioral Therapy

Cognitive Behavioral Therapy (CBT) is a structured form of cognitive therapy. The patient and therapist work together to identify patterns in thought that cause behavioral dysfunction. The programs educate the individual on how to focus on these thoughts, understand how they affect behavior, help the patient restructure their response to maladaptive cognition, then alter behavior. CBT can alleviate depression symptoms and improve quality of life [2, 3].

The CBT model emphasizes three key aspects of cognition: automatic thoughts, cognitive distortions, and underlying beliefs. CBT helps individuals become aware of dysfunctional cognition that influences emotional response and behavior. By restructuring these maladaptive cognitive processes, patients can make meaningful changes in their emotional and behavioral responses [3]. CBT has also demonstrated effectiveness in preventing relapse [10].

Automatic thoughts are an individual's immediate response to events that can significantly influence emotion, perception, and behavior. A goal of CBT is for the patient to be aware of exaggerated, distorted and unrealistic automatic thoughts and develop coping mechanisms. Such as considering a friend's brusque attitude as an indication they are under stress, as opposed to the dysfunctional thought that the person is acting out of malice.

Cognitive distortions are errors in thought patterns that arise in depressed patients that can lead to faulty conclusions and maladaptive behaviors. Emotional reasoning, catastrophizing , and black-and-white thinking are examples of cognitive distortion. CBT helps the individual become aware of these distortions and gives the patients the opportunity to restructure behaviors that arise from these errors [3].

Underlying beliefs are fundamental thoughts that shape how individuals perceive and interpret experiences. CBT helps patients observe these thoughts in order to change the behaviors that arise. These beliefs are formed through life experience, affect information processing and lead to automatic thoughts that reinforce maladaptive behavior [3]. Core beliefs such as, "The world is a dangerous place," can be rigid generalizations that are

central to the individual's perceptions. Whereas intermediate beliefs are rules and assumptions that develop as part of daily actions and behaviors, such as, "to be loved, my behavior must be perfect." CBT helps the patient see dysfunctional beliefs so thought and behavior can be restructured.

Following the model, patients typically follow an 8-to-12 week process [12]. 60–90 minute therapy sessions are conducted with a trained practitioner with treatment focused on negative thoughts and modifying behaviors. The patient is expected to be engaged and active in their treatment. Weekly homework is common to reinforce the practices developed in therapy.

Mindfulness-based cognitive therapy (MBCT) is a form of psychotherapy that builds on principles of CBT. Mindfulness practices focus on using awareness of the present moment to accept thoughts and emotions without judgement This can prepare an individual to challenge their thought patterns and guide behavioral change in CBT. MBCT is effective in treating depression symptoms and preventing relapse [10].

Mental disorders, like depression, are often comorbid with mental illnesses such as anxiety, post-traumatic stress disorder (PTSD), and other affective disorders [8]. Most papers examining mental illnesses exclude participants with substance abuse, bipolar, psychotic and other diagnoses that may confound research that seeks to clarify specific interventions. Transdiagnostic (TD) therapies can apply a variety of CBT and other treatments in developing general interventions that are not diagnosis-based. Treatment is based on general concepts and patient needs, not a rigid protocol [8].

Telehealth and Teletherapy

Telehealth is the use of technology to provide healthcare remotely using technologies like the telephone, internet, smartphone and other devices. It includes real-time consultation, health information delivery, mobile health applications, and monitoring devices. Telehealth allows patients to receive care when presented by barriers like distance, availability, and pandemic protocols [6].

Urgent care services are offered by local clinics or larger organizations like Teladoc or Docs on Demand. It is now more common for patients to be seen for primary care, chronic disease management, and mental healthcare among others. It does not supplant the in-person visits for examination and treatment when required, but offers options for patients seeking care.

One of the most promising telehealth developments for depression patients is teletherapy. Despite effective treatments, depression remains an undertreated condition [7, 11]. Patients face barriers to care such as cost and distance that can be reduced by remote care. In addition to giving rural patients or those in care deserts access to providers, telehealth allows for flexible scheduling to meet patient needs. Barriers specific to mental illness can also be ameliorated with teletherapy.

Adherence is important for positive outcomes, but patients with depression exhibit apathy and lack of motivation that can make it difficult to travel to a clinic [11]. Even if there is intent to seek treatment and desire to improve, the manifestations of the illness can prevent success. Teletherapy can reduce a patient's difficulty in adhering to CBT programs that require a structured program [11]. Stigma is one of the major barriers to mental healthcare. Not only do patients stigmatize their own illness and sometimes view the necessity of treatment as their weakness, they are influenced by the people and institutions in their lives. The opinions others have of those with depression can be damaging to the individual's life and emotions. Teletherapy offers a way for people to seek care when they are afraid that others will see their visits to a therapist and judge them unfairly. Though it can't resolve internal resistance to care, it does facilitate the initiation of therapy if it is desired.

Despite the advantages of teletherapy, the gold standard of care is still in-person therapy. There are still questions as to its effectiveness compared to in-person care [13]. Particularly the diminished ability to observe a patient and build rapport. However, its accessibility and scalability make it a valuable way to provide mental healthcare [5].

Internet CBT

Teletherapy also includes the administration of internet CBT (iCBT), which can deliver CBT programs remotely. iCBT offers the convenience of remote healthcare and potentially promotes adherence to a structured treatment modality. Programs use the same model and seek the same outcomes as in-person CBT, but the format can vary greatly among interventions. They often have a similar 8-to-12 week duration, but some programs are modified down to 4 weeks [14], or even one-day interventions. iCBT can be done through self-motivated activities and workbooks, in addition to more traditional therapist sessions. An important facet of iCBT research is how these treatment choices affect patient outcomes.

Methods of Delivering iCBT

During analysis, three relevant subgroups emerged in the research. The technology used to deliver therapy, patient interaction with the administrators of therapy, and treatment modality varied among studies. All three groups could impact the efficacy of the electronic treatment of depression.

Technology

The technology used to deliver iCBT is a critical difference in care. Most studies relied solely on website administration. Proliferation of smartphones also makes app-based delivery a valuable modality. Virtual Reality (VR) is also an emerging method of therapeutic care.

By far the most common route of providing iCBT is access to a website curated and monitored by the researchers. These websites can deliver most treatment materials in text, workbook, video, interactive modules, and more. These can be accessed via computer or smartphone, but may be designed specifically for one technology. Websites often provided contact information or messaging systems to reach researchers [15].

Smartphones are now a ubiquitous technology that are more common than laptops or personal computers [16]. Therefore, it's logical to develop methods of care that revolve around them. Apps designed to facilitate iCBT interventions can be loaded from operating system stores. These apps are still less common than traditional websites, though this does not rule out using a smartphone to access web materials. Finally, VR-based therapy is a novel approach to iCBT administration. Only one study was visible in the literature [17], but it could be a new avenue in providing care. Such interventions have been demonstrated as effective in the treatment of anxiety disorders and phobias [18]. However, little is known for the treatment of depression. Though cost of the technology may be a barrier to care [17], it is worth including in the review as potential delivery of care.

Interactions

Patients interacted with researchers in different ways among studies. Some protocols were entirely self-guided, relying on the individual to navigate the program and, in some cases, the order and speed at which they completed modules. Others offered feedback on finished materials. Therapists were available for some interventions with weekly appointments to lead modules or engage in psychotherapy with the patient. Most studies included an e-coach or non-therapeutic individual who would send reminders or interact with patients for the purpose of adherence, but not for treatment [11, 9, 19].

Self-guided interventions were the most common. These include studies that give the patient access to an iCBT course with minimal guidance beyond how to use the technology. Some of these studies gave complete access for patients to use any part of the course immediately, but most unlocked materials weekly. These patients have no therapeutic contact with the researcher, save outreach to remind the patient to complete therapy modules [20, 21].

In some studies, patients were provided feedback on their performance in the iCBT program. They would complete modules as a self-guided program but would get commentary from computer review or customized feedback from a researcher. The intention is to support patient performance and indicate ways to improve. This feedback was only in regard to completing the iCBT course; there was no synchronous interaction or therapy provided [22, 23].

Several interventions were guided primarily by therapists, either individually or in groups. In some studies, therapists would lead group therapy or begin modules with a group presentation. Additionally, some iCBT protocols included weekly meetings with therapists by phone or video [9, 24, 25].

Modality

The efficacy of the intervention may also be affected by the therapeutic modality. While all studies utilized iCBT to deliver therapeutic modules, some extended to alternative styles of therapy such as internet mindfulness-based CBT (iMBCT) and transdiagnostic CBT (TD-iCBT). There is a lack of research comparing potential efficacy differences among these modalities [8].

<u>COVID</u>

Teletherapy has been used for over 20 years with demonstrated efficacy [4]. But the novel coronavirus disease 2019 (COVID-19) pandemic limited the ability for patients to

seek in-person care. In response to social distancing requirements, telehealth services expanded rapidly to ensure continued access to healthcare [6], while changes in legislation and guidelines aided in developing new standards in remote care [4].

Teletherapy was a vital service during the pandemic. Individual, relationship, and group therapy were important amidst grief, anxiety, substance abuse and depression that followed the loss of life due to COVID-19. During a time of isolation, teletherapy was given a chance to help patients thrive [23].

Post-pandemic, teletherapy is here to stay. Due to the expansion of telehealth during the pandemic, delivery of care may be different from pre-pandemic services [5]. Research is still ongoing to determine optimal implementations that balance care effectiveness, accessibility, and convenience.

Need for Research

iCBT is generally accepted as an effective treatment for depression that is more easily accessible than in-person appointments [2, 15]. But the variety of ways an iCBT intervention can be designed are numerous. This study aims to investigate three categories of study development: the technology used to deliver care, the way patients interact with the researchers during care, and the type of therapeutic CBT-derived modality used for treatment.

The paper has also been limited to studies conducted after the start of the COVID-19 pandemic protocols in 2020. The rapid growth of telehealth services may have changed

the ways in which iCBT has been delivered. Recent papers may be more relevant to care standards post-pandemic [5].

Methods

Search Strategy

A systematic search strategy was created based on keywords, as well as inclusion and exclusion criteria. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was used to guide strategy development [27]. An electronic search was conducted using the Medical Literature Analysis and Retrieval System Online (Medline). Medline was queried with searches terms using Boolean operators that reflected research intent with synonyms when relevant. First, the complete query included a title containing "depression" while excluding "Meta*", OR "Systematic" to identify the primary diagnosis while ruling out common phrases for other review formats. Next "cognitive behavioral therapy" OR "iCBT" and relevant synonyms were searching in the title/abstract to determine if the research used the modality of interest. "online" OR "electronic" in the title/abstract was applied to filter papers that may have an internet component, while "treatment as usual" OR "waitlist" limited the control group to a normal population among depression patients. Finally, for study quality, variations of "RCT" were searched in the title/abstract.



Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were selected to ensure the relevance and quality of identified studies [Narrative review statpearl]. All studies with measures for depression symptomology were included, excluding those including bipolar disorder, schizophrenia, active drug use or alcoholism. This review included randomized controlled trials (RCTs) as the most unbiased measures of efficacy. All other study types, systematic reviews, and meta-analyses were excluded. Only studies published during or after the start of the 2019 COVID pandemic were included, with two studies excluded because the research took place prior to the pandemic. Patients from all countries were included. Literature was English only to reduce cost and errors in translation.

These iCBT interventions were often specific to a particular protocol or tailored to the experimental population but met criteria as a CBT intervention. Only iCBT programs conducted over a period of time were considered. Single session studies were excluded.

Data Extraction and Synthesis

Data extraction was tabulated with critical information entered for ease of visual comparison. Study authors and dates, populations and nationality, intervention(s) and controls, as well as sample size, treatment duration with measurement intervals, and depression measures were noted alongside summary of findings.

RCT objectivity was assessed by the Critical Appraisal Skills Program (CASP). The tool guided quality assessment of literature during the narrative review. All studies reviewed were of moderate to high quality, indicating that all studies met an even standard for narrative comparison.

Results

Search Findings and Overview of the Included Studies

The initial search process yielded 182 studies across all databases, filtered into 21 for final review. The characteristics of the included studies are presented in Table 1. The primary reasons for excluding studies were pilot/protocol studies, research conducted prior to 2020, and CBT interventions that were administered in one day. All studies had an RCT design, with differing sample sizes, sampling methods, intervention durations and measures. Heterogeneity is considered within the discussion.

Table 1. Study Characteristics **Abbreviation** iCBT: Internet CBT; iMBT: Internet MBT; TD-iCBT: Transdiagnostic iCBT

Author, Date	Sample	Technology	Interaction	Modality	Aim;
	Population,				Outcome
	Country				
Bruhns et al.,	College	Арр	Self	iMBT	Reduction;
2021 [1]	Students,				Significant
	Germany				improvement
Chen et al.,	Youth 15-25,	Арр	Self	iCBT	Prevention;
2025 [29]	China				Significant
					improvement
Duan et al.,	Peripartum	Website	Feedback	iCBT	Prevention;
2025 [14]	Depression,				No difference
	China				

Fatori et al.,	Maternal	Арр	Self	iCBT	Reduction;
2023 [29]	Depression,				No Difference
	Brazil				
Gonzales-	Depression	Website	Self	td-iCBT	Reduction;
Robles et al.,	Patients, Spain				Significant
2022 [31]					improvement.
					Benefits remained
					after one year
Gu et al.,	Breast Cancer	Website	Therapist	iCBT	Reduction;
2024 [9]	Patients, China				Significant
					improvement
Heinrich et	Depression	Website	Therapist	iCBT	Reduction;
al., 2025 [31]	Patients,				Significant
	Germany				improvement
Karyotaki et	College	Web	Feedback	td-iCBT	Reduction;
al., 2022 [19]	Students,				No Difference
	Netherlands				
Koelen et al.,	College	Website	Feedback	iCBT	Reduction; No
2024 [21]	Students,				difference at the end
	Germany				of intervention,
					improvement seen
					after 6 month

					followup
Krämer et al.,	Website	Website	Feedback	iCBT	Reduction;
2022 [23]	Recruited				Significant
	Participants,				improvement
	Germany				
Lee et al.,	Adults aged 19-	VR	Self	iCBT	Reduction;
2025 [17]	50, South Korea				No Difference
Lin et al.,	Depression	Website	Self	iCBT	Reduction;
2023 [32]	Patients, China				Significant
					improvement
Pabst et al.,	All Ages,	Website	Self	iCBT	Reduction;
2020 [33]	Germany				Significant
					improvement
					among all age
					groups
Read et al.,	Elderly with	Website	Self	iCBT	Prevention;
2020 [21]	Multimorbidity,				Significant
	Australia				improvement
Reitsma et al.,	Bereaved during	Website	Self	iCBT	Reduction;
2023 [34]	COVID,				Significant
	Netherlands				improvement
Ritvo, Ahmad	College	Website	Self	iCBT	Reduction;
et al., 2021	Students,				No Difference
[20]	Canada				
Ritvo,	Young Adults	Website	Self	iMBT	Reduction;

Knyahnytska	18-25, Canada				Significant	
et al., 2021					improvement	
[35]						
Schniering et	Adolescents,	Website	Therapist	iCBT	Reduction;	
al., 2022 [24]	Australia				Significant	
					improvement	
Simonsson et	College	Website	Therapist	iMBT	Reduction;	
al., 2021 [18]	Students, UK				No Difference	
Suchan et al.,	Peripartum	Website	Therapist	iCBT	Reduction;	
2022 [26]	Depression,				Significant	
	Canada				improvement	
Sun et al.,	Perinatal	App	Therapist	iMBT	Reduction;	
2021 [16]	Depression,				Significant	
	China				improvement	

Study Quality

Critical Appraisal Skills Programme to assess RCT design quality is provided in Table 2 [36]. Most studies showed moderate quality methodology in RCT design. Aims, methods, recruitment, analysis and ethics were considered consistently among studies. As interventions were in-depth psychological treatments over extended periods of time, blinding was limited. Due to the nature of such interventions, participant attrition was high, and sample sizes were often small, creating potential biases in analysis. Some research is not as valuable or has ambiguous findings, potentially due to the relative novelty of internet therapy research.
 Table 2. The Critical Appraisal Skills Programme (CASP)

- 1. Was there a clear statement of the aims of the research?
- 2. Is a qualitative methodology appropriate?
- 3. Was the research design appropriate to address the aims of the research?
- 4. Was the recruitment strategy appropriate to the aims of the research?
- 5. Was the data collected in a way that addressed the research issue?
- 6. Has the relationship between researcher and participants been adequately considered?
- 7. Have ethical issues been taken into consideration?
- 8. Was the data analysis sufficiently rigorous?
- 9. Is there a clear statement of findings?
- **10. Is the research valuable?**

Author, Date	<u>Q1</u>	<u>Q2</u>	<u>Q3</u>	<u>Q4</u>	Q5	Q6	<u>Q7</u>	Q8	Q9	Q10
Bruhns et al., 2021	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Chen et al., 2025	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Duan et al., 2025	Y	Y	Y	N	Y	Y	Y	Y	Y	N
Fatori et al., 2023	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Gonzales-Robles et al., 2022	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Gu et al., 2024	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Heinrich et al., 2025	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Karyotaki et al., 2022	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Koelen et al., 2024	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Krämer et al., 2022	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Lee et al., 2025	Y	Y	Y	N	Y	Y	Y	Y	N	N
Lin et al., 2023	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Pabst et al., 2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Read et al., 2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Reitsma et al., 2023	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ritvo, Ahmad et al., 2021	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ritvo, Knyahnytska et al., 2021	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Schniering et al., 2022	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Simonsson et al., 2021	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Suchan et al., 2022	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sun et al., 2021	Y	Y	Y	Y	Y	Y	Y	Y	N	Y

Outcomes

According to the reviewed literature, iCBT is not significantly better at reducing or preventing depression symptoms (p=0.09). However, the differences among technological platforms, intervention delivery and therapeutic modality may add context and raise new questions regarding the optimal delivery of iCBT. Due to the heterogeneity of studies, subgroups will be reviewed in the treatment of depression.

While all studies aimed to address depression, some focused on iCBT as a preventative measure, the majority concentrated on reducing existing symptoms. Both groups, 3 preventative studies and 18 symptom reduction studies, had a 66.6% rate of successful interventions. As both types of studies have similar aims and methodologies, they are counted together for the purposes of this review.

Among technologies, website-based delivery was most common (16 of 21 studies) with 68.7% leading to symptom improvement. Four mobile app interventions yielded a 75% chance significant improvement. The lone VR study was not significantly different from a waitlisted control.

Delivery of patient care was the second major intervention design subgroup. Self-guided delivery was the most common form of patient interaction with 10 studies with 70% significantly positive outcomes. Therapist adjacent and feedback research amounted to seven (71.4% improvement) and four (75%) studies respectively.

Treatment modality was the final intervention group. Standard iCBT treatment was the most common intervention (13 of 21) with significant improvement in 77.0% studies. Among six iMBT studies, only 66.6% demonstrated improvement. There were only two TD-iCBT studies with one positive and one negative result.

There were several notable combinations among subgroups. Website interventions had above average outcomes when self-guided, therapist-guided, or when delivering iCBT. Therapist guided interventions performed well in iMBT and iCBT interventions. Due to the heterogeneity of studies and lack of saturation in the literature, there are too few combinations between certain interventions to draw conclusions, but will be reviewed for insights for future exploration.

Table 2. Treat	ment Interati	ons	[Successes · ()ccurances]	
	by Delivery	in categories		Jeeuraneesj	
leanneigy	Δnn	Weh	VR	Total	
Self	2:3	5.6	0.1	7·10	
Feedback	0:0	1:4	0:0	1:4	
Therapist	1:1	5:6	0:0	5:7	
	3:4	11:16	0:1		
		-			
Delivery by	Modality				
	Self	Feedback	Therapist		
iMBT	1:2	1:1	2:3	4:6	
iCBT	5:7	0:2	3:4	8:13	
TD-iCBT	1:1	0:1	0:0	1:2	
	7:10	1:4	5:7		
Technology	by Modality				
	Арр	Web	VR		
iMBT	2:2	2:4	0:0	4:6	
iCBT	1:2	8:10	0:1	8:13	
TD-iCBT	0:0	1:2	0:0	1:2	
	3:4	11:16	0:1		

Discussion

Contrary to that common perception these iCBT studies only showed a weak correlation with improvement of depression symptoms [13, 19]. However, the majority of iCBT studies are conducted with website-based technologies, self-guided or therapist-driven deliveries, and general iCBT modalities. Variation in the effectiveness of technologies, interaction and modality may create specific conditions that outperform others. Negative outcomes among less common interventions like VR technology, Feedback driven interaction or the TD-iCBT modality may have driven our overall success rate down if they are not effective interventions. Among technological interventions, websites were by far the most common. In general websites are a primary way to interact with the internet, therefore a convenient method of delivery for iCBT. They are generalizable and can also be used for smartphone interventions. As the most common medium of iCBT [15], the high degree of successful outcomes may be related to the long-term development of web-based research methods. While self and therapist guided web-based interventions were very successful, it is uncertain as to why studies with feedback interactions were unsuccessful [22, 23].

Mobile phone apps are more recent developments, but the technology is a valuable, ubiquitous tool in administering teletherapy [16, 29]. Though there were only a small number of studies, apps performed positively. While VR technology is an exciting frontier in telehealth, conclusions cannot be drawn from the one study [17]. Its limited appearance may be due to cost and lack of access [17].

Provider interaction during the intervention was very clear across technologies. Selfguided and therapist interventions were very successful, whereas studies that relied on feedback to patients following activities were not [19, 20, 25]. There was a similar pattern of success and failure across modalities. The inability of feedback studies to improve depression symptomology should be investigated to determine if it's a consistent outcome that could affect the present analysis.

By far the most common treatment modality was iCBT, also called internet-based interventions (IBI) in some studies. These were especially successful in web-based interventions and when guided by the individual or therapist [30, 31]. iMBT was more effective in mobile app delivery than via the web [32, 33]. There were not enough

occurrences of TD-iCBT to draw conclusions, but it is a promising modality that may aid future treatment of diagnoses in addition to depression [8, 26].

Limitations

Research comparing the technology and methodologies of iCBT is relatively novel and therefore draws from a wide array of studies. Limitations arise from heterogeneity of present literature as issues common among similar papers as well. The variability makes it challenging to draw clear conclusions that may be answered in future research [13, 28].

Most of the categories—technology, interaction, and modality—did not have enough occurrences to make robust conclusions as to their effectiveness. VR technology and the TD-iCBT modality only had a few instances in the literature [17, 26, 30]. Future research will contribute to stronger results.

As expected from psychological intervention studies, patient adherence and dropout is a concern. Most studies use an intent-to-treat model that accounts for all participants whether they continued or dropped out to compensate for attrition. But in studies where sample size is small to start, the power may be weak [2].

Studies document the nature of the control group, typically treatment as usual (TAU) where patients seek care through a provider reference, or waitlist control (WLC) where interventions are compared to patients who are waiting to access care. Comparisons with in-person CBT would be ideal in determining which form of treatment is the gold standard. However, these studies are rare [13, 27].

Treatment duration was not examined in this study. Though most interventions were within the typical 8-to-12 week range for traditional CBT, there are other potentially effective timeframes. In particular, this paper purposefully excluded one-day interventions that can be found in the literature [14].

Studies typically exclude diagnoses that may confound depression research such as bipolar disorder, schizophrenia, and substance abuse. However, the reality of mental health is comorbidity, and there are no perfect diagnostics. A patient presenting with depression in the real world is often treated as a major depression patient until their behavior demonstrates otherwise [8]. The optimal treatment for a patient in these studies may not reflect real-world applications that will invariably include patients excluded from research.

Heterogeneity may have created uncertainty in the generalizability of results to different populations. Research was conducted in developed nations, but culture and language may play a part in delivery and reception of materials. Socioeconomic factors may also limit future scalability of the research methods [22, 19].

Conclusion and Future Directions

This review examined the effectiveness of iCBT in treating and preventing depression, focusing on intervention design elements: technological delivery, patient-provider interaction, and therapeutic modality. Contrary to broader literature, there was only a weak correlation between iCBT and improvement of depression symptoms (p = 0.09) [27, 13]. However, subgroup analyses revealed important patterns.

Website-based platforms were the most frequently used and generally effective, likely due to the platform's maturity and adaptability between technologies [15, 28]. Mobile app effectiveness is promising [29]. VR technology is underrepresented, possibly due to its novelty and cost as a treatment medium for depression [17].

Self-guided and therapist-supported models performed well with different technologies and modalities [19, 25]. Feedback-based interventions were not effective, warranting further investigation [23].

Standard iCBT interventions were the most successful, while less common approaches such as iMBT and TD-iCBT require additional data to draw clear conclusions [10, 8, 26]. Significant limitations persist, particularly due to the heterogeneity of studies that have variable populations, methods, and research designs. Certain technologies and therapies, such as VR and TD-iCBT, were not well represented in the sample and require further research to determine their viability. One of the most important directions in future research is the comparison of these technologically delivered therapeutic modalities to gold standard in-person CBT interventions [2].

Telehealth has found great success in delivering accessible care at a distance. For depression patients, that also means separation from stigma and the ability to adhere to treatment. As the COVID-19 pandemic has subsided, a new normal has been established for the provision of remote care. The responsibility of informaticists is to determine what technologies and modalities work best in delivering effective care [5, 34].

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