

Digital Copilots: Advancing Pilot Mental Health Through AI Chatbots and Systems

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ABSTRACT

Commercial pilots routinely work long, irregular schedules under high-stress conditions, and these demands are linked to higher rates of anxiety, depression, and fatigue than those seen in the general population. Persistent mental health stigma within the aviation community often drives pilots toward self-reliance rather than professional care due to the possibilities of suspension, grounding or loss of their pilot license. Recently developed AI-driven mental-health chatbots could offer pilots an anonymous support option that circumvents this stigma. Although no aviation-specific trials exist, a number of studies in the general population report moderate symptom reductions from use of mental health AI chatbots. In this review, we synthesize that evidence and evaluate its applicability to commercial pilots. For this literature review, we reviewed over 100 papers using terms for aviation psychology, pilot mental health, and digital/chatbot interventions; we also screened literature on complementary AI systems. Overall, findings suggest AI chatbots are suitable as adjunct support for pilots with mild or subclinical distress but should not replace professional care in severe cases. Chatbots may facilitate self-screening, early detection, and brief preventive coaching for pilots. In addition to chatbots, we also review other AI-based systems to understand their impact on the mental health of commercial pilots. Preliminary evidence also suggests that chatbots and other AI systems may enhance emotion-regulation skills, which could contribute to overall improved operational safety. When access to human therapists is limited, these interventions could offer discreet, scalable mental health support tailored to the unique demands of the aviation profession.

Keywords: Aviation psychology, AI chatbots, Digital mental health, Pilot mental health, Mental health AI systems

INTRODUCTION

Mental Health and Emotional Resilience in Pilots

Commercial pilots hold considerable responsibility in their profession, encompassing the operational safety of the aircraft and passengers, adherence to regulatory standards, and high-stakes decision making. The sustained engagement with these complex responsibilities exposes pilots to demanding occupational conditions, including extended working hours, circadian disruption, irregular sleep, and elevated cognitive stressors during critical decision-making episodes. Such conditions represent endemic occupational

stressors that contribute to a range of psychological effects, distinguishing pilots from the general population. Research indicates that pilots experience higher levels of mental health concerns compared to the general population. Studies by Wu et al. (2015), Venus et al. (2021), and Cahill et al. (2021) highlight elevated rates of depression, anxiety, and fatigue among pilots. Collectively, these findings underscore a consistent pattern of psychological distress within the aviation profession.

Beyond elevated symptom rates, pilots exhibit lower emotional intelligence (EI) scores than the general population across multiple domains (Dugger et al., 2022). EI encompasses facets of emotional awareness, regulation, motivation, empathy, and social skills—the ability to recognize, manage, and use emotions effectively (Goleman, 1998). Core facets such as emotional awareness, regulation, and empathy have been linked to operational safety in aviation (Dugger et al., 2022) and are key predictors of psychological resilience (Sepahpour, 2020). Lower EI among pilots may reduce coping capacity and increase vulnerability to stress-related symptoms (Schneider et al., 2013), emphasizing the need to strengthen emotional resilience within this population.

Although pilots face significant mental health risks, efforts to reduce psychological distress remain limited due to persistent stigma and fear of professional consequences. Concerns about confidentiality and potential certification loss discourage pilots from seeking formal help, leading many to rely instead on self-management and informal coping strategies (Cahill et al., 2021; Cross et al., 2024). The convergence of higher levels of depression and other mental health symptoms, limited institutional trust, and enduring stigma reinforces an urgent need for more effective, accessible, and discreet interventions that support the psychological well-being, or positive psychological functioning (Ryff, 1996), and resilience of aviation professionals.

Applications of Artificial Intelligence in Mental Health and Implications for Pilots

Artificial intelligence (AI) is increasingly transforming mental healthcare through conversational agents that simulate supportive dialogue and deliver evidence-based therapeutic content (Cruz-Gonzalez et al., 2025; Pandi-Perumal et al., 2024). Chatbots like Wysa, Woebot, Tess, and Youper use cognitive behavioral therapy (CBT), dialectical behavior therapy (DBT), and mindfulness techniques to help users manage stress, anxiety, and depression in real time (Dehbozorgi et al., 2025; Babu & Joseph, 2024). Providing stigma-free and accessible spaces, these tools encourage reflection and self-disclosure while addressing barriers such as cost or perceived judgment (Sun et al., 2025). Many also detect distress, adapt to user sentiment, and recommend personalized self-care strategies, with platforms like Woebot and Wysa integrating clinical safety and adaptive protocols (Dehbozorgi et al., 2025).

Although not replacements for human clinicians, research supports the clinical value of AI chatbots in reducing depressive and anxiety symptoms

and enhancing mood regulation and emotional awareness (Farzan et al., 2024; Balcombe, 2023; Jin et al., 2023; Pham et al., 2022). Their constant availability, affordability, and anonymity make them particularly useful for high-stress professions such as aviation, where long hours, cognitive strain, and stigma deter help-seeking (Babu & Joseph, 2024; Jin et al., 2023). For pilots, AI-driven conversational agents may offer discreet, evidence-based support that fosters resilience and wellbeing while aligning with the demanding nature of their work.

METHODS

Search Strategy

We searched five major databases, including, PubMed, PsycINFO, IEEE Xplore, the ACM Digital Library, and Google Scholar, for studies published between 2000 and 2025 in English. Our queries combined terms in two sets: one for aviation psychology (“aviation psychology” OR “pilots”) paired with mental health keywords (“mental health” OR “well-being”), and one for AI chatbots (“AI chatbot” OR “conversational agent” OR “digital mental health”) paired with intervention terms (“assessment” OR “support” OR “intervention”). We also checked reference lists of recent reviews to catch any additional eligible papers.

Inclusion and Exclusion Criteria

We included peer-reviewed journal articles or full conference proceedings that met all of the following requirements:

1. The focus is on conversational agents or chatbots using artificial intelligence or natural language processing for mental health assessment, support, or adjunctive therapy.
2. The paper reports empirical data on user outcomes, such as symptom change, usability, or engagement, or provides a detailed system evaluation.
3. Available in full, published in English, and falls within 2000–2025 window.

We excluded editorials, opinion pieces, non-English works, studies without full text, and purely technical descriptions lacking any user or clinical evaluation.

Study Selection, Data Extraction, and Synthesis

The reviewers independently screened all paper publications for relevance and then reviewed full texts against our inclusion criteria. More than 100 publications were reviewed, and ultimately a total of 34 texts were included.

For each study we recorded: authors and year, chatbot name, theoretical basis, core technical features, study design, participant details, outcome measures, and main findings. We organized these data into themes based on primary chatbot functions (for example, assessment, self-help support, and clinician adjunct) and noted any adaptations or pilot-specific findings for

aviation. Finally, we used a narrative approach to highlight where evidence is strongest, where gaps remain, and what this means for future research on supporting pilots with AI chatbots.

RESULTS

Prevalence and Nature of Mental Health Challenges in Pilots

Mental health symptoms are highly prevalent among pilots, with estimates ranging from 1.9 to 12.6 percent across studies (Hoffman et al., 2024). Wu et al. (2016) reported that 12.6 percent of pilots met the threshold for depression, and 4.1 percent indicated suicidal thoughts within the prior two weeks of operating as a pilot. Similar findings have been observed in subsequent research: Venus et al. (2022) found that 22.8 percent of pilots experienced significant depression, 12.3 percent reported significant anxiety, and 10.5 percent exhibited both. Cahill et al. (2021) likewise identified that over half of pilots surveyed met the criteria for mild depression. Compared with general population estimates of approximately 7% for depression and 6% for anxiety in 2019 estimates (Terlizzi et al., 2024), the mental health burden among pilots appears notably higher.

Work-related stressors are consistently cited as key contributors to this elevated risk. Long duty hours, irregular schedules, jet lag, and cumulative fatigue are common occupational challenges (Cahill et al., 2021; Venus et al., 2022). In the Venus et al. study, 78.6 percent of pilots reported severe or very high fatigue and that high fatigue was strongly associated with poorer mental health and well-being. Pilots experiencing higher psychosocial stress also displayed greater symptoms of depression and anxiety (Venus et al., 2022). Beyond these physiological and situational stressors, pilots tend to score lower than the general population on EI traits such as well-being, emotionality, and sociability, characteristics that have been linked to operational safety and resilience (Dugger et al., 2022). Together, these findings underscore that pilots operate under a unique combination of psychological strain and occupational risk factors that heighten vulnerability to distress.

Barriers to Help-Seeking in the Pilot Population

Despite growing awareness of mental health issues in aviation, multiple structural and cultural barriers limit pilots' engagement with professional support. The most widely reported barrier is fear of negative career consequences, particularly the potential loss or suspension of medical certification required for flight operations (Wu et al., 2016; Cross et al., 2024; Hoffman et al., 2022). Under U.S. Federal Aviation Regulations, any change in health status disclosed during aeromedical examinations can lead to temporary grounding or lengthy medical review processes that are often costly and time-consuming (Hoffman et al., 2022). As a result, many pilots delay or avoid seeking care altogether. Surveys reveal that 56 percent of pilots have engaged in some form of healthcare avoidance due to concerns about

repercussions, while 25 percent report withholding information on health questionnaires to protect their certification status (Hoffman et al., 2022).

This avoidance behavior is compounded by stigma and distrust in the confidentiality of reporting systems (Cross et al., 2024). Pilots frequently express apprehension that disclosing psychological concerns may compromise their reputation or professional identity. Qualitative analyses and social media studies further demonstrate that discussions around mental health within the pilot community are often dominated by skepticism regarding privacy protections and regulatory fairness. Consequently, many pilots rely on self-management strategies rather than formal psychological care (Cahill et al., 2021). This pattern indicates a critical need for mental health interventions that are both confidential and congruent with pilots' professional realities.

Evidence for AI Chatbots in Mental Health Support

AI conversational agents have been used for psychological assessment, prevention, and support across general populations. These chatbots simulate supportive dialogue and guide users through evidence-based techniques like CBT, DBT, and mindfulness training (Farzan et al., 2024; Pham et al., 2022). Research shows that they can effectively enhance emotional regulation, mindfulness, and access to care when human therapists are unavailable (Schillings et al., 2024).

Clinical trials demonstrate mixed but generally positive outcomes. In randomized controlled trials with stressed or subclinical populations, chatbot-guided interventions improved emotion regulation and mindfulness even when reductions in perceived stress were not statistically significant (Schillings et al., 2024). Meta-analytic evidence indicates small-to-moderate decreases in depressive and anxiety symptoms, particularly among users with mild-to-moderate baseline distress (Li et al., 2023). Qualitative findings complement these results by showing that users perceive chatbots as safe and non-judgmental spaces that encourage emotional disclosure, especially for individuals hesitant to seek human support (Chin et al., 2023; Haque et al., 2023).

In terms of assessment, chatbot-administered mental health questionnaires have shown comparable validity to clinician-administered tools and do not appear to amplify socially desirable responses (Schick et al., 2022). These capabilities position chatbots as potential instruments for self-screening, early detection, and psychological education. The cumulative evidence suggests that while chatbots are not replacements for therapists, they may effectively augment traditional mental health care through real-time, scalable, and stigma-free support.

Potential Transferability to Aviation Context

Translating these findings to aviation requires consideration of the profession's distinct constraints and cultural barriers. Because pilots commonly avoid seeking therapy due to fears of career impact and mistrust of existing reporting systems, AI chatbots designed for this population must

emphasize anonymity, data security, and trustworthiness (Cross et al., 2024). Such design priorities are crucial for facilitating engagement among users who value confidentiality. Given that over half of surveyed pilots report healthcare avoidance behaviors related to certification fears (Hoffman et al., 2022), tools that ensure privacy could encourage early self-disclosure of mental health concerns.

Evidence from general populations indicates that chatbot interventions can strengthen emotion regulation and mindfulness, skills that are directly relevant to managing fatigue, stress, and high cognitive load in flight operations (Schillings et al., 2024). Meta-analytic reviews support their efficacy in reducing depressive and distress symptoms (Li et al., 2023), while qualitative studies show that users perceive chatbots as anonymous outlets for emotional expression (Chin et al., 2023). These findings align with prior research showing that pilots often prefer self-reliant coping strategies (Cahill et al., 2021), suggesting that AI-based tools could complement existing behavioral patterns rather than disrupt them.

Chatbots could also be integrated into existing airline peer-support programs. Evidence that human-AI collaboration enhances empathy and conversational quality (D'Alfonso, 2020) implies that hybrid models may improve the effectiveness of peer interventions. Similarly, narrative-based peer sharing has been recommended as a strategy to normalize mental health discussions and reduce misinformation about medical certification processes (Hoffman et al., 2024). Finally, mobile and brief intervention formats common in chatbot delivery are compatible with pilots' operational environments, enabling use during layovers or between duty periods. These findings indicate that AI chatbots may offer a feasible and acceptable adjunct for pilot mental health support by improving coping capacity, facilitating early help-seeking, and reinforcing existing peer-support structures. Beyond chatbots, predictive AI models may be leveraged to identify individuals at risk and guide preventive interventions aimed at maintaining both mental health and flight safety (Ćosić et al., 2024).

Risks, Limitations, and Suitability

While evidence supports the feasibility of AI chatbots for mild or subclinical distress, limitations remain, systematic reviews highlight variability in effectiveness, with improvements typically in the small-to-moderate range and dependent on intervention duration, engagement, and user characteristics (Li et al., 2023). Attrition is a recurrent issue, as many users discontinue use early in the intervention process (Poudel et al., 2025). Although chatbot-based assessments demonstrate validity similar to human-administered measures, they can require greater user effort (Schick et al., 2022).

Privacy and data security are also persistent concerns. Several evaluations of mental health applications reveal weak data-protection practices and extensive third-party data sharing (Dehbozorgi et al., 2025). Furthermore, misunderstandings about chatbot capabilities leads to overreliance and avoidance of professional treatment (Khawaja et al., 2023). These findings

suggest that while AI chatbots can support preventive and adjunctive care, their suitability for severe or high-risk cases is limited. Careful implementation, ethical oversight, and transparent communication about their scope are therefore essential for their responsible use in aviation and other high-stakes professions.

DISCUSSION

Implications for Pilot Mental Health Support

This review highlights that AI chatbots may offer an effective means of addressing long-standing barriers to mental health care among pilots. Persistent stigma and the fear of certification loss often prevent pilots from seeking professional treatment (Cross et al., 2024). By providing confidential, always-available support, AI chatbots can allow pilots to explore mental health concerns privately and safely. Their discreet nature aligns with pilots' preference for self-reliant coping while helping to normalize mental health conversations within a profession that traditionally emphasizes performance and control.

In addition to stigma, pilots experience long and irregular duty hours that limit access to clinicians working standard schedules (Cahill et al., 2021; Venus et al., 2022). AI chatbots operate continuously, providing a source of psychological support during layovers or nonstandard hours. They deliver structured techniques grounded in cognitive behavioral and mindfulness principles that can strengthen emotional regulation and resilience, two protective factors found to be lower among pilots than in the general population (Dugger et al., 2022; Armstrong et al., 2011). By improving self-regulation and adaptive coping, AI chatbots could help mitigate stressors that compromise both well-being and operational safety.

Opportunities From Other AI-Based Systems

Beyond chatbots, other AI technologies can complement pilot mental health programs. Predictive analytics from smartphones and wearables can detect early signs of stress, fatigue, or burnout, supporting timely intervention before symptoms escalate (Pinge et al., 2024). Just-in-time adaptive interventions (JITAIs) can deliver brief coping or mindfulness prompts in response to real-time data such as sleep disruption or elevated workload (Nahum-Shani et al., 2018).

AI has also been incorporated into virtual reality (VR) systems for resilience training, showing reductions in anxiety and post-traumatic stress across high-stress occupations (Ćosić et al., 2024). In aviation, such training could parallel simulator-based technical practice by developing psychological readiness and stress-management skills. Natural language processing (NLP) methods could further assist peer-support and reporting programs by detecting markers of distress (Shing et al., 2018). These tools point toward a layered ecosystem, chatbots for everyday support, predictive analytics, and JITAIs for early detection, VR for structured resilience training, and NLP for monitoring and triage. When integrated under existing wellness

frameworks, this ecosystem aligns with aviation's culture of safety and data-driven prevention.

Ethical, Privacy, and Regulatory Challenges

The adoption of AI mental health tools in aviation necessitates careful attention to ethical and regulatory considerations. Ensuring data protection and confidentiality is critical in professions where disclosure may affect certification, with U.S. systems required to comply with HIPAA and maintain encrypted data storage. Algorithmic bias also poses a risk, as models trained on general populations may not represent pilots' experiences, leading to inaccurate or culturally insensitive outputs (Khawaja et al., 2023). Transparency around training data, validation, and limitations is therefore essential. Additionally, overreliance on chatbots can be problematic since they cannot interpret nuanced emotion or nonverbal cues and may provide inappropriate responses (Coghlan et al., 2023). Sustained use could also foster social withdrawal (Ta et al., 2020), underscoring the importance of defining AI tools as supplements rather than substitutes for professional care.

Organizational and Human Factors Considerations

Successful implementation of AI mental health tools will depend as much on organizational culture and human factors as on technical performance. Pilots value reliability, confidentiality, and procedural integrity, and perceived breaches in such domains could undermine engagement. Building trust requires transparent communication about data use and strong assurances of privacy. Human-centered design approaches can increase acceptance by involving pilots and aviation psychologists in system development. Co-design ensures that chatbot tone, language, and functionality align with pilots' communication norms and operational contexts. At the policy level, organizations such as the Federal Aviation Administration (FAA) and the International Civil Aviation Organization (ICAO) could establish standards for ethical AI use and certification. Airlines may integrate chatbots into existing wellness and safety management systems as voluntary resources, promoting tools for self-care rather than surveillance. Such measures could gradually shift industry's culture toward proactive mental health management while maintaining trust essential to flight safety.

Limitations of Paper

This review is limited to English-language studies published between 2000 and early 2025, which may exclude recent or non-Western research. Most existing studies examine pilots in North American or European contexts, limiting generalizability. More importantly, current evidence for AI mental health tools derives from general populations rather than aviation-specific samples. There are no controlled trials evaluating the acceptability, efficacy, or safety of AI chatbots among pilots. Existing research primarily measures short-term changes in mood or distress, offering little insight into long-term outcomes such as resilience or performance stability. Future studies should therefore employ mixed-methods and longitudinal designs, testing chatbot

interventions in simulator or operational environments, and exploring cross-cultural differences in adoption.

Future Research Directions

Future research should clarify how AI chatbots can function as adjuncts to professional care while maximizing engagement and effectiveness. Studies should examine pilots' perceptions of AI tools, focusing on trust, usability, and confidentiality. Improving chatbot emotional intelligence through adaptive learning could enhance their responsiveness to complex emotions while maintaining ethical safeguards. Given the established relationship between emotional regulation, psychological resilience, and operational safety, investigations should assess whether AI interventions measurably strengthen these capacities. Integrating AI systems into peer-support networks and recurrent training could provide natural entry points for adoption. Collaboration among aviation regulators, human-factors specialists, clinicians, and AI developers will be essential for advancing ethical standards and ensuring safety compliance.

CONCLUSION

AI-driven mental health tools, particularly chatbots, hold considerable promise for supporting pilots, a population uniquely constrained by stigma, regulatory oversight, and demanding schedules. Although pilot-specific trials have yet to be conducted, evidence from broader populations shows that AI chatbots can enhance emotional regulation, mindfulness, and self-awareness while reducing depressive and anxiety symptoms. Their anonymity and round-the-clock availability make them especially compatible with pilots' occupational conditions. Realizing this potential will require addressing ethical and privacy challenges, ensuring cultural and occupational relevance, and embedding these tools within established aviation wellness and safety frameworks. AI chatbots should complement, not replace, professional therapy, expanding access to preventive and low-intensity support. Integrating AI within aviation psychology presents an opportunity to reshape mental health culture across the industry. By promoting confidentiality, emotional regulation, and psychological resilience, AI-based interventions can advance both pilot well-being and flight safety, contributing to a more sustainable and human-centered aviation system.

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