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REVIEW ARTICLE

Deep technologies for responsible gambling: A narrative review of policies and implementation strategies

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ABSTRACT

Background and aims: Deep technologies, such as artificial intelligence, blockchain, and behavioural analytics, have emerged as promising tools to address complex social challenges. However, their integration into leisure activities, particularly online gambling, has raised concerns over the enhancement of user engagement, which might promote problem gambling behaviours. This review aimed to map how deep technologies intersect with responsible gambling regulations across jurisdictions. *Methods:* A qualitative scoping review was conducted to synthesise evidence from academic literature, legal and regulatory frameworks, and relevant grey literature. A comparative analysis was performed across key jurisdictions, including the European Union, the United Kingdom, Malta, and selected non-European countries. *Results:* The review identified very few formal legal instruments that explicitly regulate the use of deep technologies in responsible gambling. The European Union Artificial Intelligence Act introduces binding requirements for high-risk AI systems, including those deployed in gambling, representing a pioneering step toward technology-specific regulation. In contrast, regulatory frameworks beyond Europe were generally non-binding or largely absent, with innovation primarily driven by operators acting voluntarily in the absence of legal mandates. *Discussion and conclusions:* This analysis underscores persistent gaps in legal oversight and advocates for a shift toward proactive, ethics-based governance models that integrate technological accountability and robust consumer protections. Overall, the findings suggest that regulatory frameworks must not only keep pace with rapid technological innovation but also prioritise prevention through enforceable, transparent, and harmonised policies across jurisdictions.

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KEYWORDS

gambling, deep tech, policies, problematic gambling, gambling addiction

INTRODUCTION

As technological innovation continues to accelerate, growing attention has been directed toward the potential risks and ethical implications of deep technologies. These advanced computational systems, such as artificial intelligence (AI), machine learning, and big data analytics, aim to solve complex problems, often operating with high levels of autonomy (Apodaca, Murray, & Frolund, 2023; Pierce, 2023; Robinson, Couto, & Robinson, 2021; TechWorks, n.d.). While holding great promise for addressing social and scientific challenges, the increasing integration of these technologies into commercial and recreational domains has raised major concerns in terms of the mental health of the users (e.g., Coman & Kifor, 2022; Gale & Devine, 2023; Salmon, King, Elstak, McLean, & Read, 2025). Online gambling is one such domain where deep technologies are being used not only to personalise user experiences but also to influence their behaviour in ways that may compromise individual well-being (Mihai, Aleca, & Iordache, 2025; Saran, 2024). This includes fostering prolonged gambling engagement, increasing gambling frequency and expenditure, encouraging impulsive betting behaviours, and reinforcing loss-chasing patterns (Bühringer, Braun, Kräplin, Neumann, & Sleczka, 2013; Calado & Griffiths, 2016; Mihai et al., 2025; Saran, 2024). Consequently, growing concerns have emerged regarding their ethical implications, potential harms, and the adequacy of existing regulatory safeguards. For this reason, this paper aims to present a scoping review of the regulatory frameworks governing the use of deep technologies in online gambling, with particular attention to responsible gambling measures and harm minimisation strategies across jurisdictions, without geographical restrictions.

Online gambling and deep technologies

Online gambling, defined as the act of placing money or something of financial value in a virtual setting on an event with an uncertain outcome (Bühringer et al., 2013) – has been growing globally, engaging millions of users across various platforms (Calado & Griffiths, 2016; European Gaming and Betting Association, 2025; Statista, 2025; Tran et al., 2024; Wardle et al., 2024). Following this trend, gambling operators are leveraging AI-driven algorithms and behavioural analytics to optimize user engagement and maximize revenue (Chao, Trappey, & Wu, 2021; Hassanniakalager & Newall, 2019; Mihai et al., 2025; Saran, 2024). Features such as tailored promotions, adaptive game mechanics, and dynamic betting odds, have the capability to encourage prolonged gambling sessions and higher expenditures (Hassanniakalager & Newall, 2019). Although technological innovations enhance user experience, their implementation can result in the exploitation of cognitive vulnerabilities and the erosion of informed user consent (Binesh & Ghaharian, 2025).

Particularly in online gambling, the limited transparency of algorithmic systems and their manipulative potential (Binesh & Ghaharian, 2025; Lu, 2024), allied to this profit-driven context, has prompted growing scrutiny from researchers, public health advocates, and regulatory bodies (e.g., Chamberlain, Ioannidis, & Bowden-Jones, 2023; Griffiths, Wood, & Parke, 2009; Kuss & Gainsbury, 2021; Marionneau, Ruohio, & Karlsson, 2023; Mihai et al., 2025; Pompidou Group, 2024; Tran et al., 2024; Wardle et al., 2024; Woodhouse & Lalic, 2023). Similarly, aligned with the observed rise in problematic gambling (i.e., harmful gambling patterns that result in adverse personal, financial, and/or social consequences that do not necessarily meet the clinical threshold for gambling disorder), a rising preoccupation over the risks associated with online gambling has also been evidenced (Gambling Commission, 2020; Ghelfi et al., 2023; Tran et al., 2024). These behaviours may represent early stages of a trajectory that leads toward gambling addiction (American Psychiatric Association, 2013, 2022; World Health Organization, 2004), wherein gambling transitions from a reward-seeking activity to a compulsive and compensatory behaviour (Brand et al., 2019).

In response, the gambling industry has introduced a range of responsible gambling technologies, policies and practices, intended to prevent, minimize, and reduce gambling harms through consumer protection, increased awareness of risk, and promotion of informed choice and safe play behaviours (Reynolds, Kairouz, Ilacqua, & French, 2020). These include both passive and active tools, such as self-exclusion mechanisms, customisable limits (e.g., time, loss, or deposit limits), and real-time monitoring systems that generate targeted behavioural interventions (Drosatos et al., 2018; Ghaharian, Binesh, Soligo, Golab, & Abarbanel, 2024; Marchica & Derevensky, 2016; Rodda, 2021). In this context, deep technologies have a clear duality: while they can intensify user engagement through personalisation and gamification, they also hold potential for early prevention of harmful gambling patterns and minimisation of risks. With the sophistication and commercial entrenchment of these systems, important questions have been raised about their governance, transparency, and effectiveness (Gainsbury, Wood, Russell, Hing, & Blaszczynski, 2012; Riley, Oakes, & Lawn, 2024).

It is necessary to outline that the use of tracking tools is commonly associated with the responsible gambling paradigm, which focuses on the individual behaviour rather than on the social determinants of gambling. Applying algorithms to detect signs of problem gambling aims to initiate preventive measures such as recommending expenditure limitation or temporary pauses. However, they can also be used according to a public health approach, which is based on consumer protection against products that cause harm and varied interventions on the social determinants of gambling, and also at the individual level (Wardle et al., 2024).

Prevention and harm minimisation approaches prevail in the public health approach, along with early intervention. This perspective, however, demands mandatory commitments from the industry and a more stringent regulation imposing how gambling operators should act once they detect problematic patterns (Wardle et al., 2024).

Against this backdrop, the present narrative review critically examines the global regulatory landscape governing over responsible gambling technologies in online gambling environments. This review focuses specifically on the use of deep technologies within online gambling platforms, while also considering broader gambling regulatory frameworks when these directly apply to online gambling practices and responsible gambling measures. Specifically, it seeks to understand how legal frameworks address the integration of deep technologies and whether these measures are effective in mitigating gambling-related harm. No geographical restrictions were applied during the review process, allowing for the inclusion of regulatory approaches from jurisdictions worldwide. The review is guided by the following research questions: i) What legislative measures are currently in place to support responsible gambling?, ii) How do existing policies address the integration of deep technologies into responsible gambling?, iii) What gaps exist in current legislation regarding the effectiveness and deployment of these tools?

METHOD

The present review adopts a qualitative scoping approach to synthesise knowledge from academic literature, legal frameworks, and informal sources, with the goal of mapping how deep technologies intersect with responsible gambling regulation across jurisdictions. By integrating multiple source types, the review aims to provide a well-rounded analysis of current practices and emerging trends in this evolving domain. Only materials addressing active regulatory frameworks, currently implemented legislation, or jurisdictions with operative gambling regulations were included in the analysis. All searches were conducted between mid-June and mid-August, 2025.

Academic sources

Scientific literature was retrieved from three major academic databases: Scopus, EBSCO, and Web of Science. A comprehensive search string was developed to identify literature addressing the intersection of gambling, regulatory frameworks, and deep technologies. The following query was adapted slightly to fit the syntax of each database: ("gambl*" OR "loot box*" OR "online casino*") AND ("harm reduction" OR "player protection" OR "responsible tools") AND (polic* OR regulation* OR "legal framework*" OR "legal implementation*" OR legislat*) AND (technolog* OR "deep tech*" OR "advanced technolog*") AND (review* OR synthesis OR overview).

Only articles published in English, Spanish, or Portuguese were considered (the languages spoken by the research team). Studies were excluded if they (i) did not pertain to the gambling industry, (ii) lacked a regulatory or technological focus, or (iii) were purely psychological or clinical without any pertinence to gambling regulation and policy.

The initial search yielded 77 articles. After removing nine duplicates, 68 articles remained for screening through the reading of the abstracts. Of these, 54 were excluded based on relevance criteria. The remaining nine articles underwent full-text analysis, of which only six articles were included in the review. A parallel manual search also identified a further 16 peer-reviewed articles (see Table S1 in Supplementary materials).

Legal sources

Legal and regulatory documents were gathered through manual search strategies based on the authors' known sources in the domain from their prior research in gambling regulation (see Table S2 in Supplementary materials). These included legislation, policy documents, and regulatory reports published by governmental and intergovernmental bodies. European Union (EU) instruments and international regulatory frameworks addressing responsible gambling technologies were particularly considered, and only documents from official and verifiable sources were included (see Table S1 in Supplementary materials).

Informal sources

To complement formal legal documentation, informal sources (e.g., news reports, regulatory briefings, and industry publications) were used to identify recent developments and jurisdiction-specific regulatory changes. These materials served as exploratory inputs and were not treated as primary evidence. All information derived from informal sources was systematically cross-validated against official legal texts, regulatory documents, and peer-reviewed academic publications before inclusion in the analysis (see Table S3 in Supplementary materials).

In addition, ChatGPT (OpenAI, 2025) was used exclusively as an exploratory research support tool during the initial scoping phase. Specifically, it was employed to (1) generate potential keyword combinations, (2) identify possible thematic intersections between emerging technologies and gambling regulation, and (3) suggest alternative jurisdictional comparison angles. All AI-generated suggestions were independently verified through traditional academic database searches, official legal and regulatory documents, and peer-reviewed sources prior to inclusion in the review. ChatGPT (OpenAI, 2025) outputs were not used as evidence, nor did they contribute to data interpretation, legal analysis, normative assessment, or the development of the study findings. The final analytical framework and conclusions were developed exclusively by the authors based on verified primary and secondary sources (see Table S2 in Supplementary materials).

RESULTS

Overall, the retrieved materials provided information on gambling policies and regulatory frameworks across multiple jurisdictions worldwide. However, most of the available evidence originated from European and North American countries. Information from several jurisdictions was comparatively limited, as gambling activities, including online modalities, remain illegal, unregulated, or are still undergoing regulatory development (e.g., Gainsbury & Blaszczynski, 2017; Hancock, Ralph, & Martino, 2018; Kuss & Griffiths, 2012).

Responsible gambling measures and policies

In response to the first research question, most jurisdictions were found to rely on an "informed choice" model, offering voluntary responsible gambling tools (e.g., deposit limits or session timers) without systematic enforcement or evaluation of their effectiveness (Hancock et al., 2018; Jiménez-Murcia et al., 2013; Maas & Nower, 2020). Centralised self-exclusion registers were also identified in several of them, allowing gamblers to exclude themselves from all licensed gambling activities (online and offline). Examples include the Netherlands (*CRUKS*[1]), Denmark (*ROFUS*[2]), Sweden (*Spelpaus*[3]), Cyprus (National Self-Exclusion Platform – NSEP[4]), Portugal (SRIJ's platform[5]), and France (Autorité Nationale des Jeux – ANJ; valid for a minimum of three years[6]).

Beyond voluntary self-exclusion (VSE), operators may provide additional responsible gambling measures, including deposit, loss, and time limits (daily, weekly, or monthly), as well as warning messages delivered through pop-ups (Harris & Griffiths, 2017). While some jurisdictions make these tools optional (e.g., Australia[7] allows but does not mandate them), others impose strict requirements for their implementation. Germany's Interstate Treaty on Gambling[8] is one such example that mandates strict monthly deposit limits and player identity verification (Kolandai-Matchett & Abbott, 2022). Additionally, many countries also require prominent risk warnings, direct links to addiction support services, bans on marketing to minors, and other consumer protections (Hörnle & Carran, 2018; Jiménez, Dittmar, & Portillo, 2025; Pitt, Thomas, Bestman, Daube, & Derevensky, 2017).

Advertising regulations emerged as another central component of responsible gambling legislation. Countries such as Portugal[9] and Brazil[10] limit gambling publicity near schools and youth-focused areas, while Germany prohibits gambling advertising on television during specific hours (i.e., 6 a.m. to 9 p.m.).[11] Belgium[12] and Italy[13] have enacted a near-complete advertising ban. In contrast, countries such as Malta[14] and Romania[15] require operators to execute and maintain in-house responsible gambling programs (i.e., behavioural monitoring, staff training, and contributions to independent research), while Ireland[16] and the United Kingdom[17] oblige operators to fund a national gambling harm treatment and prevention program (Bowden-Jones et al., 2022).

Integrations of advanced technologies into responsible gambling

Concerning the second research question, advanced technologies, including predictive analytics, behavioural monitoring, and automated systems, were less frequently represented within formal regulatory frameworks. For example, Ontario's online gambling regulations encourage personalised dashboards and "nudge" messages to players, but these are not independently audited by the regulator (Maas & Nower, 2020). Meanwhile, many operators have developed voluntary innovations, such as real-time expenditure monitoring, predictive risk analytics, and smart notifications of risky play (Gainsbury & Blaszczynski, 2017), but these are used at the operator's discretion and are not mandated by law.

Some jurisdictions have adopted more integrated digital infrastructures. In Norway and Sweden, state-owned lottery and casinos use mandatory player cards for all gambling, allowing centralised tracking of play. This system enforces the setting of personal loss and time limits, after which an automatic block is imposed – a measure that seems to result in lower problem-gambling rates among Norwegians (Engebø, Torsheim, & Pallesen, 2021; Thompson, 2025; Rossow & Hansen, 2015). Likewise, South Korea's electronic

[1] https://cruksregister.nl/.

[2] https://www.spillemyndigheden.dk/en/rofus-rofus-.

[3] https://www.spelpaus.se/.

[4] https://nba.gov.cy/wp-content/uploads/24.01.30-NSEP-Directive-FINAL-1.pdf.

[5] https://www.srij.turismodeportugal.pt/pt/sos-jogadores/autoexclusao-e-proibicao.

[6] https://anj.fr/ts/.

[7] https://www.legislation.act.gov.au/View/sl/2002-28/current/html/2002-28.html.

[8] https://www.gluecksspiel-behoerde.de/images/pdf/201029_Gluecksspielstaatsvertrag_2021.pdf.

[9] https://diariodarepublica.pt/dr/detalhe/decreto-lei/66-2015-67098359.

[10] https://www25.senado.leg.br/web/atividade/materias/-/materia/158047.

[11] https://www.gluecksspiel-behoerde.de/images/pdf/201029_Gluecksspielstaatsvertrag_2021.pdf.

[12] https://web.archive.org/web/20240118234613/https://www.ejustice.just.fgov.be/cgi/article_body.pl?caller=summary&language=nl&numac=2023030509&pub_date=23-03-08.

[13] https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legge:2018;87.

[14] https://www.mga.org.mt/app/uploads/Directive-2-of-2018-Player-Protection-Directive.pdf.

[15] HG nr. 111/2016 (https://static.anaf.ro/static/10/Anaf/legislatie/HG_111_2016.pdf) and OUG 77/2009 (https://onjn.gov.ro/wp-content/uploads/Onjn.gov.ro/Legislatie/Rom%C3%A2n%C4%83/OUG-nr.-77.pdf).

[16] Gambling regulation act 2024 (https://www.irishstatutebook.ie/eli/2024/act/35/enacted/en/html).

[17] https://www.legislation.gov.uk/uksi/2025/213/regulation/4/made.

player card automatically suspends a gambler's access when they exceed preset limits (Park, Choi, Kim, Boots, & Lee, 2021).

Regulatory gaps

In relation to the third research question, current legislation reveals a significant gap: it does not clearly differentiate between traditional gambling and emerging gambling-like activities. Modern online games often include loot boxes (e.g., Gibson, Griffiths, Calado, & Harris, 2022), skin betting (Harris, Griffiths, & Gibson, 2025), or cryptocurrency speculation (Delfabbro, King, Williams, & Georgiou, 2021) with algorithmically-curated rewards – mechanics that can be as immersive and addictive as slot machines (Hancock et al., 2018; Harris et al., 2025; Spicer et al., 2022). Privacy regulations also emerged as a relevant consideration. Data protection frameworks (such as the EU's General Data Protection Regulation [GDPR]) may limit the sharing of behavioural data across operators, potentially constraining the development of cross-platform monitoring systems and AI-based harm detection approaches.

On the policy level, international bodies have begun to respond. Organisations such as the Economic Co-operation and Development (OECD)[18] and the EU[19] have issued general AI guidelines calling for transparency, fairness, and human-centric design in high-risk applications (including gambling). The EU Artificial Intelligence Act (EU AI Act)[20] now explicitly covers gambling technologies employing user profiling, predictive analytics, or algorithmic personalization. Under the Act, any AI system used in gambling that is designed to exploit players' vulnerabilities (e.g., by encouraging addictive behaviour) is strictly prohibited. Gambling operators utilizing "high-risk" AI systems, such as automated behavioural monitoring tools, affordability checks, or AI-driven interventions, must conduct rigorous risk assessments and implement transparency and accountability measures. This includes explaining how AI models make decisions, maintaining human oversight of automated systems, and keeping detailed audit logs of AI outputs (e.g., Coraggio, 2025; Future of Life Institute, 2024). By contrast, low-risk tools (e.g., generic time-limited bonuses or static promotions that do not adapt to an individual's data) are exempt from these requirements unless they involve personalization.

Outside the EU, the global regulatory landscape is fragmented. Malta[21] stands out as an exception, with detailed rules for blockchain and distributed ledger technologies that mandate regulatory approval and robust player protections. In most jurisdictions, like the United Kingdom, Australia, Canada, and Spain, operator-led innovation has driven the integration of real-time monitoring, predictive analytics, and smart notifications. However, these remain largely voluntary and unregulated (Gainsbury & Blaszczynski, 2017; Hancock et al., 2018; Jiménez-Murcia et al., 2013; Maas & Nower, 2020).

DISCUSSION

The present review aimed to comprehensively summarise the legislative and regulatory documentation concerning the integration of deep technologies within the gambling industry, particularly regarding their use in responsible gambling and user protection initiatives. Across the three research questions, the findings indicate that: (1) most jurisdictions continue to rely predominantly on voluntary responsible gambling approaches, such as self-exclusion registers, expenditure limits, and warning systems, (2) advanced technologies, including predictive analytics, behavioural monitoring, and AI-driven interventions, remain only partially integrated into formal regulatory frameworks, despite some pioneering initiatives, and (3) important regulatory gaps persist regarding emerging gambling-like activities and the governance of AI applications in gambling environments. Overall, the findings suggest that regulatory systems continue to evolve more slowly than technological innovation.

As previously noted, recent years have been marked by increasing pressure on governments, regulators, and gambling operators to promote healthier gambling practices and strengthen consumer protection measures (Chamberlain et al., 2023; Griffiths et al., 2009; Kuss & Gainsbury, 2021; Kuss & Griffiths, 2012; Marionneau et al., 2023; Mihai et al., 2025; Pompidou Group, 2024; Tran et al., 2024; Wardle et al., 2024; Woodhouse & Lalic, 2023). However, despite these efforts, many technological innovations implemented within gambling environments continue to focus primarily on customer engagement, retention, and monetisation rather than harm prevention. Consequently, legal and regulatory frameworks appear to be progressively outpaced by technological development, often remaining in a reactive position and adapting only after innovations have already been implemented by the industry (Gainsbury & Blaszczynski, 2017; Hancock et al., 2018; Maas & Nower, 2020).

The findings also suggest that current responsible gambling policies continue to rely predominantly on voluntary approaches. Although voluntary self-exclusion

[18] https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449.

[19] http://data.europa.eu/eli/reg/2024/1689/oj.

[20] European Parliament, Council of the European Union. (2024). (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending certain Union legislative acts (Artificial Intelligence Act). EEA relevance. Directorate-General for Communications Networks, Content and Technology. Official Journal of the European Union, L 1689, 1–144. https://eurlex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32024R1689.

[21] https://www.mga.org.mt/app/uploads/Policy-on-the-use-of-Distributed-Ledger-Technology-by-Authorised-Persons-1.pdf.

(VSE) programs can support gamblers seeking to reduce or interrupt gambling involvement, their effectiveness depends entirely on voluntary enrolment. This limits their preventive capacity, as many at-risk individuals do not actively choose to self-exclude (e.g., Hopfgartner, Auer, Helic, & Griffiths, 2023). Furthermore, available evidence indicates that the long-term effectiveness of VSE remains moderate: individuals who adopt longer exclusion periods appear less likely to relapse, whereas short-term exclusion periods often show limited effectiveness in reducing problematic gambling behaviours (e.g., Hopfgartner et al., 2023). Similarly, warning messages, deposit limits, expenditure controls, and awareness-oriented interventions aim primarily to increase player awareness and encourage self-regulation (Auer & Griffiths, 2024). Nevertheless, evidence suggests that these measures may produce limited long-term effects in reducing gambling-related harm (Auer & Griffiths, 2016), particularly among problem gamblers and high-risk users (Auer & Griffiths, 2018).

Enforcement also remains inconsistent across jurisdictions. Despite the existence of advertising restrictions and responsible gambling requirements, gambling advertisements continue to be widely displayed in public spaces and social media environments, frequently including promotions from illegal operators. Moreover, sponsorship agreements involving major sports teams and public figures continue to expose younger audiences to gambling-related messaging (Hörnle & Carran, 2018; Jiménez et al., 2025).

Overall, the findings indicate that current legislation frequently treats responsible gambling technologies as optional enhancements rather than mandatory protective measures. Existing regulations continue to focus predominantly on traditional interventions, including self-exclusion registers, expenditure limits, session timers, and pop-up warnings. Although some jurisdictions have adopted stricter measures, for example, Germany's mandatory monthly deposit limits and player identity verification requirements (Kolandai-Matchett & Abbott, 2022), and others have implemented more integrated digital infrastructures, these initiatives remain exceptions rather than the norm.

A limited number of jurisdictions have pioneered integrated technological systems with promising results regarding gambling-related harm reduction. Examples include Norway and Sweden, where mandatory player cards enable centralised monitoring and automatic enforcement of expenditure and time limits, as well as South Korea's electronic player card system that automatically suspends access once predefined thresholds are exceeded. Nevertheless, these approaches remain uncommon internationally, as integrated monitoring and automated enforcement mechanisms are not legally required in most jurisdictions.

The review further identified important tensions regarding advertising restrictions. Although limiting gambling exposure may contribute to harm reduction, preliminary evidence suggests that stricter advertising bans may also unintentionally encourage migration toward unlicensed offshore operators (Gainsbury & Blaszczynski, 2017; Jans, Hudders, & Newall, 2024). Consequently, regulatory approaches must balance exposure reduction with mechanisms capable of maintaining users within regulated environments.

The emergence of gambling-like activities presents additional challenges. Features such as loot boxes, skin betting, esports gambling, and cryptocurrency-based gambling applications increasingly resemble traditional gambling mechanisms while frequently remaining outside existing regulatory definitions. This is particularly concerning given the high participation of younger users within these environments. However, regulatory systems in many jurisdictions have not yet updated legal definitions to adequately encompass these emerging forms of play.

Additional challenges emerge from data governance and privacy regulations. Although frameworks such as the General Data Protection Regulation (GDPR) strengthen consumer privacy protections, they may also fragment behavioural data across operators, limiting opportunities for coordinated monitoring and public-health interventions. Consequently, potentially valuable behavioural insights often remain siloed within private companies rather than being integrated into broader consumer protection strategies (Aimo, Bassoli, & Marionneau, 2023; Hörnle & Carran, 2018).

At the international level, recent regulatory developments suggest increasing recognition of these issues. In particular, the EU Artificial Intelligence Act represents one of the most comprehensive regulatory frameworks addressing AI use in gambling environments. Rather than prohibiting AI broadly, the EU approach seeks to restrict manipulative or opaque applications while permitting lower-risk and non-personalised forms of automation (Future of Life Institute, 2024). This framework places particular emphasis on transparency, accountability, human oversight, and risk assessment procedures for technologies involving profiling, behavioural monitoring, and predictive analytics.

Nevertheless, important regional differences remain. Globally, many innovative developments continue to be driven by gambling operators, who increasingly deploy AI tools, predictive analytics systems, behavioural monitoring technologies, and personalised interventions ahead of regulators (Casey, 2023; Fisher et al., 2025). Consequently, regulatory authorities often remain in a reactive position, attempting to adapt existing legislation after technological implementation has already occurred. The European Union currently presents the strictest and most comprehensive obligations, particularly regarding technologies that profile, predict, or influence player behaviour. In contrast, many jurisdictions, including the USA, continue to rely primarily on voluntary approaches or remain in early stages of regulatory development (National Conference of State Legislatures, 2025). This divergence highlights an increasing gap between formal regulatory structures and industry-led technological innovation in responsible gambling.

Looking ahead, emerging technologies such as AI-powered analytics may offer important opportunities for proactive harm reduction by facilitating the early detection of risky gambling behaviours and enabling tailored

interventions (e.g., Marionneau et al., 2023). However, their implementation remains heterogeneous, and evidence indicates that their effectiveness depends strongly on context, methodological approaches, and governance mechanisms (Aimo et al., 2023; Jiménez et al., 2025). In particular, the limited transparency surrounding commercial risk assessment models restricts independent evaluation and public accountability (Marionneau, Ristolainen, & Roukka, 2025). Accordingly, scholars and regulators increasingly agree that technology alone cannot solve gambling-related harms. AI systems require strong accountability mechanisms, explainability standards, ethical oversight, and independent auditing procedures (Ukhova, Marionneau, Nikkinen, & Wardle, 2025). Simultaneously, calls for reforms targeting exploitative game design features, stronger international cooperation, and clearer regulation of gambling-like activities continue to increase (Pham & Davies, 2024).

In summary, reducing gambling-related harm in the era of AI will require integrated and multi-stakeholder strategies. Jurisdictions demonstrating stronger harm minimisation approaches, such as the United Kingdom, Sweden, and Norway, tend to combine regulatory measures with sustained investments in treatment services, education, prevention initiatives, and research. Responsible gambling legislation and AI regulation remain essential; however, they are insufficient in isolation. Regulatory systems must evolve continuously alongside technological innovation and remain embedded within broader public health frameworks supported by rigorous human oversight to effectively protect vulnerable users (Thomas et al., 2023).

Limitations

Although an effort was made to integrate the most comprehensive body of knowledge available on the application of deep technologies within the gambling industry, the literature and legislative frameworks on this subject remain scarce. Few published studies have examined how these technologies may be leveraged to enhance the safety and integrity of online gambling. Furthermore, the present review relies, in part, on sources and materials selected according to the authors' expertise in the field, which may have introduced a degree of selection bias and consequently influenced the findings. Nonetheless, the authors contend that the systematisation and critical analysis provided here represent a valuable step toward informing the development of more precise, evidence-based, and user-centred policies and regulatory measures.

Implications

The analysis here demonstrates an urgent need for regulatory reform. Table 1 summarises key regulatory and implementation gaps alongside corresponding actionable recommendations for AI-driven responsible gambling

Table 1. Key gaps in AI-driven responsible gambling frameworks and corresponding recommendations

Identified gap	Recommendation (policy/practice-oriented)
Predominance of voluntary and reactive responsible gambling measures	Mandate proactive, AI-driven responsible gambling systems, including real-time behavioural monitoring, dynamic risk scoring, and automated harm-prevention interventions integrated into gambling platforms
Limited enforcement of responsible gambling tools across jurisdictions	Establish minimum global regulatory standards requiring mandatory implementation of core responsible gambling features (e.g., deposit limits, time limits, behavioural alerts) with enforceable compliance mechanisms
Lack of transparency in AI-based gambling systems	Require explainable AI standards, including disclosure of model logic, intervention criteria, and decision pathways to regulators and audited summaries for oversight bodies
Insufficient independent auditing of responsible gambling technologies	Introduce mandatory third-party auditing and certification of AI-driven gambling systems, including periodic performance evaluations and harm-prevention effectiveness assessments
Fragmented cross-operator and cross-jurisdictional data availability	Develop regulated data-sharing frameworks enabling privacy-preserving collaboration (e.g., federated learning, anonymised data trusts) to support real-time harm detection across operators
Tension between data privacy regulations and harm prevention needs	Implement GDPR-compliant public health exemptions or governance frameworks that allow controlled data use for harm prevention under strict ethical and regulatory safeguards
Operator-led innovation without regulatory oversight	Require pre-deployment regulatory approval for high-risk AI systems used in gambling, including risk assessment and validation before market release
Limited integration of advanced analytics in regulatory frameworks	Update gambling legislation to explicitly incorporate AI-based predictive analytics and automated intervention systems as regulated safety tools
Emerging gambling-like mechanics not captured by current laws (e.g., loot boxes, crypto-gambling, skin betting)	Expand legal definitions of gambling to include gambling-like digital mechanics and algorithmically driven reward systems under regulatory oversight
Weak harmonisation across international regulatory systems	Promote international coordination (e.g., EU/OECD-led frameworks) to establish baseline standards for AI governance in gambling and ensure cross-border consistency
Lack of accountability mechanisms for AI-driven interventions	Implement mandatory logging systems, audit trails, and human-in-the-loop oversight for all automated responsible gambling interventions
Limited real-world effectiveness validation of AI tools	Require longitudinal evaluation studies and real-world effectiveness testing of AI-driven responsible gambling interventions before and after deployment

systems. A shift must be made from voluntary and reactive measures to the mandatory integration of proactive initiatives, aimed at detecting and preventing the unfolding of problematic gambling behaviours (e.g., real-time behavioural monitoring systems, AI-based risk scoring, and automated intervention triggers). Persistent legal gaps, particularly regarding emerging gambling modalities and influential product features, warrant globally harmonised and updated legislation to address evolving risks and ensure consistent player protection. Data privacy regulations are essential to uphold the effectiveness of responsible gambling strategies. However, they often impede necessary cross-operator and cross-jurisdictional data sharing. Therefore, policies being developed need to establish a clear balance between public health imperatives and the protection of private data (e.g., privacy-preserving data-sharing mechanisms such as anonymisation, federated learning, or regulated data trusts), which will enable widespread and improved real-time harm mitigation. Accountability challenges, including limited transparency and insufficient auditing of responsible gambling technologies, call for clear standards, independent inspection, and explainable AI requirements to strengthen efficacy and trust, including mandatory algorithmic audits, documentation of model decision logic, and regulator access to system performance metrics. The fragmented global regulatory landscape further complicates enforcement, underscoring the need for greater international cooperation and standardised practices, such as shared regulatory benchmarks for AI-driven gambling tools and cross-border compliance frameworks. Ultimately, embedding responsible gambling within broader public health strategies, integrating regulation, education, treatment, and research, and adopting agile policy frameworks and innovation-support mechanisms will be critical to match the rapid technological developments and achieve effective, proactive, and transparent harm reduction (Dores et al., 2026).

CONCLUSION

The aim of the present review was not to provide an exhaustive review of all legislation related to responsible gambling, but rather to offer a systematic overview of key developments, particularly regarding the integration of advanced technologies and how regulatory frameworks have responded to this shift. From this perspective, a central conclusion emerged: while significant progress has been made, especially in select jurisdictions, most regulatory systems still emphasize remediation over prevention. Despite growing awareness of the risks associated with online gambling and the increasing availability of technological tools capable of prevention and early intervention, formal legislation remains limited, fragmented, and often reactive. Many of the current initiatives employing AI, behavioural monitoring, and blockchain appear to be driven primarily by industry innovation and commercial objectives rather than by independent scientific research or regulatory frameworks. This imbalance highlights the urgent need for greater investment in independent, publicly funded research to evaluate both the risks and benefits of these technologies in gambling contexts.

To create a safer and more responsible gambling environment, future efforts should focus on establishing coherent, forward-looking policies that mandate the ethical and transparent deployment of deep technologies, prioritise harm prevention, and ensure that innovation serves the public interest. Strengthening collaboration between researchers, policymakers, and the gambling industry is essential to align technological advancement with the protection and well-being of individuals in the online gambling space.

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LIST OF ABBREVIATIONS

AI	Artificial intelligence
EU	European Union
OECD	Economic Co-operation and Development
VSE	Voluntary self-exclusion

SUPPLEMENTARY MATERIAL

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