

Optimization of the Mechanism for Determining Liability for Torts Involving Virtual Property on the Internet under the Civil Code and Data Analysis of Judicial Practice

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ABSTRACT Although the Civil Code of the People's Republic of China establishes a basic framework for civil rights protection, provisions concerning online virtual property remain principle-oriented and lack specific operational rules for determining tort liability. Based on the basic spirit and principles of the Civil Code, this paper aims to construct a systematic and refined mechanism for determining tort liability involving online virtual property. The study first clarifies theoretical controversies and practical difficulties in liability determination through literature review. It then uses big data analysis to extract, clean, and quantitatively analyze relevant judicial cases published on China Judgments Online from recent years. From the dimensions of case trends, infringing parties, behavior patterns, liability basis, and compensation determination, the paper analyzes the current state of judicial practice, identifying both disagreements and emerging consensus. Based on these findings, it proposes optimization paths for determining responsible parties, clarifying fault elements, proving causation, valuing virtual property, identifying electronic evidence, and defining platform liability.

INDEX TERMS online virtual property, tort liability, civil code, judicial practice, data analysis

I. INTRODUCTION

ARTICLE 127 of the Civil Code of the People's Republic of China expressly provides "Where the law provides for the protection of data and virtual property on the internet, such provisions shall apply." This article establishes for the first time at the level of basic civil law the legal status of virtual property. However, it should also be noted that this article is an indicative provision and it needs to be brought into force in a more complete way through special laws or the interpretative contributions provided by the judicial interpreters. Currently, the theoretical debate on the issue of whether virtual property constitutes property rights, creditor's rights, intellectual property rights, or a novel type of property right, has yet to calm. This theoretical uncertainty has a direct effect on judicial practice, which results in the different courts, and even the same court at different times potentially issuing vastly different judgments on similar or identical torts. This legal ambiguity leads to a lack of uniformity and predictability in the application of the law.

Therefore, under the macro-background of the implementation of the Civil Code, how to transform its basic principles and spirit into specific, operable rules for

determining liability for virtual property infringement has become a major issue urgently needing to be addressed by both legal theorists and practitioners. Simple theoretical deductions or case studies are insufficient to address this systemic challenge; it is necessary to shift the perspective to the macro-level landscape of judicial practice and, through large-scale data analysis, empirically reveal the true logic, common practices, and potential problems in current tort liability determination. This study aims to systematically review existing research findings and utilize data mining techniques to conduct quantitative and qualitative analysis of massive amounts of judicial documents. This paper answers the following core questions: First, what is the main judicial logic followed by Chinese courts in handling disputes involving online virtual property infringement? What consensus and disagreements exist regarding key elements such as the responsible party, principles of liability, causation, and damages? Second, based on the framework of the Civil Code, how should a clearly structured, well-defined, and effective mechanism for optimizing tort liability determination be constructed to guide judicial practice? Third, at the operational level, how can thorny issues such as virtual property valuation, electronic evidence identification,

and the boundaries of platform liability be resolved?

II. RELATED WORK

The legal regulation of virtual property is always in tension between technological iteration and institutional response. Sugianto and Hananto[1] found that the price of virtual property shows significant spatial clustering. Wahyuningsih and Chen[2] explored the relationship between cryptocurrency market fluctuations and virtual real estate prices. Yadulla et al.[3] collected public sales data from multiple blockchain metaverse platforms (such as Decentraland and Cryptovoxels) and conducted descriptive statistics and trend analysis. Spithoven[4] used a combination of theoretical analysis and case studies to examine the governance mechanism of the blockchain-based virtual world and compared it with traditional digital platforms. Deng[5] analyzed the current status of protection of virtual property rights in online games from the perspective of civil law and proposed targeted civil law regulation, such as promulgating laws and regulations on virtual property rights in online games to provide a reference for protecting the virtual property rights of relevant subjects in online games.

Sanjaya and Rajavenkatesan[6] extracted and reviewed selected cases and legal issues in current protection practices, attempting to reveal the gap between law and practice. Lim[7] used legal hermeneutics and comparative law to analyze the regulation of NFT-based digital art in virtual space by copyright laws of various countries. Nusratullaevich[8] analyzed the legal characteristics of virtual property as a new type of digital object through theoretical deduction and compared the regulatory strategies of different jurisdictions in Europe, America and Asia. Jon and Yang[9] conducted an in-depth analysis of the key provisions of the Virtual Asset User Protection Act and compared it with previous regulatory guidelines and enforcement cases. Rane[10] studied the special technical-legal intersection of disputes related to virtual assets and its tension with traditional dispute resolution mechanisms. This study empirically deconstructs the judicial logic of existing tort liability determination through data mining and typological analysis of large court judgments, seeks judicial differences and consensus, and proposes a set of optimized tort liability determination mechanisms with clear levels and specific requirements based on the Civil Code and the concept of digital government, in order to promote the protection of virtual property from theoretical consensus to judicial unification.

III. METHODS

To achieve the aforementioned research objectives, this study employs a combination of qualitative and quantitative research methods, specifically including literature review, case data analysis, and comparative analysis. Among these, big data analysis of judicial cases is the core of this empirical study.

A. LITERATURE REVIEW METHOD

This study is the first that examines at a systemic level and analyzes the academic literature, laws and regulations, policy documents and authoritative judicial interpretations about the legal attributes of online virtual property and who is liable in torts at home and abroad. It focuses on the general provisions of the Civil Code and relevant judicial interpretations (for example, in respect to the issue of online liability for torts and protection of personal information) on the elements of liability for torts, principles of liability and damages, and the various theoretical perspectives and schemes advanced by scholars concerning how the aforementioned provisions of the Civil Code should be applied to the virtual property scenario. This process is aimed at clarifying the theoretical foundation, basic points of contention and rule design ideas that can be learned from in this study, and providing theoretical support and analytical framework for subsequent empirical analysis and mechanism construction [11].

B. CASE DATA ANALYSIS METHOD

The empirical data for this research paper is mainly taken from the “China Judgments Online” website. To make the data as comprehensive and representative as possible, a systematic data collection and processing process was scheduled.

1) Data retrieval strategy

Full-text search will be carried out by using keywords including “online virtual property,” “virtual property infringement,” “game equipment,” “account theft,” “virtual currency,” and any other related terminology combination. The time period of the search is from January 1, 2021, as from now on the date of the Civil Code is effective until December 31, 2024. The cause of action is limited to “civil cases,” with a further focus on categories such as “tort liability disputes,” “online tort liability disputes” and “property damage compensation disputes.”

2) Data cleaning and screening

After the retrieval of a huge volume of judgment documents with an initial retrieval, several rounds of manual cleaning and screening was conducted. First, documents that do not relate to infringement of online virtual property (such as documents with only keywords but undervalued as having no relation to the case), procedural rulings (such as rulings on jurisdictional objection) and documents with incomplete content were excluded [12-13]. Second, the case summaries and reasoning sections of remaining documents were carefully read in order to ensure that indeed, the core disputes of the selected cases did involve infringement of online virtual property. Finally, a valid library of 312 judgment documents (case sample case library) was obtained for in-depth analysis.

3) Data Analysis Framework

For the valid cases selected for the study, a standardized coding table was created for content analysis. The main dimensions of coding include:

- (1) basic case information (such as the court of trial, level of trial, and year of judgment);
- (2) type of infringing party (such as network service provider, ordinary user, hacker, etc.);
- (3) type of infringed virtual property (such as game equipment, virtual currency, network account, etc);
- (4) mode of infringing behavior (such as illegal stealing, account stealing, playing based on system vulnerabilities and unfair banning, etc);
- (5) principle of liability impacting determined by the court (such as the principle of fault liability, or the application All coding work has been done independently by 2 researchers and cross-checking has been undertaken to ensure consistency and reliability of the coding work.

C. COMPARATIVE ANALYSIS AND LOGICAL DEDUCTION METHOD

Based on the empirical analysis and combining the theoretical knowledge that can be gained from literature research, the result of the data analysis is interpreted and discussed thoroughly. The consensus practices and points of disagreement in the judicial practice are obtained by comparing the differences in judgments in different cases, with similar facts and circumstances [14-15]. Furthermore, given the methods of legal hermeneutics and logical deduction, based on the section of the tort liability of the Civil Code, and other principles, but referring to the cutting-edge concepts of the digital governance, the systematic construction is made on how to optimize the mechanism of determination. This process puts stress on logical self-consistency and the workability of rules, in an effort to make sure that the proposed mechanism can respond to the concerns raised by the theorists, as well as to the actual needs of the judicial practice.

IV. RESULTS AND DISCUSSION

Based on a systematic analysis of 312 valid court judgments, this study reveals the judicial practice landscape of liability determination for infringement of online virtual property in the era of the Civil Code, and discusses the core issues.

A. ANALYSIS OF THE OVERALL LANDSCAPE AND TRENDS OF JUDICIAL PRACTICE

Data analysis shows that since 2021, the number of online virtual property infringement disputes has shown a steady upward trend, with a significant increase between 2023 and 2024. This reflects the increasing frequency of virtual property rights disputes as digital economic activities deepen. Table 1 shows that since the implementation of the Civil Code, the number of such disputes has shown a significant upward trend, with online game virtual property being the main type of litigation.

TABLE 1. Analysis of Basic Circumstances of Online Virtual Property Infringement Cases (N=312)

Analysis Dimensions	Category	Number of cases	Percentage (%)
Referee Year	2021	45	14.4
	2022	68	21.8
	2023	92	29.5
	2024	107	34.3
Court level of adjudication	Basic People's Court	198	63.5
	Intermediate People's Court	101	32.4
	Higher People's Court	13	4.1
Main types of virtual property involved in litigation	Virtual assets in online games (equipment, accounts, game currency)	265	85.0
	Virtual currency/points/tokens	25	8.0
	Online accounts (social media, e-commerce, etc.)	18	5.8
	Other (domain names, digital collectibles, etc.)	4	1.2

The growing number of cases highlights the urgent need to enhance legal protection of virtual property. The high percentage of disputes where virtual property plays a major role in games seems to show that this is currently an area where infringement is a hotbed, likely as a result of the add-on value of the gaming industry being very high, user engagement, and trading of virtual items. This indicates that there needs to be more consideration by legislation and the judiciary area. Figure 1 illustrates the trends in the level of support by court in the infringement claims from 2021 to 2024 including the distribution of the proportions of three outcomes: "full support," "partial support," and "dismissal of the claim."

As shown in Figure 1, from 2021 to 2024, the number of cases in which plaintiffs requested "full support" and "partial support" both showed a steady upward trend, consistent with the overall upward trend in the number of infringement cases. However, the absolute number of cases with "rejection requests" also increased, and the proportion was relatively high in 2022. This may reflect that in the early stages of the implementation of the Civil Code, some courts adopted a more cautious attitude towards the elements constituting virtual property infringement, especially the proof of damage and the determination of value. This phenomenon reflects the cautious exploration process in judicial practice during the early stages of the implementation of the Civil Code. On the one hand, the surge in the total number of cases led to a corresponding increase in the absolute number of dismissed cases; on the other hand, because Article 127 of the Civil Code is only a principle provision and lacks specific operational rules, courts tend to adopt a more conservative and cautious approach when facing emerging and difficult issues such as the valuation of virtual property, the acceptance of electronic evidence, and the boundaries of platform liability. In particular, when the plaintiff's evidence is insufficient or the value of the property is difficult to determine, courts are more likely to dismiss the claims, thus resulting in a relatively high dismissal rate in the early stages.

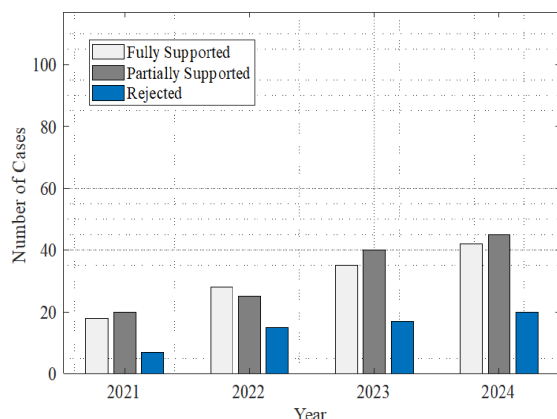


FIGURE 1. Annual Distribution of Plaintiffs' Requests for Support in Cases of Infringement of Virtual Property Online

B. CORE CONTROVERSIES AND JUDICIAL DISAGREEMENTS IN THE DETERMINATION OF TORT LIABILITY

Through coded analysis of the reasoning behind court judgments, it was found that the core points of contention in determining tort liability are highly concentrated in the following aspects:

1) Determining the responsible party

Particularly the boundaries of liability for network service providers (such as game operators and social media platforms). When users' virtual property is damaged due to third-party infringement (such as account theft) or platform actions (such as banning accounts or rolling back data for violations), whether and to what extent the platform should bear responsibility is a key point of contention. In the sample, approximately 30% of the cases listed the platform as a defendant or added it as a third party.

2) Determination of fault elements

There are differing interpretations regarding platform fault. One view holds that the platform is only liable if it acted intentionally or with gross negligence in causing user losses (such as failing to promptly fix security vulnerabilities or clearly mishandling user complaints). Another view tends to impose a higher security obligation on the platform; if the user can prove that the damage occurred within the platform's control, the platform may be presumed to be at fault, requiring the platform to prove its innocence.

3) Proving causation

Users often find it difficult to prove a direct and unique causal relationship between their losses and the platform's actions or the alleged infringement. For example, proving the link between account theft and loss of virtual assets becomes difficult due to the susceptibility of electronic evidence to alteration.

4) Determining the amount of damages

This is the biggest challenge in the judicial practice. Courts have different rubrics for deciding what virtual property is worth. The main methods include: calculate according to the user's recharge amount, according to the prices of market transactions (including the prices on third-party trading platforms), taking into account the cost of time and efforts of the user comprehensively, and even refuse to claim for damages due to the inability to determine the value. In the basic point of investigating damage compensation, the practice of the judiciary shows a high rate of support but various methods of determination. While courts have upheld the claims of plaintiffs for damages in most cases, the three major approaches to valuing virtual property are the amount of the user's recharge, evidence of market prices, and court discretion. (See Table 2).

The confusion about value assessment is one of the direct causes of different judgments in similar cases. Simply using the amount recharged is likely to fail in expressing actual market value of the property or the emotional investment by the user; market price references have difficulties like legal sanction on transaction and great price fluctuations; and court discretionary decision highly depends upon the judgement duty, without any guidance. This is in great need of the establishment of a multi-layered more operational set of value assessment guidelines. Simultaneously, in judging platform liability, there is necessarily to be a balance between the protection of user rights on the one hand and the burden on platforms on the other, while taking into account the specifics of the content and criteria of judgment of the platform's security obligations.

C. OPTIMIZATION PATH OF TORT LIABILITY DETERMINATION MECHANISM

Based on empirical findings and closely aligned with the tort liability system of the Civil Code, this paper proposes the following optimization pathways:

First, the foundation for applicability of the principles of liability attribution ought to be articulated. While the fault-based liability principle is the fundamental principle for determining liability for virtual property infringements, which aligns with the spirit of the Tort Liability section of the Civil Code and offers advantages in balancing the interests of all parties, the principle of pure fault-based liability may lead to difficulties for users in providing evidence, thus failing to achieve substantive fairness, given the significant technological and informational asymmetry between internet service providers and users. Therefore, it is necessary to introduce a reasonable allocation mechanism for the burden of proof under specific conditions. For network service providers their liability should be on the basis fault for violating their security obligations. These security obligations should be specified, for example requiring platforms to adopt technical measures that meet industry standards to protect user assets, accessible complaint and redress channels, as well as fulfil their obligation to provide

TABLE 2. Support for Liability for Damages Related to Virtual Property and Methods of Value Assessment (N=312)

Compensation details and determination methods	Category	Number of cases	Percentage (%)	Remark
Will the court support the claim for damages?	Support (all or part)	238	76.3	
	turn down	74	23.7	
Supporting methods for determining the value of claims (N=238)	Calculated based on user top-up amount or direct monetary investment.	125	52.5	
	Refer to market prices (such as prices on trading platforms).	68	28.6	
	The court, at its discretion (taking into account factors such as investment costs and property utility), determined...	42	17.6	
	Authenticated by a third-party evaluation agency	3	1.3	

sufficient explanation and notification regarding disclaimers in standard terms and conditions.

Secondly, we need to establish a hierarchical and categorized system of requirements for determining liability.

1) For different infringing parties

For infringements between ordinary users, the focus is on examining subjective intent or negligence and the directness of the infringing act. Regarding the platform's liability, a review chain of "obligation-violation-consequence" is constructed, focusing on determining whether it has fulfilled its reasonable duty of care and security measures commensurate with its technical capabilities and business scale. In such situations, since users often lack access to the operational details of the platform's internal security measures, if they can provide preliminary evidence proving that the damage occurred during the platform's control period and was not caused by their own actions, the burden of proof can be appropriately shifted. This would require the platform to prove that it has fulfilled a reasonable duty of care commensurate with the nature of its services, technical capabilities, and risk control obligations. This method of liability determination based on specific circumstances does not universally adopt a presumption of fault. Rather, it is a judicial rule adjustment designed to address the evidentiary difficulties in specific types of disputes, while adhering to the principle of fault liability. Its purpose is to achieve substantive fairness in the allocation of the burden of proof.

2) For different behavioral patterns

For active infringements such as illegal theft and account theft, the causal relationship is relatively direct; for platform inaction (such as failure to prevent hacker attacks), the burden of proof needs to be reasonably allocated. It can be considered to transfer the burden of proof that the user has fulfilled its obligations to the platform after the user completes the initial evidence (proving that the damage occurred and its connection with the platform's services). In such cases, to alleviate the difficulties users face in providing evidence due to technological and information asymmetry, a rule for mitigating the burden of proof can be introduced.

Users need to provide "preliminary evidence," which should be specific and actionable, and should at least include:

(1) proof that their virtual property on the platform has been reduced or lost due to reasons other than their own initiative (such as login records or asset transfer records not performed by them);

(2) proof that they have promptly reported or complained to the platform about the damage.

Once the user completes the above preliminary evidence, the burden of proof shifts to the platform, which must prove that it has fulfilled its reasonable duty of care commensurate with its business nature and technical capabilities, or prove that the damage was caused by the user's gross negligence.

Third, explore diverse methods for assessing damages. A priority order is recommended: First, examine whether there is an explicit agreement between the parties, but the validity of such an agreement must be subject to review under the Civil Code's rules regarding standard form clauses. If relevant clauses in the platform service agreement constitute standard form clauses that unreasonably exempt the platform from liability, increase the user's liability, or exclude the user's main rights (e.g., unilaterally claiming that virtual property has "no economic value" or that "users only have the right to use the account but not ownership"), then according to Articles 496 and 497 of the Civil Code, such clauses should be deemed invalid and cannot be used as the basis for determining the amount of compensation. Only when the terms of the agreement are legally valid can the amount of compensation be determined based on the agreed content. Second, for the items with an active, legal and public market, reference can be made to market transaction prices; Third, for the items without market reference but with direct cash investment by the user, the recharge amount can be proportionally determined on the basis of the depreciation of properties and consumption; Finally, for the items without market or direct investment, the court can determine the appropriate amount taking into account all the elements such as the difficulty in acquiring the property, its For virtual property with special commemorative value or great personal attachment (such as one unique account which represents a hard work), the application of emotional

distress compensation can be cautiously explored in extreme cases, but strict conditions must be set.

Fourth, improve the rules of evidence. Courts are encouraged to actively utilize the provisions on electronic evidence in the Civil Code and the Civil Procedure Law, recognizing the evidentiary value of compliant electronic data hash values, timestamps, and other technologies. Rules that reduce the burden of proof should be appropriately applied to alleviate the difficulties users face in providing evidence due to technological asymmetry. Specifically, hash value technology can solidify the existence and ownership information of virtual property at a specific point in time, providing an objective and tamper-proof evidentiary basis for solving the problem of determining causation. For example, by comparing hash values before and after infringement, the process of transferring specific virtual property (such as a unique digital fashion design) from user control to the infringer's control can be clearly proven. Meanwhile, timestamp technology can accurately record the time of the infringement, which is crucial for distinguishing platform liability and determining the scope of losses. By combining hash values and timestamps with valuation systems, such as using blockchain timestamps to record the real-time market price of virtual property on specific trading platforms, credible and efficient data support can be provided for courts to adopt the "market price" valuation method, thereby effectively addressing the "valuation" problem.

Fifth, the relationship between service agreements and tort liability should be handled prudently. When determining tort liability, courts should review the legality of the relevant clauses in the platform's service agreement. If a clause itself constitutes an undue restriction on the user's legitimate rights or exempts the platform from its legal obligations (for example, an unreasonable exemption from the platform's security obligations in a standard clause), then that clause should not be used as a basis for the platform's exemption from liability. Courts should independently judge the fairness and legality of the agreement's content based on the provisions of the Civil Code regarding the validity of standard clauses, preventing platforms from using standard agreements to indirectly commit torts.

Based on the principle of fault liability and considering the difficulties in liability determination revealed in empirical analysis, this study constructs optimized guidelines for liability determination for different tortfeasors, aiming to provide a more operational hierarchical review framework for judicial practice. (See Table 3.)

TABLE 3. Optimization Guidelines for Layered Determination of Liability for Virtual Property Torts Based on the Fault-Based Liability

Liability Requirements	Principle	
	For ordinary users who infringe on rights	For network service providers (platforms)
Infringement	Illegally acquiring, damaging, deleting, or illegally trading other people's virtual property, etc.	1. Direct infringement: Deleting or freezing user assets without cause. 2. Indirect infringement/breach of security obligations: Failure to fix major security vulnerabilities in the system, slow response or improper handling of user reports of third-party infringement, unreasonable exemption from liability in standard terms.
Fault determination	Intentional or negligent (breach of general duty of care).	Breach of reasonable duty of care and duty to ensure safety. The standard of fault may be higher than that for ordinary users, but substantive review is required. If a user proves that the damage occurred within the platform's control and was not caused by their own fault, the platform may be presumed to be at fault, subject to the platform's rebuttal. If a user can provide preliminary evidence to prove that the damage occurred within the platform's control, the platform can be presumed to be at fault, and the platform must provide evidence to refute this.
Causal relationship	Users need to prove a causal relationship between the infringing act and the resulting damage.	Users must provide preliminary evidence that the damage is related to their use of the platform's services. If the platform violates its security obligations, there must be a causal link between the violation and the extent of the damage or the platform's failure to prevent the damage from occurring.
Damage assessment	The above-mentioned diversified evaluation methods (agreement, market price, recharge conversion, discretionary) are adopted.	Same as above. The scope of liability borne by the platform should be commensurate with the degree of its fault.

This optimization mechanism is in an attempt to concretize and contextualize the general principles of the Civil Code. Its essential is to make determination of liability more targeted and precise by subdividing subjects and behaviors. While adhering to the fundamental principle of fault liability, the introduction of rules for shifting the burden of proof in specific situations aims to correct the technological and informational asymmetry between users and platforms, and to achieve a unity of procedural and substantive justice. Diversified methods of assessing damage aim to offer clear and flexible tools of valuation for the courts for more rational judgments rather than arbitrary judgments. Of course, the final implementation of this mechanism is still waiting for the confirmation and refinement of the Supreme People's Court by issuance of guiding cases or formulation of special judicial interpretation.

V. CONCLUSION

This study, with the help of large-scale data analysis of judicial precedents on legal issues related to infringement disputes on online virtual property as the prerequisite since the implementation of the Civil Code, is able to clearly point out the challenges faced by the current mechanism of tort liability determination in reality: the increase in the number of cases reflect the urgency of protecting, but there is a large difference between the judgment on the determination of the responsible party, judgment on the determination of fault, and especially the judgment on the value of the damage, which reflects the judicial dilemma caused by the lack of unified rule. The legal protection of virtual property is in

a critical transitional period at this moment and is moving from the domain of the declaration of legal principles to the construction of specific rules. Based on this, this paper proposes a systematic optimization mechanism for liability determination. This fundamental approach ensures that the legal framework can effectively address intellectual property challenges. This mechanism, centered on the principle of fault liability, constructs a hierarchical system of liability determination elements to refine the liability composition for different infringers and behavioral patterns. Furthermore, addressing the pain points and challenges in the operation of judicial organs, this mechanism calls for the adoption of diversified damage assessment methods and reasonable rules for the allocation of the burden of proof, providing clear guidance for judicial decisions.

AUTHOR CONTRIBUTIONS

Jialan Zhao designed, collected and analyzed the data, and drafted the manuscript. Jialan Zhao conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Jialan Zhao participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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