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An Innovative Science Communication Model for the Prevention and Control of Foodborne Poisonous Mushroom Poisoning in Ethnic Minority Areas: The 'Farewell to Mushroom Poisoning, Happiness for Every Household' Project in Pengshui, Chongqing

Hu Xin
Pengshui Miao and Tujia Autonomous County People's Hospital, Chongqing, China

Abstract: Accidental poisoning by wild poisonous mushrooms remains a conspicuous public health problem in mountainous and rural regions across the world. In the ethnic minority communities of the Wuling mountainous area in southwest China, long-standing mushroom-gathering customs, language and cultural barriers, and difficult terrain leave conventional health communication materials poorly matched to local needs and limited in effectiveness. This paper draws on the 'Farewell to Mushroom Poisoning, Happiness for Every Household' science communication project conducted in Pengshui Miao and Tujia Autonomous County, Chongqing, and presents a dual-track intervention that combines technology-enabled communication with cultural immersion. Artificial-intelligence image recognition and three-dimensional molecular visualization are used to make the content accurate and readily perceptible, while Miao and Tujia cultural elements are woven into bilingual communication, folk-art adaptation and a village-elder endorsement mechanism so that health knowledge fits local culture and reaches residents effectively. Scenario-based interventions are tailored to five audience groups, and all materials are re-engineered for the 2G-network conditions found at the grassroots level. The project is expected to raise the one-month retention of key first-aid knowledge to 75% among the target population and to reduce poisoning incidents markedly. The model offers a replicable practical template for foodborne-disease communication in ethnic minority areas and adds empirical evidence to the study of cross-cultural health communication.

Keywords: Poisonous Mushroom Poisoning; Science Communication; Ethnic Minority Areas; Cultural Adaptation; Health Communication

1. Introduction

Acute poisoning caused by the accidental ingestion of wild toxic mushrooms accounts for a substantial share of the global foodborne-disease burden. According to World Health Organization sources, tens of thousands of mushroom-poisoning incidents are reported worldwide each year, with case-fatality ratios of 5%–10%, and the overwhelming majority occur in rural and mountainous settings where health-care resources are comparatively thin. Analysis of data from China's national public health emergency reporting system recorded 570 poisonous-mushroom incidents between 2014 and 2023, involving 2,768 cases and 604 deaths; mushroom poisoning accounted for 56.24% of all deaths from food poisoning over the period, which makes it the leading cause of food-poisoning mortality in the country. In 91.75% of incidents the mushrooms had been picked by the victims themselves, and 86.67% of events took place in the home [1]. Incidents cluster between June and September, which together contributed 83.51% of the total (Figure 1), and the southwestern provinces of Yunnan, Sichuan and Guizhou reported the largest shares, at 35.79%, 16.32% and 10.70%, respectively [1].

The most recent surveillance figures point in the same direction. In 2024, incidents were reported across 28 provincial-level administrative divisions; Sichuan, Yunnan, Hunan, Guizhou and Chongqing recorded the highest numbers, the events concentrated in June through October with a June peak, and deaths were still reported in Guizhou, Sichuan and Chongqing [2]. Provincial studies from the high-incidence regions consistently show summer–autumn clustering, household concentration and a heavier burden in the countryside. In Hubei,

more than 95% of incidents reported between 2021 and 2023 occurred in homes [3]; Shandong logged 290 incidents and 26 deaths from 2012 to 2024 [4], and Guizhou produced similar findings for 2011–2021 [5]. A spatial analysis of Hunan for 2016–2022 found the distribution of incidents significantly associated with temperature, humidity and forest cover [6], while a time-series analysis of Mengzi in Yunnan showed that incidents tracked closely with the timing of the rainy season and with temperature changes over 2018–2023 [7]. Taken together, these studies help identify high-risk periods, areas and populations, and they suggest that prevention needs to move upstream, before the gathering behavior ever occurs.

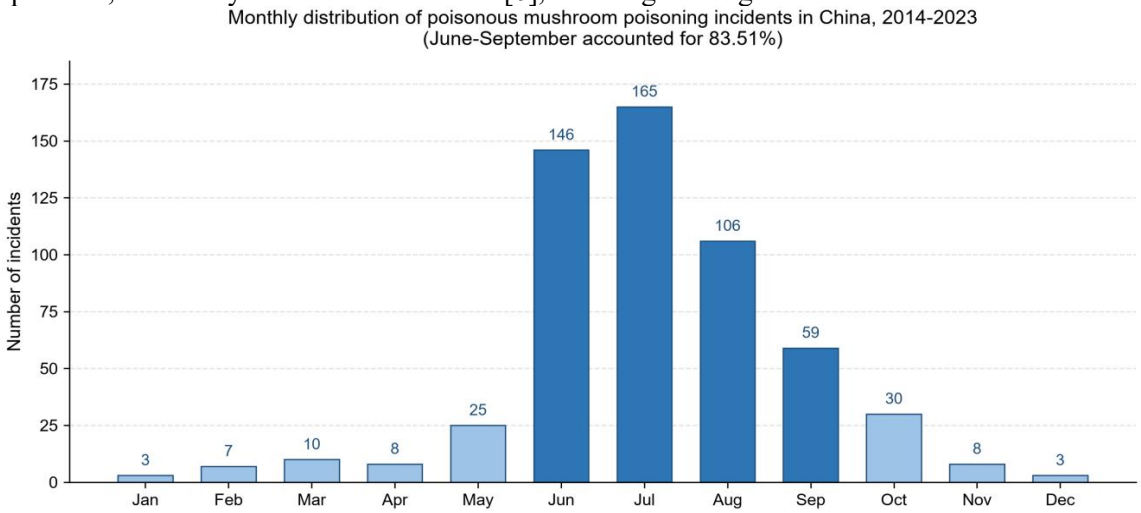


Figure 1. Monthly Distribution of Poisonous Mushroom Poisoning Incidents in China, 2014–2023

The Wuling mountainous area of southwest China enjoys a mild, humid climate and abundant wild mushrooms, and local communities have gathered wild fungi for generations. Pengshui Miao and Tujia Autonomous County lies in the heart of these mountains, where Miao and Tujia people make up more than 60% of the population and many residents still identify and collect wild mushrooms on the basis of inherited experience. Scattered villages, difficult mountain terrain and weak grassroots health resources make the prevention situation especially serious. Research from Chuxiong in Yunnan illustrates the complexity: 315 poisoning cases fell into seven clinical categories, including acute liver injury, acute renal failure and neuropsychiatric illness, with acute liver injury carrying the highest fatality [8]. The diversity of toxic species, compounded by the range of clinical damage they cause, adds to the difficulty of prevention and treatment at the grassroots level.

For years, grassroots mushroom-prevention communication in China has relied on generic, didactic materials, and these fare poorly in ethnic minority areas. Language differences and gaps in cultural understanding leave many residents unreceptive to Mandarin-language content and unlikely to retain it, a mismatch often described as materials that 'do not fit the local soil.' Weak network infrastructure in remote mountain areas compounds the problem by keeping digital resources from reaching residents, and the digital divide deepens health inequality. International studies indicate that culturally adapted, community-participatory health education outperforms generic interventions when it comes to raising knowledge among indigenous populations [9, 10]. How to build a communication model suited to the culture and resource conditions of ethnic minority areas thus stands as a pressing practical question in public health. Drawing on the 'Farewell to Mushroom Poisoning, Happiness for Every Household' project in Pengshui, this study explores an approach that blends modern technology with local culture. Its aim is to ease the core mismatch that plagues health communication in ethnic regions, cut the disability and death toll from mistaken ingestion, and offer a transferable scheme for comparable areas.

2. Practical Difficulties of Mushroom-Prevention Communication in Ethnic Areas

Pengshui Miao and Tujia Autonomous County sits in the Wuling mountainous area in southeastern Chongqing and is a typical ethnic

minority county whose residents retain their own languages, folk customs and ways of life. Forest cover is extensive and wild fungi are numerous; spring and summer bring both the peak season for gathering and the peak period for poisoning. Mountain geography leaves many villages in remote locations, the service radius of grassroots health care is large, and getting communication resources to the community is difficult. Some older residents speak only Miao or the local dialect and understand generic Mandarin materials only to a limited degree, which forms a major barrier to passing on health knowledge. Fieldwork and grassroots health practice point to four shortcomings in current mushroom-prevention communication—insufficient cultural adaptation, insufficient technological reach, insufficient scenario targeting and overreliance on a single channel. Their manifestations and the responses built into the dual-track model are summarized in Table 1.

Table 1. Shortcomings of Conventional Mushroom-Prevention Communication in Ethnic Areas and the Responses of the Dual-Track Model

No.	Shortcoming	Specific manifestation	Response in the dual-track model
1	Insufficient cultural adaptation	Materials are produced in generic Mandarin, with no grounding in local languages, cultural understanding or local context; residents "cannot understand, remember or trust" them, and knowledge conversion is low.	Bilingual Miao-Chinese products that incorporate folk songs, ethnic medicine and traditional proverbs, supported by a village-elder endorsement mechanism.
2	Insufficient technological reach	Digital products are designed for 4G/5G networks, whereas many remote villages have only 2G coverage; videos will not play smoothly and coverage gaps result.	Videos are specially encoded and compressed into standard-definition versions for 2G networks, substituting technical optimization for hardware upgrades.
3	Insufficient scenario targeting	Communication relies on single formats such as centralized lectures and posters, without distinguishing high-risk settings (gathering, trading, cooking, field study) or tailoring content to different groups.	Scenario- and audience-specific content designed around five audience groups and typical high-risk settings.
4	Overreliance on a single channel	Heavy reliance on internal health-administration channels fails to activate traditional networks such as village broadcasts, folk events and local authorities, limiting reach and credibility.	A multi-channel network built on village doctors, elders, broadcasts and folk festivals, with online and offline delivery working together.

These four shortcomings reinforce one another. Cultural barriers raise the threshold for receiving knowledge, network conditions keep digital materials from arriving, and single formats and channels make it difficult for even the limited content that does get through to translate into changed behavior. Mushroom-prevention communication in ethnic areas therefore cannot simply copy approaches used in cities or generic regions; content production, technical adaptation, channel organization and trust building all need to be rebuilt together. That is the practical basis for the dual-track model of technology-enabled communication and cultural immersion.

3. Construction and Implementation of the Dual-Track Model

With the core goal of lowering mushroom-poisoning incidence and protecting food safety for mountain residents, the project is organized around a dual strategy of technology-enabled communication and cultural immersion. Artificial intelligence and visualization address the abstract, vague and imprecise character of conventional communication, while the cultural resources of the Miao and Tujia peoples are drawn on to embed health knowledge in the local context, overcoming weak acceptance and low credibility. The two tracks work together and are delivered through scenario-based, targeted intervention for five audience groups, producing a precise, efficient and sustainable system; the overall framework appears in Figure 2.

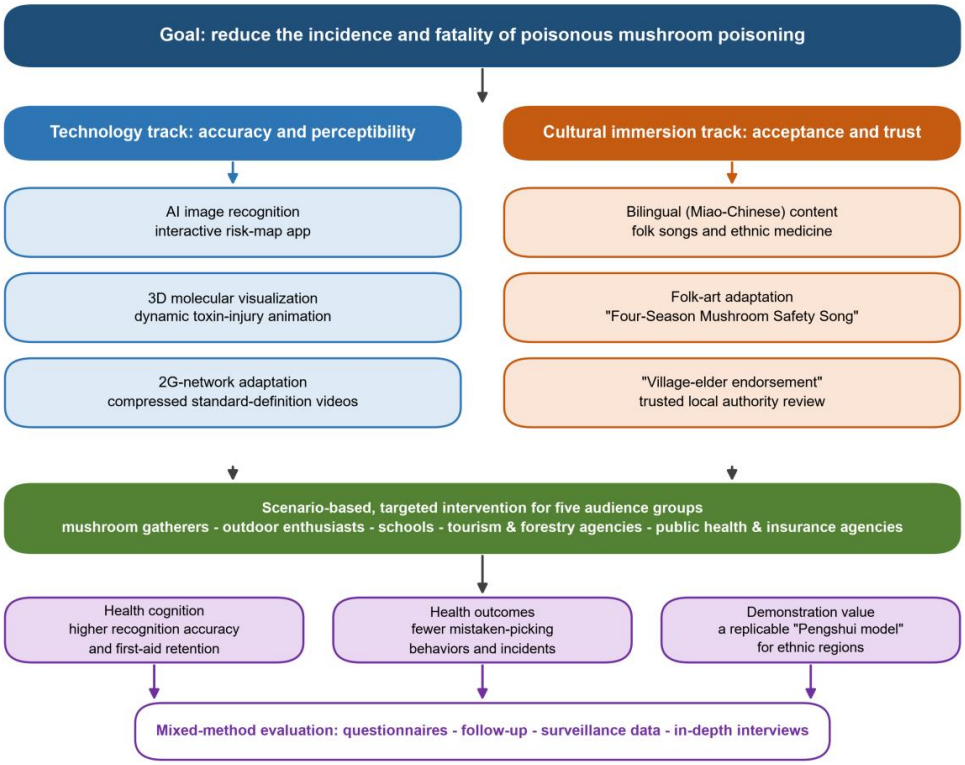


Figure 2. Framework of the Dual-Track Intervention Combining Technology-Enabled Communication with Cultural Immersion

AI mushroom recognition and risk maps. The project introduces AI image recognition through an interactive 'mushroom risk map' application. Deep learning has shown considerable accuracy in wild-mushroom identification in recent years; for example, a recognition model built on a multimodal bilinear pooling mechanism performs well on fungal images set against complex backgrounds [11]. The application contains a database of poisonous species commonly found in Pengshui, and a user who photographs a wild mushroom quickly receives species identification and a risk-level assessment together with emergency-response guidance. Distribution and historical poisoning data are used to generate a county risk heat map that displays risk levels by area and period, giving residents precise guidance when gathering and supporting grassroots prevention planning.

Three-dimensional molecular visualization. Three-dimensional animation and microphotography dynamically render the molecular-level damage that major toxins such as the amanitins inflict on liver cells. Toxicological research shows that α-amanitin inhibits RNA polymerase II in eukaryotic cells, which causes a progressive decline in messenger RNA, blocks protein synthesis and ultimately drives hepatocyte apoptosis and necrosis—the central mechanism behind deaths from Amanita mushrooms [12,13]. The visualization turns this abstract mechanism into concrete imagery and highlights the long latent period, the deceptive 'false recovery' phase and the severe crisis phase characteristic of Amanita poisoning, addressing the long-standing communication problem in which 'the danger cannot be explained and the principle cannot be understood.'

Adaptation to low-network conditions. Given the 2G coverage typical of remote mountain villages, every video product is specially encoded and compressed into a standard-definition version that plays smoothly on 2G networks, while offline materials such as illustrated leaflets and audio broadcasts that require no network are also supplied. Rather than waiting for networks or conditions to improve, the design substitutes technical optimization for hardware upgrades and offers a low-cost, workable way to run digital health communication in resource-poor settings, an approach grounded in the principle of health equity.

Bilingual content and cultural elements. Every product is produced in both Mandarin and Miao, voiced in the local dialect of Anzi Miao village and interwoven with elements of classic Miao songs such as Jiao A Yi, which strengthens

cultural familiarity and recognition. Miao understandings of traditional medicine are integrated with modern toxicology into a dual knowledge system of 'modern medicine plus ethnic wisdom.' An intervention among indigenous people in Malaysia confirmed that interactive health education delivered in the local language markedly raises participants' disease knowledge [9], and co-design work with ethnic minority communities in Colombia likewise showed that blending local and expert technical knowledge makes health education more acceptable and sustainable [10].

Folk-art adaptation. The traditional Tujia art of weeding gongs and drums is adapted into a Four-Season Mushroom Safety Song, whose lyrics weave in the risk features, identification points and first-aid methods associated with each season. Broadcast over village loudspeakers and performed at folk festivals, the song lets health knowledge reach listeners in a form they enjoy and pass on across generations. Folk art, with its strong rhythm, repetition and embeddedness in familiar scenes, fits the memory reinforcement and behavioral cues that health knowledge requires and can improve both acceptance and long-term retention.

Village-elder endorsement. The project introduces a village-elder endorsement mechanism, in which respected Miao elders and ethnic-culture specialists review and approve communication content. Modern warning phrases are combined with traditional sayings such as 'mushrooms in the third month are more poisonous than snakes,' and the elders' standing in the community lends the materials credibility, converting 'an outside health requirement' into 'local life wisdom' and breaking through the trust barrier. Co-design research on cross-cultural health education likewise identifies the participation of community authorities and opinion leaders as key to acceptance and compliance [10].

On the basis of these products, the project tailors content and delivery channels to five core audiences—high-risk mushroom gatherers, outdoor enthusiasts, schools and educational institutions, tourism and forestry agencies, and public health and medical-insurance agencies—according to their behavior and information needs; the specific strategies are shown in Table 2.

Table 2. Scenario-Based, Targeted Intervention Strategies for Five Core Audience Groups

No.	Target group	High-risk settings	Key intervention content	Main channels
1	High-risk mushroom gatherers	Field gathering; home cooking	Identification features of local poisonous mushrooms; the no-gathering/no-eating rule; core first-aid skills such as retaining samples, inducing vomiting and seeking prompt care.	Village-doctor visits, on-site demonstrations, village broadcasts
2	Outdoor enthusiasts	Hiking, camping, field study	Risk reminders; the 'three don'ts'; use of the AI recognition tool; poisoning and emergency-call procedures.	Risk-map app, scenic-area notices, outdoor organizations
3	Schools and educational institutions	School, home, field study	Mushroom safety integrated into safety-education courses; children bringing risk awareness home to their families.	Standardized courseware, class meetings, home-school linkage
4	Tourism and forestry agencies	Scenic areas, forests, markets	Videos and warning signs at key sites; visitor education and identification training for staff.	Scenic-area screens, warning signs, special training
5	Public health and insurance agencies	Surveillance, early warning, emergency response	Coverage expanded through the three-tier public health network; audience feedback mechanisms; improved regional warning and emergency systems.	CDC network, follow-up monitoring, information platforms

In implementation, the project presents three innovations. The first is one of model: rather than following a purely technical or purely didactic route, it builds a dual-track approach for ethnic-area mushroom prevention, in which the technology dimension handles accuracy and perceptibility and the cultural dimension handles acceptance and credibility. The second is one of mechanism: traditional community authority is combined with modern health communication through a village-elder endorsement system that activates local social capital and traditional communication networks. The third is one of approach: rather than waiting for improved infrastructure, the project adapts to existing 2G conditions and substitutes technical optimization for hardware upgrades, which produces an inclusive digital-communication scheme for

low-resource environments.

4. Expected Outcomes, Evaluation and Conclusions

The expected outcomes span three levels—health cognition, health outcomes and demonstration value—and an indicator system defines the targets and data sources, as shown in Table 3. In terms of coverage, the project is expected to reach more than ten key administrative villages and over 20,000 direct recipients. For behavior and outcomes, mistaken gathering and eating are projected to fall by 40%, the number of poisoning incidents by 30% year on year, and secondary injuries caused by improper post-poisoning handling to decline markedly. As demonstration value, the work should yield a replicable, transferable 'Pengshui model' for ethnic-area mushroom prevention, with the added benefits of ecological protection and reduced insurance burdens.

Table 3. Indicator System for Evaluating Expected Outcomes

No.	Level	Indicator	Expected target	Assessment method and data source
1	Health cognition	Recognition accuracy for local common poisonous mushrooms	Increase of at least 60% over baseline	Structured pre-/post-intervention questionnaires
2	Health cognition	One-month retention of key first-aid steps	75%	One-month follow-up retesting
3	Health behavior	Incidence of mistaken wild-mushroom gathering and eating	40% reduction	Household follow-up combined with self-report
4	Health outcomes	Number of mushroom-poisoning incidents	30% year-on-year reduction	CDC poisoning-incident surveillance data
5	Health outcomes	Secondary injury from improper post-poisoning handling	Marked reduction	Case review and medical-institution records
6	Demonstration value	Key villages covered; direct recipients	10+ villages; 20,000+ recipients	Project process records
7	Demonstration value	Transferability of the model	A 'Pengshui model' extended to comparable areas	Expert review and experience summaries

Evaluation combines quantitative and qualitative methods. The same questionnaire before and after the intervention measures changes in knowledge, and one-month follow-up tracks retention and behavior change. Surveillance data on poisoning incidents allow contemporaneous comparison of real prevention effects, while in-depth interviews with residents, village doctors and elders gather feedback on the suitability of content and the effectiveness of channels, creating an evaluate–feedback–improve loop that refines the materials over time. Where conditions allow, quasi-experimental comparison with control townships will be introduced to control confounding further and strengthen the evidence on effectiveness.

Health communication in ethnic minority areas is, at its core, an exercise in cross-cultural communication. Generic materials perform poorly because they overlook differences in local cultural understanding and communication context: for modern public health knowledge to be accepted by traditional communities, it must be 'assembled' through local culture and woven into the group's beliefs, emotions and discourse. The dual-track model uses cultural adaptation to make people willing and able to listen, and technology to make the content clear and memorable, while scenario-based, audience-specific intervention drives the conversion of knowledge into behavior; it offers a practical framework for cross-cultural health communication. International experience likewise identifies cultural adaptation, community participation and local language as core ingredients of effective health education for indigenous populations [9,10], and the design logic of the dual-track model is consistent with that evidence.

The 'Farewell to Mushroom Poisoning, Happiness for Every Household' project addresses a genuine public health pain point in ethnic areas by integrating modern information technology with Miao and Tujia traditional culture, producing a mushroom-prevention communication system that is precise, inclusive and readily accepted, and easing the mismatch that conventional health communication encounters in ethnic regions. The model demonstrates both the value of technological innovation and the part local culture plays in health communication, and its lessons apply not only to foodborne-disease prevention but also to health communication in other fields within

ethnic areas. The outcome targets remain projections: the stability of AI recognition for the area's complex species and the long-term effects of folk-art products await verification through longitudinal monitoring and controlled evaluation during implementation. Future work will continue to expand the local poisonous-mushroom database, refine the recognition model, and explore extending the approach across the Wuling mountains and comparable ethnic minority communities nationwide, offering practical reference for foodborne-disease prevention in mountain and indigenous communities across the world.

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