Preplanned Studies

Mushroom Poisoning Outbreaks — China, 2021

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Summary

What is already known about this topic?

Mushroom poisoning is one of the most serious food safety issues in China. Most poisoning incidents resulted from eating mushrooms causing gastroenteritis and psycho-neurological disorder from which patients usually could fully recover. Most deaths resulted from species causing acute liver failure and rhabdomyolysis, and the remaining deaths were attributed to acute renal failure and hemolysis.

What is added by this report?

In 2021, the total number of investigations was 327 from 25 provincial-level administrative divisions, involving 923 patients and 20 deaths, and the overall mortality was 2.17%. Overall, 74 poisonous mushrooms causing 6 different clinical syndromes were successfully identified, 15 of which were newly recorded in China as poisonous mushrooms.

What are the implications for public health practice?

Considering the potential huge risks for collecting and eating wild mushrooms, we strongly advise not collecting and eating unfamiliar wild mushrooms. Promoting knowledge about poisonous mushrooms is essential and urgent to reduce mushroom poisonings. Precise species identification timely after mushroom poisoning is important for appropriate diagnosis and treatment. Many deaths were ascribed to delayed hospitalization.

In recent years, an efficient mushroom poisoning control and prevention working system involving governments, clinical doctors, CDC experts, and mycologists has been established in China (*1*–*2*). Based on the technical support network, mushroom poisoning information was systematically collected by WeChat, telephone calls, and E-mails. Mushroom samples were collected by CDC staff or hospital professionals. Species identification depending on morphological observations and DNA data was carried out by mycologists from China CDC, universities, and research institutes nationwide. Related clinical symptoms data were summarized from the hospital records (*1*–*2*). In 2021, 327 independent mushroom poisoning incidents from 25 provincial-level administrative divisions (PLADs) involving 923 patients and 20 deaths were investigated. About 74 poisonous mushrooms resulting in 6 different clinical syndromes were successfully identified. Among the 74 species, 15 species were newly recorded in China. *Hygrocybe rimosa*, *Inosperma muscarium*, and *Pseudosperma arenarium* nom. prov. were three new species discovered in China. *Mallocybe fulvoumbonata*, *Psilocybe ovoideocystidiata*, and *P. papuana* were 3 records new to China, and the 9 remaining previously edibility unclear species were confirmed to be poisonous from poisoning incidents.

In 2021, a total of 327 mushroom poisoning incidents involving 923 patients and 20 deaths were investigated and the overall mortality was 2.17%. The number of cases ranged from 1 to 20, the average number of cases per incident was 2, and 6 incidents involved more than 10 patients. Of these cases, 68 patients from 14 incidents ate poisonous mushrooms purchased from a market or given by friends; 46 patients from 10 incidents were poisoned after eating dried mushrooms and 113 patients from 28 incidents ate mixed mushrooms.

Monthly distribution analysis showed that mushroom poisonings occurred every month, centered from May to November involving 294 incidents, 796 patients, and 18 deaths, and reached its peak in August (Figure 1). The first death appeared in early March from Guangdong. The top 3 months for deaths caused by poisonous mushrooms were September, July, and November with 7, 5, and 4 deaths, respectively.

In terms of geographical distribution, mushroom poisoning incidents were reported in 25 PLADs. Overall, 10 PLADs had over 10 incidents, and Hunan, Yunnan, Sichuan, Fujian, and Guizhou were the top 5 PLADs; 12 PLADs had over 20 patients and Yunnan, Hunan and Sichuan were the top 3 PLADs. Yunnan, Guizhou, and Guangdong had 4 deaths, Sichuan and

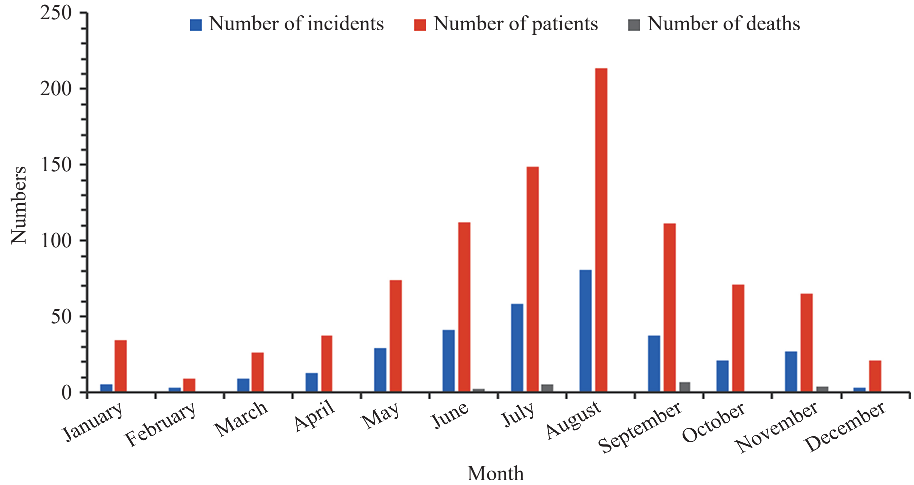

FIGURE 1. Monthly distribution of mushroom poisonings in China, 2021

Shanxi had 2 deaths, followed by Hunan, Guangxi, Beijing, and Xizang (Tibet) with 1 death each, and the remaining 16 PLADs had no deaths. Southwest China [Yunnan, Sichuan, Guizhou, Chongqing, and Xizang (Tibet)] was the most severely affected region with 138 incidents, 426 patients, and 11 deaths. Detailed information for each PLAD was shown in Table 1.

In 2021, 74 species of poisonous mushrooms caused 6 different clinical syndromes; acute liver failure, acute renal failure, rhabdomyolysis, hemolysis, gastroenteritis, and psycho-neurological disorder were successfully identified (Supplementary Table S1, available in http://weekly.chinacdc.cn/). A total of 15 species were newly recorded as poisonous mushrooms and were added to the Chinese poisonous mushroom list. *Hygrocybe rimosa*, which causes gastroenteritis, *Inosperma muscarium* and *Pseudosperma arenarium* nom. prov., which stimulated parasympathetic nervous system, were three new species discovered in China. *Mallocybe fulvoumbonata*, *Psilocybe ovoideocystidiata,* and *P. papuana* resulted in psycho-neurological disorders were three records new to China. *Agaricus atrodiscus*, *Boletellus indistinctus*, *Lactarius purpureus*, *L. rubrocorrugatus*, *Lactifluus pseudoluteopus*, *Melanoleuca humilis*, *Ramaria gracilis,* and *Scleroderma* aff. *albidum* cause gastroenteritis, and *Inocybe* aff. *glabrodisca* stimulates the parasympathetic nervous system; these species were confirmed to be poisonous from poisoning incidents.

The top three lethal mushroom species were *Russula subnigricans*, *Galerina sulciceps,* and *Lepiota brunneoincarnata*, which caused 6, 5, and 3 deaths, respectively. *Chlorophyllum molybdites*, the most widely distributed mushroom (discovered in 13 PLADs),

TABLE 1. Geographical distribution of mushroom poisoning incidents in China, 2021.

Location	Number of incidents	Number of patients	Deaths	Case fatality rate (%)
Hunan	64	159	1	0.63
Yunnan	59	200	4	2.00
Sichuan	34	98	2	2.04
Fujian	32	82	0	0
Guizhou	26	69	4	5.80
Zhejiang	21	50	0	0
Chongqing	17	53	0	0
Guangdong	16	33	4	12.12
Ningxia	13	26	0	0
Guangxi	12	42	1	2.38
Jiangsu	4	24	0	0
Hainan	4	11	0	0
Jiangxi	4	4	0	0
Shandong	3	20	0	0
Hubei	3	7	0	0
Beijing	2	14	1	7.14
Anhui	2	7	0	0
Shaanxi	2	4	0	0
Hebei	2	3	0	0
Xizang	2	2	1	50.00
Inner Mongolia	1	5	0	0
Xinjiang	1	4	0	0
Shanxi	1	3	2	66.67
Tianjin	1	2	0	0
Jilin	1	1	0	0
Total	327	923	20	2.17

caused the most poisonings incidents (appearing in 66 incidents affecting 123 patients) and had distinct long active period (from middle April to late December).

In 2021, 8 species (6 *Amanita* spp., 1 *Galerina* sp., and 1 *Lepiota* sp.) causing acute liver failure were identified in China (Supplementary Table S1, available in http://weekly.chinacdc.cn/). *Galerina sulciceps* killed 5 persons in 14 incidents involving 39 patients turned out to be the most dangerous species causing acute liver failure. *Lepiota brunneoincarnata* was responsible for 3 deaths in 15 incidents involving 45 patients, and this is the first report for its distribution in Yunnan Province (*1–3*). *Amanita fuligineoides* was originally described from Hunan and known from Yunnan as well (*4–5*). In late June, 2021, 5 people from Fujian were poisoned by this lethal species, which is indicative of a wider distribution of *A. fuligineoides*.

Three species causing acute renal failure were identified from mushroom poisoning incidents (Supplementary Table S1, available in http://weekly.chinacdc.cn/). *Amanita oberwinklerana* caused the most incidents. It grew in March in Guangdong, then appeared from July to August in Central and Southwest China. *Amanita kotohiraensis* was responsible for poisoning 2 patients on August 19.

Exposure to *Russula subnigricans* led to rhabdomyolysis causing 6 deaths; this species was found in 9 PLADs and appeared from May 10 to September 9. A total of 2 incidents involving 2 patients and 1 death caused by *Paxillus involutus* resulting in hemolysis occurred in Lasa, Xizang (Tibet).

A total of 39 species causing gastroenteritis were identified from mushroom poisoning incidents in China in 2021 (Supplementary Table S1, available in http://weekly.chinacdc.cn/). Among them, *Agaricus atrodiscus*, *Boletellus indistinctus*, *Hygrocybe rimosa*, *Lactarius purpureus*, *L. rubrocorrugatus*, *Lactifluus pseudoluteopus*, *Melanoleuca humilis*, *Ramaria gracilis*, and *Scleroderma* aff. *albidum* were species newly discovered as poisonous mushrooms and subsequently added to the Chinese poisonous mushroom list (*1–3*). *Hygrocybe rimosa* was a new species discovered in 2021 (*6*). Notably, *A. atrodiscus* poisoning was reported for the first time from Yunnan since it was originally described from Thailand in 2015 (*7*) and discovered in Hainan Province, China, in 2020 (*8*). The top three species in this category were *C. molybdites*, *R. japonica* and *Entoloma omiense*.

About 22 species causing psycho-neurological disorders were identified from mushroom poisoning incidents in China in 2021 (Supplementary Table S1, available in http://weekly.chinacdc.cn/). Among them, 6 species (*Inocybe* aff. *glabrodisca*, *Inosperma muscarium*, *Pseudosperma arenarium* nom. prov., *Mallocybe fulvoumbonata*, *Psilocybe ovoideocystidiata,* and *P. papuana*) were newly discovered as poisonous mushrooms (*1–3*). *Inosperma muscarium* and *Pseudosperma arenarium* were two new species. The former species was described in 2021 (*9*) and the latter was identified as *P.* cf. *bulbosissimum* in 2020 (*2*). Further study showed that *P.* cf. *bulbosissimum* was a new species. *Mallocybe fulvoumbonata*, *P. ovoideocystidiata,* and *P. papuana* were Chinese new records. The top five species were *Amanita subglobosa*, *Gymnopilus dilepis*, *A. pseudosychnopyramis*, *Inosperma muscarium*, and *Pseudosperma arenarium*.

Nine boletes (*Baorangia major*, *B. pseudocalopus*, *Boletellus indistinctus*, *Heimioporus gaojiaocong*, *H. japonicus*, *Neoboletus venenatus*, *Rubroboletus sinicus*, *Suillus pinetorum*, and *Tylopilus neofelleus*) causing gastroenteritis and one (*Lanmaoa asiatica*) causing psycho-neurological disorder were identified from poisoning incidents.

Interestingly, 2 incidents caused by polypores occurred in 2021. On February 28, 2021, one person from Guangxi had slight gastrointestinal symptoms after consumption of *Cryptoporus volvatus*, a recorded medicinal polypore (*3*). On the same date, one person from Guangdong also suffered from gastroenteritis after drinking boiled water using dried "medicinal mushrooms." This mixture was confirmed as medicinal or edible mushrooms, *Trametes hirsuta*, *Irpex lacteus*, and *Schizophyllum commune* (*3*). Their toxicity and safe usage need to be further studied.

About 6 edible mushrooms were also identified from mushroom poisoning incidents in 2021, which could be attributed to the consumption of mixed mushrooms with poisonous mushrooms, contaminated mushrooms, or some species potentially poisonous to certain people.

DISCUSSION

In 2021, mushroom poisoning incidents and patients were more than 2019 but less than 2020 as deaths slightly decreased (20 *vs.* 22 and 25) (*1–2*). Shaanxi, Xinjiang, Tianjin, and Jilin were four PLADs with newly recorded incidents (*1–2*). Approximately 74 poisonous mushrooms were successfully identified, among which 46 species were already recorded in 2019 and 2020 (*1–2*), raising the total species number from incidents reached over 150 in China by the end of

2021. The most dangerous mushroom was *Russula subnigricans*, killing 6 people in 2021, differing from *Amanita exitialis* that killed 13 people in 2019 and *Lepiota brunneoincarnata* that killed 5 people in 2020 (*1*–*2*).

Monthly distribution analysis showed that mushroom poisonings in 2021 centered from May to November, longer than 2019 and 2020, peaking in August, which was later than the July peak in 2019, and different from 2020 that had 2 peaks in June and September (*1*–*2*).

The top two PLADs with the most incidents were Hunan and Yunnan in 2021, identical to 2019 and 2020, and Southwest China remained the most severely affected area (*1*–*2*). Yunnan had the most deaths in the last three years, but declined markedly (*1*–*2*). Mushroom poisoning incidents decreased sharply in Zhejiang from 50 in 2019 to 43 in 2020 and to 21 in 2021 (*1*–*2*).

Mushroom poisoning resulting in acute liver failure caused by *Amanita* spp. dropped sharply from 32 incidents, 80 patients, and 19 deaths in 2019 (*1*), to 53 incidents, 153 patients and 10 deaths in 2020 (*2*), and to 17 incidents, 52 patients and 5 deaths in 2021. This great progress mainly contributed to the continuous science popularization and health education on *Amanita* spp. *Galerina sulciceps* poisoning increased from 4 incidents, 9 patients, and 1 death in 2019 (*1*), to 6 incidents, 12 patients, and 2 deaths in 2020 (*2*), and to 14 incidents, 39 patients, and 5 deaths in 2021. Except appearing in autumn and winter, *G. sulciceps* also resulted in 1 death in April in Hunan. Attention must also be paid to *Lepiota brunneoincarnata* that caused 3 incidents in 2019 and 15 incidents in 2020 and 2021. Continuous and extensive science popularization about these lethal species was necessary and urgent in future.

Similar to 2019 and 2020, *Amanita oberwinklerana* caused the most incidents, but resulted in relatively less incidents and patients than the last two years (*1*–*2*). *Amanita kotohiraensis* was discovered from one mushroom poisoning incident and expanded its distribution to Fujian (*5*).

Compared to 2019 and 2020, *Russula subnigricans* leading to rhabdomyolysis caused more deaths (6 *vs.* 1 and 4), was discovered in more PLADs (9 *vs.* 5 and 4), and appeared earlier (*1*–*2*). *Paxillus involutus* resulting in hemolysis appeared earlier in Xizang (Tibet) than in Inner Mongolia, 2020 (*2*). On account of the huge risk of eating this mushroom, we strongly advise not collecting and eating this species although it was previously accepted as edible and medicinal fungus in China and seems safe to many people (*2*).

Overall, 39 species causing gastroenteritis were successfully identified in 2021, which was more than 2019 (30 species) and less than 2020 (56 species), and the top three species were *Chlorophyllum molybdites*, *Russula japonica*, and *Entoloma omiense*, the same as 2019 and 2020 (*1*–*2*).

Lactifluus pseudoluteopus was a species originally described from tropical Yunnan and was considered edible (*10*). In 2020, 5 people experienced gastroenteritis after eating *Lf. pseudoluteopus*, and we suspected the species might be poisonous (*2*). Subsequently, on June 4, 2021, another person also developed gastroenteritis after eating *Lf. pseudoluteopus* and we now could confirm that this species is toxic (*10*).

Many species from *Agaricus* section *Xanthodermatei* were considered poisonous as they resulted in gastroenteritis, and 7 species were discovered in China by 2019 (*3*). In 2021, *Agaricus atrodiscus* and *A. xanthodermus* were identified from mushroom poisoning incidents. This was the first poisoning incident report caused by *A. atrodiscus* worldwide and supplemented poisoning information of *A. xanthodermus* (*3*,*7*).

Omphalotus guepiniformis caused poisoning incidents in East, Central, South, and Southwest China in the recent years, whereas *O. olearius* poisoning only occurred in Yunnan Province (*1*–*2*). On July 11 and October 3, 2021, 22 persons were poisoned by a white, wood-rotting fungus which was similar to *Pleurotus* spp. Further studies showed that it might be an undescribed species of *Omphalotus* species, and we temporarily recorded it as *Omphalotus* sp. in the present investigation.

Coprinellus micaceus, *Coprinopsis atramentaria*, and *Coprinus comatus* were three common and widely distributed mushrooms resulted in several poisoning incidents in 2021. They could produce coprine, especially when mature, and thus resulted in disulfiram-like mushroom poisoning when consumed with alcohol (*11*). In China, *Cp. atramentaria* and *C. comatus* were also considered edible, and *C. comatus* has been widely cultured commercially. *Coprinellus micaceus* was also considered as medicinal fungus (*3*). For the sake of safety, we strongly advise not eating these three species collected from the field or drinking alcohol when consuming cultured *C. comatus*.

Baorangia major was firstly discovered in Fujian and Yunnan and resulted in 2 poisoning incidents either individually or in conjunction with *B. pseudocalopus* consumption in 2020 (*2*), and caused another incident in Fujian, 2021. Previously, *Neoboletus venenatus* was often discovered from incidents in which dried boletes were consumed (*1–2*). On September 19, 2021, 7 people from Yunnan were poisoned after eating fresh basidiomata. On August 19, 2021, 1 person from Fujian suffered from gastroenteritis after eating a red bolete. Our study indicated that it might be a new species and temporarily recorded as *Rubroboletus* sp.

About 22 species causing psycho-neurological disorders were identified in 2021, which was more than 2019 (18 species) but less than 2020 (28 species), and *Amanita subglobosa* occupied the first for the last three years (*1–2*). Except the 6 newly added poisonous species, the previously convincible poisonous species *A. ibotengutake*, *A. melleialba*, *A. pseudopantherina*, *A. pseudosychnopyramis*, and *Panaeolus bisporus* appeared in poisoning incidents in 2021 (*1–5*).

Amanita is the most famous genus worldwide since it includes many notorious poisonous mushrooms which could cause acute liver failure, acute renal failure, and psycho-neurological disorder (*1–3*, *5*, *11*). In China, many species are China-specific, 9 lethal species leading to acute liver failure and 10 species leading to psycho-neurological disorder were originally described from China (*4–5*), and their toxicity of many species had been confirmed from poisoning incidents (*1–2*). Although dozens of species of this genus are edible, on account of the high phenotypic similarity between edible and lethal species, we strongly advise not eating *Amanita* spp. unless the identity is fully determined.

Lanmaoa asiatica, commonly known as "red bolete with onion smell," is a delicious bolete that needs properly cooking, which was originally described from China (*12*). When causing poisoning, this species could cause hallucinations. Different from species containing psilocybin, its toxicity is still unclear and needs further studies.

The incidents reported in this study only represent a portion of actual mushroom poisonings. In some poisoning incidents, some specimens cannot be given a satisfactory species name. More taxonomic work is needed and more new species will be hopefully discovered (*1–3*, *5–10*, *12*). The low level of awareness of mushroom poisoning, in contrast to the high species diversity in China is a huge challenge for mushroom poisoning control and prevention. The practice demonstrates that more efforts and closer cooperation are still urgently needed from governments, CDC staff, doctors, and mycologists to properly control mushroom poisoning events in the future.

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REFERENCES

1. Li HJ, Zhang HS, Zhang YZ, Zhang KP, Zhou J, Yin Y, et al. Mushroom poisoning outbreaks — China, 2019. China CDC Wkly 2020;2(2):19 – 24. http://dx.doi.org/10.46234/ccdcw2020.005.
2. Li HJ, Zhang HS, Zhang YZ, Zhou J, Yin Y, He Q, et al. Mushroom poisoning outbreaks — China, 2020. China CDC Wkly 2021;3(3): 41 – 5. http://dx.doi.org/10.46234/ccdcw2021.014.
3. Wu F, Zhou LW, Yang ZL, Bau T, Li TH, Dai YC. Resource diversity of Chinese macrofungi: edible, medicinal and poisonous species. Fungal Divers 2019;98(1):1 – 76. http://dx.doi.org/10.1007/s13225-019-00432-7.
4. Zhang P, Chen ZH, Xiao B, Tolgor B, Bao HY, Yang ZL. Lethal amanitas of East Asia characterized by morphological and molecular data. Fungal Divers 2010;42(1):119 – 33. http://dx.doi.org/10.1007/s13225-010-0018-4.
5. Cui YY, Cai Q, Tang LP, Liu JW, Yang ZL. The family Amanitaceae: molecular phylogeny, higher-rank taxonomy and the species in China. Fungal Divers 2018;91(1):5 – 230. http://dx.doi.org/10.1007/s13225-018-0405-9.
6. Wang CQ, Zhang M, Li HJ, Huang H, Deng WQ, Li T, et al. *Hygrocybe rimosa* (Hygrophoraceae, Agaricales), a new poisonous species from southern China. Phytotaxa 2021;527(4):293 – 300. http://dx.doi.org/10.11646/phytotaxa.527.4.7.
7. Ariyawansa HA, Hyde KD, Jayasiri SC, Buyck B, Chethana KWT, Dai YC, et al. Fungal diversity notes 111–252-taxonomic and phylogenetic

contributions to fungal taxa. Fungal Divers 2015;75(1):27 – 274. http://dx.doi.org/10.1007/s13225-015-0346-5.

8. Zeng NK, Jiang S. Atlas of macrofungi from yinggeling of Hainan, China. Haikou: Nanhai Publishing Company. 2020. (In Chinese)
9. Deng LS, Kang R, Zeng NK, Yu WJ, Chang C, Xu F, et al. Two new *Inosperma* (Inocybaceae) species with unexpected muscarine contents from tropical China. MycoKeys 2021;85(3):87 – 108. http://dx.doi.org/10.3897/mycokeys.85.71957.
10. Wang XH, Verbeken A. Three new species of *Lactarius* subgenus *Lactifluі* (Russulaceae, Russulales) in southwestern China. Nova Hedwigia 2006;83(1 – 2):167 – 76. http://dx.doi.org/10.1127/0029-5035/2006/0083-0167.
11. White J, Weinstein SA, De Haro L, Bédry R, Schaper A, Rumack BH, et al. Mushroom poisoning: a proposed new clinical classification. Toxicon 2019;157:53 – 65. http://dx.doi.org/10.1016/j.toxicon.2018.11.007.
12. Wu G, Zhao K, Li YC, Zeng NK, Feng B, Halling RE, et al. Four new genera of the fungal family Boletaceae. Fungal Divers 2016;81(1):1 – 24. http://dx.doi.org/10.1007/s13225-015-0322-0.

SUPPLEMENTARY TABLE S1. Mushroom species involved in poisoning incidents and their spatial and temporal distribution in China, 2021.

Clinical syndromes or mushroom species	Number of incidents	Number of patients	Deaths	Case fatality (%)	Spatial and temporal distribution
Acute liver failure					
Amanita exitialis	3	8	1	12.50	March 3, Guangdong; June 24 to 26, Yunnan
Amanita exitialis and *A. fuligineoides*	1	4	0	0	July 2, Yunnan
Amanita fuliginea and *A. oberwinklerana* [ARF]	1	5	0	0	July 5, Hunan
Amanita fuligineoides	2	9	1	11.11	June 25 and July 2, Fujian, and Yunnan
Amanita pallidorosea	1	2	0	0	June 19, Hunan
Amanita rimosa	1	3	0	0	June 2, Hunan
Amanita subjunquillea	1	2	0	0	September 17, Sichuan
Amanita spp.	7	19	3	15.79	June 22 to July 26, Yunnan, Hunan, Chongqing, and Zhejiang
Galerina sulciceps	14	39	5	12.82	April 16, Hunan; November 3 to 30, Sichuan, Chongqing, Hubei, Guizhou, and Hunan
Galerina sp.	1	18	0	0	December 28, Sichuan
Lepiota brunneoincarnata	15	45	3	6.67	July 4 to September 28, Yunnan, Hebei, Shanxi, Xinjiang, Shandong, Inner Mongolia, Ningxia, Shaanxi, Jilin, Beijing, and Tianjin
Rhabdomyolysis					
Russula subnigricans	16	50	6	12.00	May 10 to September 9, Yunnan, Zhejiang, Hunan, Jiangsu, Fujian, Jiangxi, Guizhou, Guangdong, and Guangxi
Acute renal failure					
Amanita kotohiraensis	1	2	0	0	August 19, Fujian
Amanita oberwinklerana	6	9	0	0	mid-March, Guangdong; July 20 to August 29, Hubei, Sichuan, and Guizhou
Amanita aff. *pseudoporphyria*	2	2	0	0	August 22 and 23, Hunan
Hemolysis					
Paxillus involutus	2	2	1	50.00	July 31 and August 7, Xizang
Gastroenteritis					
Agaricus atrodiscus	1	6	0	0	July 28, Yunnan
Agaricus xanthodermus	1	1	0	0	April 29, Hunan
Agaricus sp.	1	2	0	0	August 20, Hunan
Baorangia major	1	5	0	0	May 28, Fujian
Baorangia pseudocalopus	2	8	0	0	June 23, Yunnan; September 17, Hunan
Boletellus indistinctus	1	6	0	0	August 3, Yunnan
Chlorophyllum aff. *globosum*	2	8	0	0	August 30 and September 5, Sichuan
Chlorophyllum hortense	2	3	0	0	August 12 to September 29, Hunan, and Guangxi
Chlorophyllum molybdites	65	120	0	0	April 15 to December 27, Zhejiang, Guizhou, Hunan, Hainan, Fujian, Guangdong, Guangxi, Yunnan, Sichuan, Chongqing, Jiangsu, Hubei and Jiangxi
Chlorophyllum molybdites and *Cordyceps gunnii* [M]	1	3	0	0	August 21, Guizhou
Coprinellus micaceus	1	1	0	0	September 29, Beijing
Coprinellus micaceus and *Panaeolus bisporus* [P]	1	3	0	0	September 20, Ningxia
Coprinopsis atramentaria	1	1	0	0	April 19, Shandong
Coprinus comatus	1	1	0	0	October 19, Sichuan

Continued

Clinical syndromes or mushroom species	Number of incidents	Number of patients	Deaths	Case fatality (%)	Spatial and temporal distribution
Cryptoporus volvatus M	1	1	0	0	February 28, Guangxi
Entoloma caespitosum	1	4	0	0	May 24, Fujian
Entoloma omiense	7	22	0	0	June 6 to August 30, Fujian, Guangdong, Yunnan, Zhejiang, and Guizhou
Entoloma aff. *strictius*	1	3	0	0	April 12, Hunan
Entoloma aff. *sinuatum*	1	9	0	0	August 8, Yunnan
Gymnopus densilamellatus, *G. dryophilus* G and *Ripartites tricholoma* U	1	2	0	0	August 6, Hebei
Gymnopus indoctus U, *Leucoagaricus sinicus* U, *Panaeolus papilionaceus* P, *Ileodictyon gracile* U and *Agaricus* sp. U	1	4	0	0	October 14, Guangdong
Heimioporus gaojiaocong	3	5	0	0	January 12, Yunnan (dried boletes bought from market); June 3 to July 20, Yunnan
Heimioporus japonicus	2	9	0	0	August 26 and September 7, Fujian
Hygrocybe rimosa	1	2	0	0	July 1, Guizhou
Lactarius purpureus	1	1	0	0	August 29, Hunan
Lactarius rubrocorrugatus	2	7	0	0	July 11 and 27, Sichuan
Lactifluus pseudoluteopus	1	1	0	0	June 4, Yunnan
Melanoleuca humilis	1	2	0	0	September 15, Ningxia
Neoboletus brunneissimus E,M, *Butyriboletus yicibus* E, *Catathelasma subalpinum* E and *Cortinarius similis* U	1	3	0	0	August 16, Sichuan (dried boletes from Yunnan)
Neoboletus venenatus	3	12	0	0	March 10 and July 2, Hunan and Sichuan (dried boletes, bought from market); September 19, Yunnan
Omphalotus guepiniformis	1	3	0	0	May 1, Guizhou
Omphalotus olearius	2	4	0	0	July 28 and October 18, Yunnan
Omphalotus sp.	4	44	0	0	July 11 and October 18, Yunnan
Pholiota multicingulata	1	4	0	0	September 13, Chongqing
Ramaria gracilis	1	1	0	0	August 28, Yunnan
Rubroboletus sinicus and *Retiboletus fuscus* E	1	20	0	0	January 11, Jiangsu (dried boletes bought from market)
Rubroboletus sp.	1	1	0	0	August 19, Fujian
Russula foetens	1	1	0	0	August 26, Fujian
Russula japonica	24	70	0	0	May 25 to August 26, Guangxi, Hunan, Sichuan, Guizhou, Yunnan, Chongqing, Fujian, and Zhejiang
Russula japonica and *R. punctipes* G	1	2	0	0	May 31, Hunan
Russula leucocarpa U and *Russula* sp.	1	4	0	0	September 4, Fujian
Russula punctipes	1	6	0	0	August 23, Hunan
Scleroderma* aff. *albidum	2	9	0	0	March 7 and July 9, Guangxi and Sichuan
Scleroderma cepa	4	7	0	0	July 5 to August 25, Yunnan; October 27 to November 15, Hunan
Suillus pinetorum, *Amanita javanica* E, *Boletus bainiugan* E and *Phlebopus portentosus* E	1	8	0	0	April 15, Yunnan
Thicholoma highlandense	1	1	0	0	November 20, Guizhou
Trametes hirsuta M, *Irpex lacteus* M and *Schizophyllum commune* E,M	1	1	0	0	February 28, Guangdong (dried mushrooms from Sichuan)
Tricholoma stans	1	2	0	0	November 3, Yunnan
Tricholoma aff. *stans*	2	5	0	0	November 2 and December 1, Guizhou and Yunnan

Continued

Clinical syndromes or mushroom species	Number of incidents	Number of patients	Deaths	Case fatality (%)	Spatial and temporal distribution
Psycho-neurological disorder					
Amanita ibotengutake	1	17	0	0	September 5, Shandong
Amanita melleialba	1	1	0	0	August 10, Yunnan
Amanita orientigemmata	1	2	0	0	August 10, Yunnan
Amanita pseudopantherina	1	1	0	0	August 9, Yunnan
Amanita pseudosychnopyramis	2	11	0	0	April 6 and 15, Fujian and Zhejiang
Amanita orsonii and *Amanita* sp. U	1	3	0	0	June 29, Chongqing
Amanita rufoferruginea	1	6	0	0	July 6, Sichuan
Amanita subglobosa	4	13	0	0	June 29 to August 19, Sichuan and Hunan
Amanita sychnopyramis f. *subannulata*	1	5	0	0	May 28, Guangxi
Clitocybe subditopoda	1	3	0	0	October 26, Guizhou
Clitocybe sp.	1	2	0	0	October 18, Hainan
Gymnopilus dilepis	3	5	0	0	May 1 to July 2, Sichuan and Guizhou
Inocybe* aff. *glabrodisca	1	4	0	0	November 26, Guizhou
Inosperma muscarium	2	7	0	0	May 30 and June 5, Guangxi and Fujian
Lanmaoa asiatica	1	1	0	0	July 2, Yunnan
Lanmaoa asiatica, *Heimioporus japonicus* G and *Tylopilus neofelleus* G	1	4	0	0	January 27, Chongqing (dried boletes bought from market)
Panaeolus bisporus	1	2	0	0	August 14, Guizhou
***Pseudosperma arenarium* nom. prov.**	2	3	0	0	September 22 and 30, Ningxia and Shaanxi
Pseudosperma umbrinellum and ***Mallocybe fulvoumbonata*** P	1	2	0	0	September 21, Ningxia
Psilocybe ovoideocystidiata	1	2	0	0	March 26, Guizhou
Psilocybe papuana	1	2	0	0	April 30, Hunan
Unclassified					
Cortinarius cupreorufus U	1	3	0	0	September 3, Ningxia
Laccaria vinaceoavellanea E	1	2	0	0	August 1, Yunnan
Leucoagaricus barssii E	1	2	0	0	September 6, Ningxia
Porphyrellus nigropurpureus U	1	4	0	0	August 1, Fujian
Russula densifolia E	1	2	0	0	August 13, Yunnan
Scleroderma yunnanense E	1	4	0	0	July 2, Yunnan
Stropharia rugosoannulata E	2	2	0	0	April 29 and May 16, Hunan and Chongqing
Tricholoma myomyces E	1	2	0	0	March 16, Hunan

Note: Species newly recorded as poisonous mushrooms in China are in italic bold.
Abbreviations used for mushroom poisoning incidents with more than two species: ARF=Acute renal failure, G=Gastroenteritis, P=Psycho to neurological disorder, M=Medicinal, U=Unclassified, E=Edible.