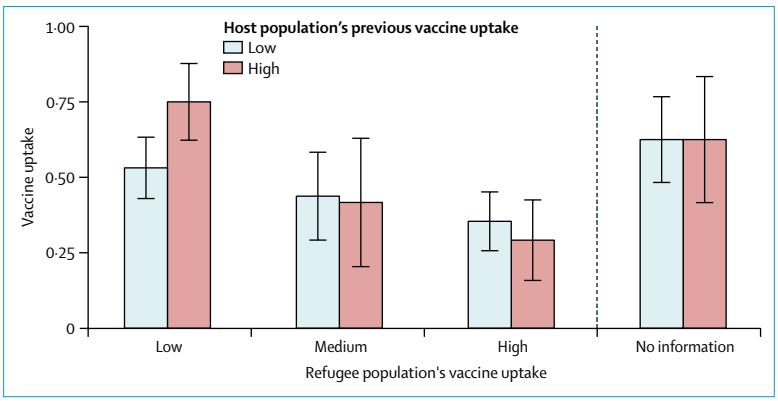

Figure: **Mean vaccination uptake in an interactive vaccination game as a function of the host population's previous vaccine uptake and the refugee population's vaccine uptake**
N=96. Error bars represent 95% CIs. See appendix for statistical analysis. Data available on the Open Science Framework.[4]

was similar to the behaviour displayed when refugee vaccination uptake was low. Generally, the host population was significantly less willing to vaccinate when information about the refugee population's vaccine uptake was available (*vs* when it was absent).

The experiment shows that communicating refugees' vaccination status can have detrimental effects, especially when both the vaccine uptake of refugees and the host population's vaccine rate are high. This effect might increase with higher refugee influx.[1] Health officials and society as a whole must undoubtedly combat prejudice and discrimination against refugees by debunking misinformation. Regarding vaccine uptake, however, debunking should be complemented with communication measures aimed at preventing reliance on herd immunity. Communicating the social benefit of vaccinations is a potential remedy.[5] Only then will it be possible to pursue both goals at once: fighting discrimination and infectious diseases.

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One Health strategies for rabies control in rural areas of China

In December, 2015, WHO proposed to eradicate rabies transmission from dogs to human beings by 2030 as described in a Comment by Dara Mohammadi.[1] At present, about 59 000 people die of rabies every year worldwide, and the number of rabies cases in China is second only to India.[2,3] Although prevention and control methods have been effective in reducing the number of overall cases (figure; appendix pp 5–7), prevention of human cases is still a challenge, especially in rural areas, because rabies virus is a reemerging pathogen in China.[4]

See Online for appendix

After analysing epidemiological characteristics of the human–animal rabies cases in China (appendix pp 3–7), we find that the highest incidence of human rabies was in 2007. Only 804 cases were reported in 2015, and only Tibet reported no human rabies cases (figure, appendix pp 6–7). Cases were mainly localised to rural areas in the southern and eastern provinces, and were rare in urban areas such as Beijing and Shanghai (figure, appendix pp 6–7), despite pet bites being a fairly common occurrence. Rabies has expanded geographically to the west and north since, with reemergence in areas that had not reported human cases previously. The immunisation of urban stray or pet dogs, pet owners as well as rural populations at high risk of exposure, and wild or domestic animals is crucial to rabies prevention and control. Accumulating evidence shows that rabies viruses can also be found in other wild animals and livestock, such as rats, foxes, sheep, pigs, deer, and ferret-badgers (appendix p 8).[2] Furthermore, phylogenetic analysis shows that rabies viruses from wildlife and livestock are grouped within various clades (appendix p 3), and wildlife strains are mostly in the China IV clade.[5] Notably, the reemerging rabies virus found in stray dogs in Qinghai province belongs to the China IV clade, the same as that found in Tibet, and could be a consequence of spillover from wildlife (figure; appendix p 3).[5] The better transportation network and the increase of dog trade among Chinese provinces has contributed to the geographical spread of rabies.[4] In addition, this reemergence could be caused by transmission from wildlife to dogs.[5] Moreover, subtypes from other Asian countries were identified in Chinese wildlife.[6] In the nucleoprotein

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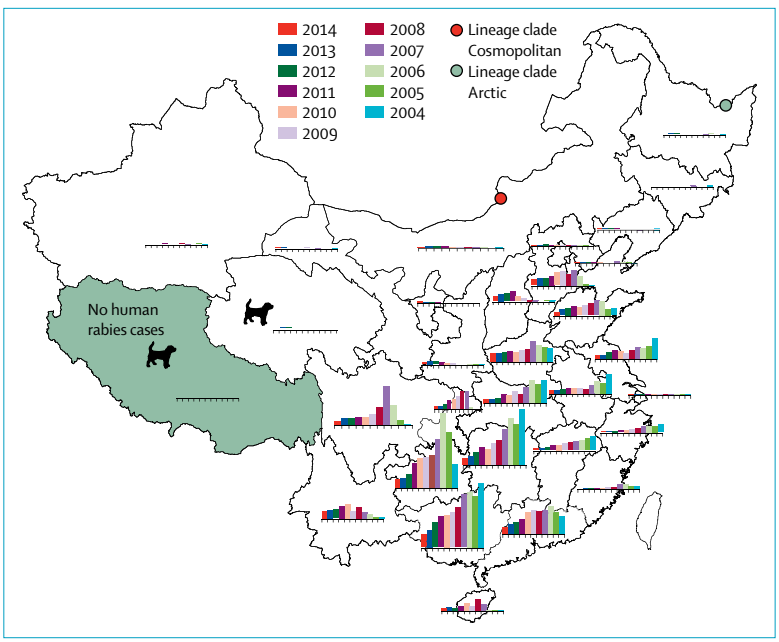

Figure: **Distribution of human rabies cases in China from 2004 to 2014**
Each colour indicates the year and the length indicates the number of human infected cases in that year. The green area indicates no human rabies virus infection. Data are from The Public Health Sciences Data Center. Notably, the black dogs indicate the reemergence and geographical diffusion of rabies virus in Qinghai and Tibet province. The red and green circles show provinces where the virus was isolated from wildlife that might have been infected in the neighbouring country

For the **The Public Health Sciences Data Center** see http://www.phsciencedata.cn/Share/en/index.jsp

(N) gene phylogenetic tree, wildlife rabies viruses in China are distributed in three lineage clades: Asian, Arctic, and Cosmopolitan (appendix p 4). Of note, the rabies virus isolated from domestic and wild animals matches closely the strains identified in neighbouring countries (appendix p 4), indicating the possibility of transmission of the virus between China and other countries through transborder passage of wild animals. There is a need to pay attention to rabies spread across borders (figure), and immunisation of wild animals and livestock might be the next challenge for China.

Epidemiological surveys and phylogenetic analyses show that there are two levels of rabies control in China. The first level, the control of human rabies, is straightforward to implement. Strengthening of rabies prevention and vaccination in rural areas will be essential through the government, news organisations, and medical institutions. Public awareness of rabies in high-risk populations living in rural areas also needs to be improved. The second level is to eliminate rabies in wild animals and stray dogs, which will be important to address the reemergence of rabies in areas that were previously declared rabies free. More research on immunisation strategies and surveillance of rabies from wild animals and stray dogs is needed. Studies showed that domestic animals can be infected with rabies virus after being bitten by wild, infected animals.[6,7] Therefore, strengthening the surveillance of wild animals and livestock and establishing a detailed monitoring network in wild and domestic animals in rural China is needed.

A novel strategy for combating rabies in China is the interdisciplinary One Health collaborative. The American Veterinary Association defines One Health as "the collaborative effort of multiple disciplines—working locally, nationally, and globally—to attain optimal health for people, animals and the environment".[8] Although the Chinese Government is doing its best to eliminate rabies, the immunisation rates of human beings as well as wild and domestic animals at high risk of exposure, and surveillance in rural areas can still be improved. Promoting the development of immunological products for use in wild and domestic animals, as well as vaccines, is necessary.[6] Wildlife biologists, ecologists, and doctors in human and veterinary medicine need to partner with the government to implement vaccination and surveillance efforts, using the concept of One Health to promote exchange across disciplines, share data, and coordinate anti-rabies efforts.

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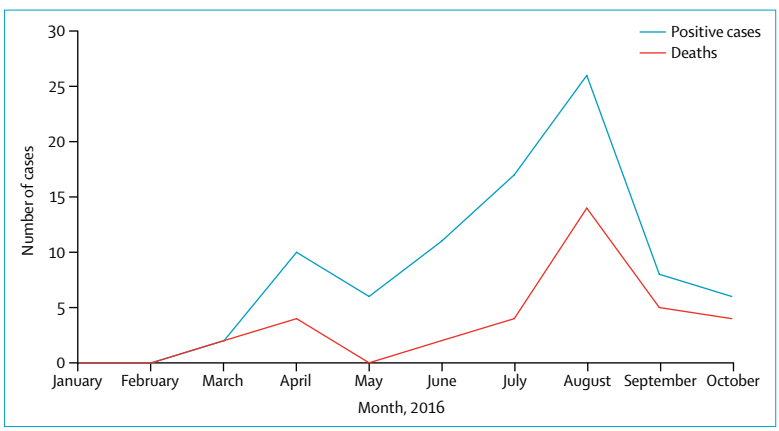

Figure: **Nationwide surveillance for Crimean-Congo haemorrhagic fever in Pakistan in 2016**
Number of patients in Pakistan that tested positive for Crimean-Congo haemorrhagic fever and number of deaths in January to October, 2016, before and after the festival of Eid-ul-Adha (Sept 13–15).

Surveillance of Crimean-Congo haemorrhagic fever in Pakistan

Sajjad Haider and colleagues[1] recently reported on the Crimean-Congo haemorrhagic fever (CCHF) outbreaks in Pakistan. CCHF virus (CCHFV) is a highly virulent pathogen that has caused 10 000 human infections globally.[2] However, Haider and colleagues[1] reported data regarding CCHF-positive cases in just three big cities in Pakistan (Karachi, Rawalpindi, and Quetta). Therefore, there is a need for thorough surveillance of CCHF in all provinces of Pakistan so that the objective of controlling and preventing CCHF can be achieved.

Between January and October, 2016, 483 patients with suspected CCHF were admitted to hospitals located across all provinces of Pakistan, and we prospectively tested their serum samples by CCHFV-specific IgG using ELISA kits, as previously described.[3] Of these 483 patients, 86 were positive for CCHFV. Balochistan had the highest number of positive cases (38 [44%] of 86 positive patients). The other provinces that had positively confirmed CCHFV cases were Sindh with 17%, Khyber Pakhtunkhwa with 17%, Punjab with 13%, and Azad Kashmir (Pakistan-administered region) with 8%. Gilgit Baltistan had no cases. Of the 86 patients who tested positive, 35 (41%) died. The highest prevalence of deaths (ten [29%] of 35) was reported in Balochistan, followed by Sindh (23%), Khyber Pakhtunkhwa (20%), Punjab (20%), and Azad Kashmir (9%). This report is the first to present the nationwide distribution of CCHFV infections in Pakistan.

Balochistan is the poorest province bordering Iran and Afghanistan. Before the festival Eid-ul-Adha, animals are transported from Afghanistan and Iran to Balochistan and then supplied to the other provinces. CCHFV is most likely being transported by the imported animals, which would explain why Balochistan had the highest number of positive cases. To confirm this hypothesis, we did ELISAs on samples from 21 randomly selected transported animals from Afghanistan and Iran, and found that 13 (62%) of them were CCHFV positive. Furthermore, according to demographic data from the patients, 58% (22 of 38) of patients in Balochistan who tested positive had been to far-flung areas of Afghanistan. Therefore, border control regulations must be enforced, because movement of people from Afghanistan into Pakistan without any monitoring or health checks has overwhelmed the local public health system, as previously described.[4]

To show that the festival of Eid-ul-Adha (held on Sept 13–15 in 2016) is a vulnerable period for CCHF outbreaks, as reported by Tauqeer Hussain Mallhi and colleagues,[5] we calculated the number of positive cases and deaths during each month of 2016 (figure). The highest numbers of positive cases and deaths were observed in August, 2016, just before the festival. During this period, there were many chances for people to come into contact with domestic or imported animals that might have been infected with CCHFV, suggesting that the festival could play an important part in CCHF outbreaks. Therefore, the general public, farmers, animal handlers, and health-care workers need to be educated about periods of high risk for CCHF infection.

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