## The big business of blood plasma

China, a country that holds the questionable honour of being a world leader in liver disease, is now also the highest consumer of serum albumin, using 300 tonnes annually, roughly half of the worldwide total use, according to an article in the Financial Times. Serum albumin is most commonly derived from blood plasma, and over half of the albumin in China is imported. This increasing demand is driving up prices, and fake products billed as albumin have been found. Liver disease is a growing problem in China, primarily because of the high burden of viral hepatitis in Asia, but also because of the growing prevalence of non-alcoholic fatty liver disease. Advanced stages of liver disease are characterised by protein wasting and can result in albumin depletion, which can have major effects on the cardiovascular system, renal system, and risk of infection.

Human serum albumin is the most abundant protein found in the blood. It is a multifunctional non-glycosylated, negatively charged plasma protein that is synthesised primarily in the liver. Albumin regulates colloid oncotic pressure by its role in the intravascular protein pool, managing water retention, and via the Gibbs-Donnan effect. Albumin has long been used for various medical indications from trauma resuscitation to treatment of liver damage. Although there is conflicting evidence about just how useful human serum albumin is for certain liver indications, it is generally accepted as a useful treatment for those with liver damage.

The proportion of individuals who donate blood in China is low, due to a myriad of reasons. In the 1990s, Henan Province had become a blood farm built on a criminalised plasma economy. Thousands of Chinese donors became infected with HIV and hepatitis C because of contaminated equipment. Although now disproven, the boasting of a young woman about her lavish lifestyle while working for the Red Cross Society of China had seriously damaged the reputation of the charity that helps the government collect blood. In 1998, China introduced a blood donation law banning the commercial sale of blood and encouraging voluntary donation instead. It also tightened rules on plasma collection and increased blood testing. However, Chinese law also limits individual whole-blood donations to twice a year, and provinces rarely share blood. Chinese law now encourages patients who require a blood transfusion to

present a certificate showing that they, their friends or relatives, have donated blood when they need to access the national supply. For those who can afford it, they can overcome this requirement by accessing the black market in which mediators pay people off the street to donate blood at a state blood bank and sell their donation certificates to those who need them.

Adding to the complexity of the issue is that there are two separate blood markets, one for whole blood and another for blood plasma. While whole-blood donations are primarily used for clinical transfusions, the plasma industry uses plasma to produce various blood products, including clotting factors, intravenous immunoglobulin, and albumin. Globally, the plasma industry is a big business. Companies that specialise in plasma have been regularly subjected to takeovers, and the industry is growing. It is generally accepted (and recommended by WHO) that the safest blood supplies are those freely given by carefully screened donors who have no vested interest. However, the model is different for plasma. Plasma donors are often paid and can donate much more frequently than whole-blood donors. Although most countries set a plasma donation limit of once every 2 weeks, in the USA, individuals are able to donate twice a week. The financial incentive can be appealing for those who struggle to raise funds by other means, which can encourage lying during medical screening and could adversely affect the health of the donors as well. With some companies pooling hundreds of thousands of donations together for processing, this can be an important safety risk. There have been suggestions that the USA use plasma to close the trade deficit between the USA and China. However, this economic relationship would need careful consideration and regulation to be viable on all sides.

In view of the challenges of a safe and adequate supply of serum albumin from human blood, it is important to look for safe alternatives. Global efforts to eliminate viral hepatitis by 2030 will no doubt help to address the problem of liver disease in the future, and there are currently studies underway to produce human serum albumin from transgenic rice seeds. Prevention, alternative sources, and better regulation will hopefully enable the protection of the health of not only those who require human serum albumin, but also those who provide it. 

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For the **report on albumin use in China** see https://www.ft.com/ content/40ba0978-6abc-11e7bfeb-33fe0c5b7eaa

See Comment Lancet Haematol 2016; **3:** e60–62 and Editorial Lancet Haematol 2015; **2:** e222.

For trade suggestion see https:// www.forbes.com/sites/ patrickwwatson/2017/08/28/ why-trump-should-literally-startselling-american-blood-tochina/#6e9252cf6f88

For the **transgenic article** see http://www.pnas.org/content/108/47/19078.long