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## In a fog of war

How did an Indian Air Force Mi-17 helicopter get shot down by the IAF? What are the protocols in place to distinguish enemy from friendly aircraft?

**DINAKAR PERI**

**The story so far:** On the morning of February 27 this year, as jets of the Indian Air Force (IAF) and Pakistan Air Force were engaged in a dog fight over the Naushera sector in Jammu and Kashmir, an IAF Mi-17 helicopter with two pilots and four personnel took off from Srinagar air base. It crashed within 10 minutes at Budgam killing all the personnel and a civilian on the ground. As the fog settled, it was suspected that the Mi-17 may have been shot down by friendly fire. A Court of Inquiry (CoI) was ordered to ascertain the facts of the incident.

**How are aircraft identified?**
There are a range of methods used to identify friendly aircraft. These include visual sightings, radio transmission, designated entry and exit points for friendly aircraft and a transponder-based Identification Friend or Foe (IFF) system. With supersonic aircraft and long range radars, the IFF system is the predominant method used in both civil and military aviation to identify aircraft. The IFF is a transponder-based identification device that communicates with ground radars and exchanges encrypted codes to indicate that the aircraft is a friendly one. Some modes of transponders also indicate the speed and specific coordinates of the aircraft which are used by civil air traffic controllers to identify commercial aircraft. In addition, there are designated air corridors marked safe for friendly aircraft to fly. This is because during a combat situation, air defences in sensitive areas are free to fire at any violator.

> In a directive last year, the IAF mandated that all aircraft coming in to land should have the Identification Friend or Foe system switched on. It was switched off in the Mi-17

**What went wrong with the helicopter?**
The Mi-17 had crashed in an inhabited area and the Flight Data Recorder (FDR), commonly referred to as the black box and the most crucial thing in case of any air accident, was lost. It could not be traced and officials said it may have been taken away by civilians who thronged to the helicopter. The absence of the FDR has delayed the inquiry process. In the absence of the black box which would have provided straight answers to most questions, the CoI had to pursue circumstantial evidence and rule out options to draw likely conclusions. Preliminary indications are that the Mi-17 was shot down by the IAF's Israeli-origin SPYDER surface-to-air missile system.

The CoI has found several procedural violations. The biggest of them is that the IFF system was switched off, especially when there was a high alert, and an aerial engagement was under way close by. Due to this, in the midst of the air battle over the skies close by, the Mi-17 was mistakenly identified as belonging to the adversary. In fact, last year, the IAF had issued a directive that all aircraft coming in to land should have the IFF system switched on. But contrary orders seem to have been issued at the Srinagar air base which the CoI would confirm in its report. In addition, it is not clear why the Mi-17 was called back after taking off and not diverted to a safe corridor instead.

As the investigation was under way, the Air Officer Commanding (AOC) of the Srinagar air base under whose watch the incident occurred was posted out in early May. However, the IAF has not said if it was related to the incident or other reasons.

**What happens next?**
The CoI is expected to submit its report soon. However, a CoI is a fact-finding body ordered by the assembling authority. Ascertaining blame is only the first step in a long process. Also, a CoI has no legal standing. After completion of the CoI, the court based on its findings makes several recommendations. Recommending action against personnel found guilty on certain counts is one of them.

Based on the facts of the case and recommendations, the authorities may go for administrative action or disciplinary action. If disciplinary action is intended, a charge sheet is framed and a summary of evidence may then be ordered. Based on it, authorities may again take a call on a court martial or other action. For instance, an error of judgement can be awarded administrative action, but a gross violation will be given a court martial. A legal branch gives its final recommendation on the punishment and the file is then sent to the Air Headquarters for final decision. A punishment under the Indian Penal Code can also be awarded. IPC is read under Section 71 of the Air Force Act.

However, with clear indications of serious procedural violations leading to loss of life, senior IAF officials have said that criminal proceedings are likely to be initiated against those responsible as soon as the report comes in.

# Why is China laying down gene editing rules?

After twin experiments with genetic engineering technology, the country agrees with the worldwide scientific community that it needs to be used with care

**R. PRASAD**

**The story so far:** In a bid to make babies immune to infection by the human immunodeficiency virus (HIV), He Jiankui, a researcher from the Southern University of Science and Technology in Shenzhen, China, used a clinically untested gene editing tool (CRISPR-Cas9) to modify a particular gene. The tool has also been used on another woman to make a gene-edited embryo; the pregnant woman is expected to deliver in August. The announcement of the birth of gene-edited twin girls late last year set off an international furore.

**How does it work?**
Unusual but repeated DNA structures that scientists had been observing for some time were given a name – Clustered regularly interspaced short palindromic repeats or CRISPR. In 2012, scientists discovered that CRISPR is a key part of the "immune system". For instance, when a virus enters a bacterium, it fights back by cutting up the virus's DNA. This kills the virus but the bacterium store some of the DNA. The next time there is an invasion, the bacterium produce an enzyme called Cas9 which matches the stored fingerprints with that of the invader's. If it matches, Cas9 can snip the invading DNA. The CRISPR-Cas9 gene editing tool thus has two components – a short RNA sequence that can bind to a specific target of the DNA and the Cas9 enzyme which acts like a molecular scissor to cut the DNA. To edit a gene of interest, the short RNA sequence that perfectly matches with the DNA sequence that has to be edited is introduced. Once it binds to the DNA, the Cas9 enzyme cuts the DNA at the targeted location where the RNA sequence is bound. Once the DNA is cut, the natural DNA repair mechanism is utilised to add or remove genetic material or make changes to the DNA.

**Was it wrong to use the gene tool?**
Dr. He used the CRISPR-Cas9 gene editing technique in the twin girls to disable a gene called CCR5, which encodes a protein that allows HIV to enter and infect cells.Though no guidelines have been drawn up so far, there is a general consensus in the scientific and ethics communities that the CRISPR-Cas9 gene-editing technique should not be used clinically in embryos. There is also consensus that gene editing can be potentially used only to prevent serious genetic disorders that have no alternative treatment. While HIV cannot be cured, medicines can keep the virus under check.

Importantly, human clinical trials have not been carried out anywhere in the world to test whether disabling the gene completely prevents HIV infection and what the side-effects of doing so would be. In the absence of any clinical trial data as well as consensus to use this tool to prevent HIV infection, performing it on babies as a form of medical intervention is unethical.

According to *Nature*, the hospital that had supposedly given Dr. He ethical approval to use the technique on pregnant women issued a press statement denying this. The hospital also "questioned the signatures on the approval form" and said no committee meeting had been held related to his research work.

Apparently, information on the consent form suggests that the parents who had participated in the experiment were never told about the problems of disabling the gene.

**Can disabling the CCR5 gene prevent HIV?**
While it is generally believed that babies without a functional CCR5 gene will become resistant to HIV infection, certain other strains of HIV use another protein (CXCR4) to infect cells. Hence, even people who are born with two copies of the non-functional CCR5 gene are not completely protected or resistant against HIV infection.

There is also the possibility that the gene editing tool could have caused unintended mutations in other parts of the genome, which may lead to unpredictable health consequences.

Most importantly, medicines and delivery through caesarean section and avoiding breast feeding can prevent vertical viral transmission from mother to foetus. While women with HIV have greater chances of passing the virus to the foetus, in this case, the mother was HIV-free; the father was HIV positive.

**Does the CCR5 gene have any protective role?**
The CCR5 gene's protective role against the West Nile virus is well established. According to *Nature*, the CCR5 gene also helps to protect the lungs, the liver and the brain during certain serious infections and chronic diseases. The gene is known to prompt the immune system to fight the influenza virus in the lungs. Without this gene the defence system would fail. In the case of people with multiple sclerosis, absence of this gene

> According to the draft regulation, those found violating the rules will be punished and this includes a lifetime ban on research

makes them twice as likely to die early.

**Was the gene removed in both babies?**
There are two copies of the gene in every person. In the case of one baby girl both the copies of the gene were disabled but in the other baby, only one copy was disabled. So the baby with one functional copy of the gene might still be susceptible to HIV infection. The decision to implant the embryo with only one disabled copy makes the work all the more unethical. Though Dr. He claimed the babies were born in early November last year, *The New York Times* reported that the babies were born premature in October.

**What steps has China taken to prevent misuse?**
The day Associated Press broke the story, the Chinese national health commission asked the Guangdong health commission to start an investigation. On January 21 this year, Dr. He was fired from the university where he worked after a probe by the Guangdong health commission found that he had violated the national regulations against using gene-editing for reproductive purposes.
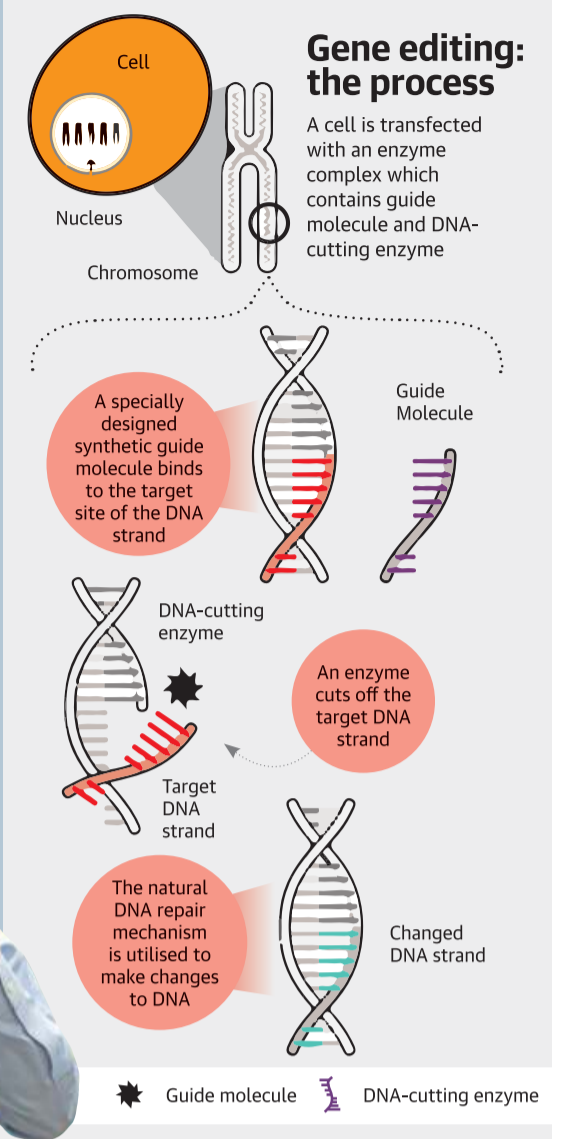
According to *The Scientist*, Dr. He's experiment violates the 2003 guidelines that prohibits the use of gene-manipulated embryos for reproductive purposes. On February 26, China posted the draft regulation requiring researchers to obtain prior approval from the government before undertaking clinical trials. Those found violating the rules will be punished and this includes a lifetime ban on research. China is now all set to introduce gene-editing regulation.

### Snip and change

A DNA editing technique, called CRISPR/Cas9, works like a biological version of a word-processing programme's "find and replace" function

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Chinese scientist He Jiankui • AP
Source: Reuters, Nature

- It is generally believed that babies without a functional CCR5 gene will become resistant to HIV infection
- On the other hand, the CCR5 gene is known to protect the lungs, the liver and the brain during certain serious infections and chronic diseases. The gene is known to prompt the immune system to fight the influenza virus in the lungs
- Human clinical trials have not been carried out anywhere in the world to test whether disabling the gene completely prevents HIV infection and what the side-effects of doing so would be

### Gene editing: the process

A cell is transfected with an enzyme complex which contains guide molecule and DNA-cutting enzyme

Cell
Nucleus
Chromosome

A specially designed synthetic guide molecule binds to the target site of the DNA strand

Guide Molecule

DNA-cutting enzyme

An enzyme cuts off the target DNA strand

Target DNA strand

The natural DNA repair mechanism is utilised to make changes to DNA

Changed DNA strand

⬤ Guide molecule   ⟍ DNA-cutting enzyme

# What does the merger of NSSO and CSO entail?

Will the move undermine the NSSO's autonomy which has been dogged by controversies over data reporting?

**PRASHANTH PERUMAL J.**

**The story so far:** On May 23, the government announced that the National Sample Survey Office (NSSO) will be merged with the Central Statistics Office to form the National Statistical Office (NSO). Many believe that this move will undermine the autonomy of the NSSO which has been at the centre of various public controversies over data on economic growth and unemployment. The NSO will be headed by the secretary of the Ministry of Statistics and Programme Implementation (MOSPI). This is in contrast to the original plan proposed by experts to merge various statistical bodies such as the NSSO and others to create a unified statistics body that is accountable to Parliament, rather than the government.
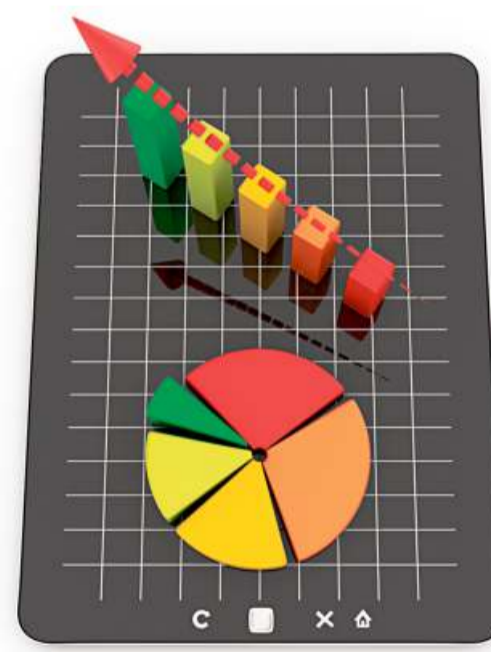
**What is the issue?**
In May, the NSSO came out with a report which cast serious doubt on the reliability of raw data that is used to calculate India's gross domestic product (GDP). The NSSO stated that it could not either trace or classify 38.7% of the companies included in the MCA-21, a database of private companies that is maintained by the Ministry of Corporate Affairs, whose financial numbers the government currently uses to calculate GDP figures. The NSSO found that data from the Economic Census and the Business Register were far less affected by these issues that plagued the MCA-21 database.

Many believe that the poor quality of raw company data could heavily skew the measurement of private sector business growth, which is a part of the overall GDP of the economy. When data gathered from the MCA-21 database was first used to revise earlier growth figures, sectors such as manufacturing showed significant growth in size in 2013-14. This was in stark contrast to the earlier estimates that showed an actual contraction in the size of manufacturing.

**What is the government stand?**
MOSPI, however, has defended the use of the MCA-21 database to calculate GDP numbers stating that appropriate adjustments are made to make sure there is no overestimation of GDP. In a clarification issued on May 10, the government stated that companies classified as "out-of-coverage" by the NSSO still contributed to the economy even though they may not fall strictly under the services sector. It further stated that the weightage given to companies that report their financial numbers is far greater and that, in reality, only about 16.4% of companies in the MCA-21 are either closed or non-traceable. The NSSO's apprehension over the MCA-21

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database still adds to concerns that already exist about the reliability of GDP data that is put out by the government due to recent changes in methodology.

**How is MCA-21 important to GDP?**
Experts feel that the financial accounts of several shell companies that are included in the MCA-21 database could be fictitious, and thus cannot be considered as a good proxy for real economic activity. For instance, under the revised GDP series that was introduced in 2015, financial data from companies that filed their accounts with the government even just once in three years were considered sufficient to help make GDP growth estimations. Supporters of the new methodology believe that, in reality, the accounts of most shell companies reflect the financial activities of actual businesses which remain camouflaged behind these fictitious entities. So, they believe, the non-inclusion of shell companies will actually lead to a significant underestimation of the true size of the economy.

Government statisticians have for long used small surveys to gather the raw data that are required to make "blown up" estimations about the growth of the wider economy. This, however, changed in 2015 when the government introduced a new GDP series with 2011-12 as the base year (from the previous base year of 2004-05)

and introduced the MCA-21 database as the mainstay for calculating GDP figures. The fact that even data for the organised sector of the economy were unreliable has raised doubts about the reliability of other data. Data on the large unorganised sector, for instance, are even cruder and can be extremely unreliable. It is worth noting that policymakers within the government depend heavily on official GDP figures to frame their policies.

> The lack of transparency in the production of economic data can over time cause the users of such data to discount its value

**Is the data collected reliable?**
The field of economic statistics largely involves the estimation of trends in the economy based on sample data that is collected through surveys and other means. This usually gives rise to disagreements even among experts within the field who could have a genuine difference in opinion about how raw economic data should be collected, and about the various assumptions that should go into the calculation of GDP and other economic estimations. What has caused a rise in concerns about the reliability of India's GDP figures in the last few years, however, is the belief that the government led by Prime Minister Narendra Modi may be increasing its interference in the process of the production of economic data. Further, the divergence between official GDP figures which show that growth has fallen below 6% in the fourth quarter and high-frequency economic data which reveal how various sectors are facing a serious slowdown has cast further doubt on the reliability of government data. In January, two non-government members of the National Statistical Commission resigned over, among other reasons, the government's reluctance to release jobs data collected by the NSSO. The NSSO's periodic labour force survey, which was leaked in January, had reported that the unemployment rate was at a 45-year high of 6.1% in 2017-18.

**Will the merger impact the credibility of government data?**
The move will give the government greater leverage over production of key data. The lack of transparency in the production of economic data can over time cause the users of such data to discount its value. This has been the case in countries such as China where the constant tinkering with official economic data has caused analysts to lose trust in them.