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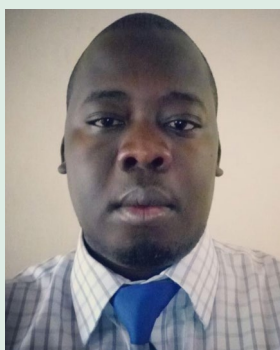
## RADIOLOGY & IMAGING | RESEARCH ARTICLE

# Outcome at two weeks in patients with Traumatic brain injury following road traffic accidents in an urban tertiary hospital in Uganda

Geoffrey Erem<sup>1\*</sup>, Samuel Bugeza<sup>1</sup> and Elsie Kiguli Malwadde<sup>1,2</sup>

**Abstract:** Road traffic accidents (RTAs) are a major global public health problem and are now a recognized neglected pandemic. Head injuries cause immediate death in 25% of acute trauma. We conducted this study to determine the immediate outcomes in adult with head injury following RTA. A prospective study was conducted among 178 adult patients and followed up for two weeks to determine immediate outcomes. Multivariate logistic regression analysis was used to determine predictor variables of immediate outcome. Majority had moderate disability (38.2%), then severe disability (25.8%) and good recovery (24.7%) at two weeks. Persistent vegetative state and death occurred in 2 and 9% of patients respectively. Sixty-three percent of patients had favourable outcome. Convulsions, intracerebral haemorrhage had significant  $p$ -values at bivariate analysis (0.019, 0.008 respectively) at GCS. Vomiting, convulsions, extra cerebral haemorrhage and intracerebral haemorrhage had significant association  $p$  values (0.000, 0.001, 0.000 and 0.000 respectively) at two weeks by GOS. Level of consciousness ( $p$ -value = 0.000), intracerebral haemorrhage ( $p$  = 0.003), skull fractures ( $p$  = 0.001) and surgery ( $p$  = 0.016) were statistically significant at multivariate analysis. GCS and GOS were important in assessment of immediate outcomes at 2 weeks but GOS was a more reliable assessment tool.

### ABOUT THE AUTHORS



Geoffrey Erem

We set out to firstly determine the profile of patients presenting to a tertiary hospital with head injury following RTA, thereafter we determine the immediate outcomes in these patients which is present in this paper. A prospective hospital based study was conducted among 178 adult patients with head injury and followed up for two weeks to determine immediate outcomes. This research work highlighted that most of our patients had moderate disability followed by severe disability then good recovery at two weeks. We also found out that GCS and GOS were important in assessment of immediate outcomes at 2 weeks but GOS was a more reliable assessment tool. Predicting outcomes at presentation ensures that we correctly identify patients who are likely to have poor neurological status and institute prompt and timely intervention.

### PUBLIC INTEREST STATEMENT

Road traffic accident is a worldwide public health problem; it is now recognized as a neglected pandemic. Head injuries cause immediate death in one in every four victims.

We conducted this study to determine the functional status of patients with head injury following RTAs. We recruited 178 patients and followed then up for two weeks.

Most of the patients in our study had moderate disability followed by severe disability and then good recovery at two weeks. Very few patients were totally helpless and some had died by or at two weeks.

Convulsions and intracerebral haemorrhage were associated with poor outcomes at GCS; vomiting, convulsions, extra cerebral haemorrhage and intracerebral haemorrhage were associated with poor outcomes by GOS.

GCS and GOS were important in assessment of immediate outcomes at 2 weeks but Glasgow outcome score was a more reliable assessment tool.

**Subjects:** Quality of Life; Computed Tomography; Diagnostic Imaging; Neuroradiology; Neurosurgery; Trauma

**Keywords:** immediate outcomes; head injury; road traffic accidents (RTA); adults; Uganda

## 1. Introduction

Road traffic accidents (RTAs) have emerged as a major global public health problem and are now recognized as a major neglected pandemic (Dinesh, 2003). The developing countries have a large burden accounting for about 85% of the deaths as a result of RTAs (Peden & Sminkey, 2004). Head injuries cause immediate death in 25% of acute trauma victims (Feliciano, Moore, & Mattox, 1996). It has been predicted that by 2020, RTAs will rank as high as third among causes of disability adjusted life years (DALYs) lost (Ghaffar, Hyder, & Masud, 2004; Murray & Lopez, 1996; Nantulya & Reich, 2002).

A study by Kobusingye et al. showed that RTAs accounted for 35.1% of all traumas in Kampala. Over half of the cases required admission (351/697, 50.4%), and 10 (1.4%) died in the casualty department (Andrews, Kobusingye, & Lett, 1999). RTAs are the leading causes of surgical admission in Mulago Hospital, the National Referral Hospital in Uganda. This is mainly because of reckless taxi operators on poorly designed roads in Uganda. In Ghana, all age injury mortality was estimated at 62/100 000/year, with a non-fatal rate of 7.56/100/year (Mock, nii-Amon-Kotei, & Maier, 1997).

More than 20 million people are severely injured or die on the world's roads each year, mainly happening in low-income countries of Africa, Latin America and Asia (David, 2010; Smith & Barss, 1991; Zwi, 1993).

The majority of patients who are severely injured survive with severe disability and few end up in a vegetative state (Hukkelhoven et al., 2003). The Glasgow Coma Scale (GCS) (Teasdale & Jennett, 1974) is a tool for assessing the depth of coma from traumatic and non-traumatic causes of unconsciousness. Early in the establishment of this scale and the associated Glasgow Outcome Scale (GOS) (Jennett & Bond, 1975) it became clear that deeper levels of coma as measured by lower scores on the GCS typically carry a worse prognosis and poorer outcome on the GOS in adults (Narayan, Greenberg, & Miller, 1981).

The negative effects of boda bodas as a means of transport with respect to head injury was highlighted in the study by Naddumba (Naddumba, 2004). This study highlights the prevalence and pattern of boda boda injuries and the related health cost estimates at Mulago Hospital with no relation to the immediate outcomes (Naddumba, 2004). Immediate outcome is assessed by GCS into mild (12–15), moderate (9–12) and below 8 as severe injury and GOS as good recovery, moderate disability, severe injury, persistent vegetative state and dead at two weeks.

Previous studies with regards to cranial CT findings following RTA in Uganda have been done but these have not been correlated with the immediate outcomes. Therefore, the purpose of this study was to describe the immediate outcomes in adult patients presenting with head injury at a tertiary urban hospital in Uganda.

## 2. Material and methods

### 2.1. Study setting and design

We conducted a descriptive, prospective hospital based study at the National Referral Hospital in Central Uganda. *This tertiary hospital is located in the capital city of Uganda which is both the administrative and business capital of Uganda.* Adult patients who presented to accident and emergency (A & E) department following RTAs with head injury were recruited by systematic sampling into the study. The National Referral Hospital has a bed capacity of 1,500 and bed occupancy rate of between 180 and 200%. *The composition of the population is cosmopolitan with regard to tribe. Majority of the city dwellers are young and middle aged civil servants and people participating in trade of various kinds.*

We included adult patients aged 18 and above who presented with head injury following RTA and had a Brain CT scan performed on them in this study, they were then followed up for two weeks from the time of injury. Patients with major poly traumas were excluded from our study because they could be confound the outcomes at two weeks.

### **2.2. Recruitment procedure for participants**

Informed consent was obtained from all patients who met the inclusion criteria. All the study patients had their clinical history *taken and examined by the attending doctor and then* followed by brain CT scan examination. The information was captured using pre-tested questionnaires. The patients were followed for two (2) weeks to determine their clinical outcomes by assessing for GCS and GOS at two weeks.

There is no emergency ambulance referral system in Uganda so the patients were brought to the hospital using various locally available means of transport available at the time of the road traffic accident. This is likely to cause a lot of delays between the time of crash to arrival to the hospital.

### **2.3. Sample size and sampling procedures**

A total of 178 adult patients *or relatives* were recruited in the study. All the patients were admitted through Accident and Emergency (A & E) Department, patient history and examination were taken by the admitting doctor in the emergency unit. They all had brain CT scans performed on them in the radiology department after initial stabilization, the examinations was performed by the CT technician on duty and interpreted by the principal investigator in consultation of the co-authors for quality control. The results were dispatched immediately to the attending physician.

### **2.4. Equipment**

A Philips Tomoscan MX16 Host model August 2010 CT machine in the Department of Radiology was used to perform all the Cranial CT scan examinations. Patients were stabilized in the emergency room before CT scan was performed. Non-enhanced helical brain CT scans were performed from the skull base to the vertex. The images were annotated and a hard copy printed in bone and soft tissue windows.

### **2.5. Data analysis**

Data was coded, cleaned and entered into a computer using EpiData version 3.1 and exported to SPSS computer software version 16 for analysis. *Frequency tables were generated for clinical characteristics of immediate outcome and GOS. Statistical significance was determined for the CT characteristic. Bivariate analysis was run for the clinical and CT findings against GCS and GOS at two weeks. Characteristics with significant p-values at bivariate analysis with then analyzed further at multivariate regression.*

### **2.6. Study variables**

Clinical variables included passenger detail namely; pedestrian, car passenger, motorcycle passenger then vomiting, convulsions, headache, influence of alcohol, clinical diagnosis namely open and closed head injury. Outcome variables were GCS; 13–15, 9–12,  $\leq 8$  and GOS; Good recovery, moderate disability, severe disability, persistent vegetative stage and death.

### **2.7. Outcomes at two weeks**

The outcomes at two weeks shall be measured by determining the GCS and GOS during the two weeks follow up from the time of injury. Furthermore outcome by GOS can be classified into favorable and unfavorable as follows. Good recovery and moderate disability were defined as favorable outcome and severe disability, persistent vegetative state and death were defined as unfavorable outcome.

### 2.8. Ethical considerations

The study was approved by Institutional Review Board of Makerere University College of Health Sciences. Written informed consent was sought from all patients or relatives.

## 3. Results

### 3.1. Clinical characteristics as a predictor of immediate outcomes

Patients who were unidentified at the time of hospitalisation were classified as unknown (100%), convulsions (66%), open head injury (41.3%) and being a cyclist (41.2%) had unfavourable outcomes whereas car drivers (83.3%), pedestrians (66%), car passengers (73.3%) had favourable outcomes (Table 1).

### 3.2. CT characteristics as a predictor of immediate outcome

Patients with sub-arachnoid haemorrhage ( $p = 0.00$ ), intracerebral haemorrhage ( $p = 0.00$ ) and mid-line shift ( $p = 0.01$ ) significantly had unfavourable outcome while midline shift of less than 3 mm had favourable outcome. Epidural haemorrhage (0.37), subdural haemorrhage (0.27), severity of skull fractures (0.198) and site of skull fracture (0.268) did not have significant  $p$ -values (Table 2).

### 3.3. Distribution of outcomes by GOS

Most of the patients had moderate disability (38.2%) followed by severe disability (25.8%) and good recovery (24.7) at two weeks. Persistent vegetative state and death occurred in 2% and 9% of patients respectively (Figure 1). Sixty-three percent of patients favourable outcome with the rest having unfavourable outcomes (Figure 2).

### 3.4. Cross tabulation of management with GOS

The majority of patients who were managed conservatively had moderate disability (39.2%) closely followed by good recovery (33.7%) and severe disability (20.3%).

Of the patients managed surgically, the majority also had severe disability (37.2%) followed by moderate disability (27.9%). About 7% of patients died in both arms of management (Figure 3).

**Table 1. Summary of the clinical outcomes**

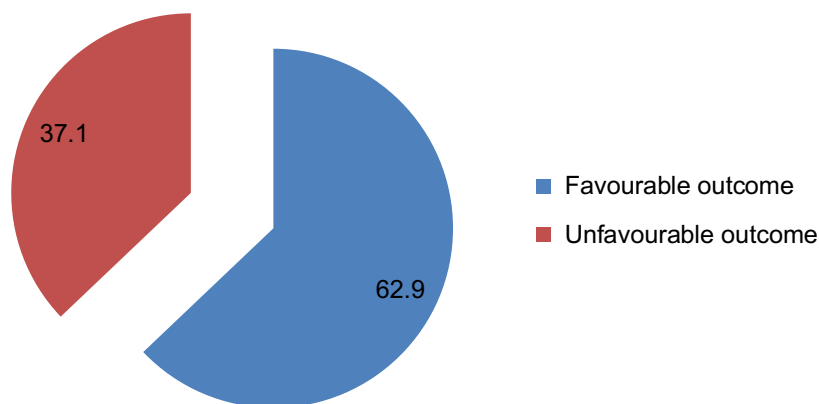
| Characteristics       | Favourable outcomes $n$ (%) | Unfavourable outcomes $n$ (%) |
|-----------------------|-----------------------------|-------------------------------|
| Pedestrians           | 33 (66)                     | 17 (34)                       |
| Motor cyclists        | 40 (58.8)                   | 28 (41.2)                     |
| Motor cycle passenger | 18 (62.1)                   | 11 (37.9)                     |
| Car passenger         | 11 (73.3)                   | 4 (26.7)                      |
| Driver                | 10 (83.3)                   | 2 (16.7)                      |
| Unknown               | 0 (0.00)                    | 4 (100)                       |
| Vomiting              | 30 (62.4)                   | 18 (37.5)                     |
| Influence of alcohol  | 19 (70.4)                   | 8 (29.6)                      |
| Convulsions           | 11 (44.0)                   | 14 (66.0)                     |
| Closed head injury    | 57 (68.7)                   | 26 (31.3)                     |
| Open head injury      | 54 (58.7)                   | 38 (41.3)                     |
| Headache              | 92 (71.3)                   | 37 (28.7)                     |

**Table 2. CT characteristics as a predictor of immediate outcome**

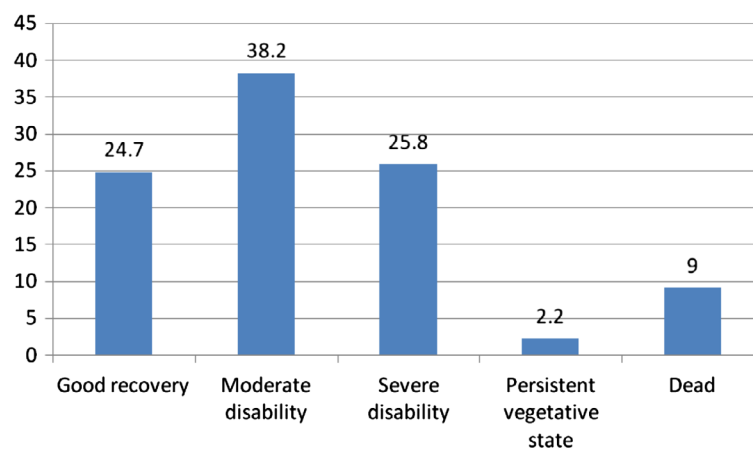
| CT characteristics                | Favourable outcome<br>n (%) | Unfavourable outcome<br>n (%) | p-value |
|-----------------------------------|-----------------------------|-------------------------------|---------|
| Epidural haemorrhage              | 9 (52.9)                    | 8 (47.1)                      | 0.37    |
| Subdural haemorrhage              | 21 (55.3)                   | 17 (44.7)                     | 0.27    |
| Subarachnoid haemorrhage          | 6 (25)                      | 18 (75)                       | 0.00*   |
| Intraparenchymal haemorrhage      | 38 (42.9)                   | 50 (57.9)                     | 0.00*   |
| <i>Severity of skull fracture</i> |                             |                               |         |
| Depressed                         | 14 (48.3)                   | 15 (51.7)                     | 0.198   |
| Linear                            | 11 (32.4)                   | 23 (67.6)                     |         |
| <i>Site of skull fracture</i>     |                             |                               |         |
| Skull base                        | 7 (29.2)                    | 17 (70.8)                     | 0.268   |
| Skull vault                       | 16 (43.2)                   | 21 (56.8)                     |         |
| <i>Midline shift</i>              |                             |                               |         |
| ≤3                                | 98 (71)                     | 40 (29)                       | 0.01*   |
| 4–6                               | 8 (44.4)                    | 10 (55.6)                     |         |
| 7–9                               | 4 (30.8)                    | 9 (69.2)                      |         |
| ≥10                               | 2 (28.6)                    | 5 (71.4)                      |         |

\*Indicates that the values have a significant p-value of less than 0.05.

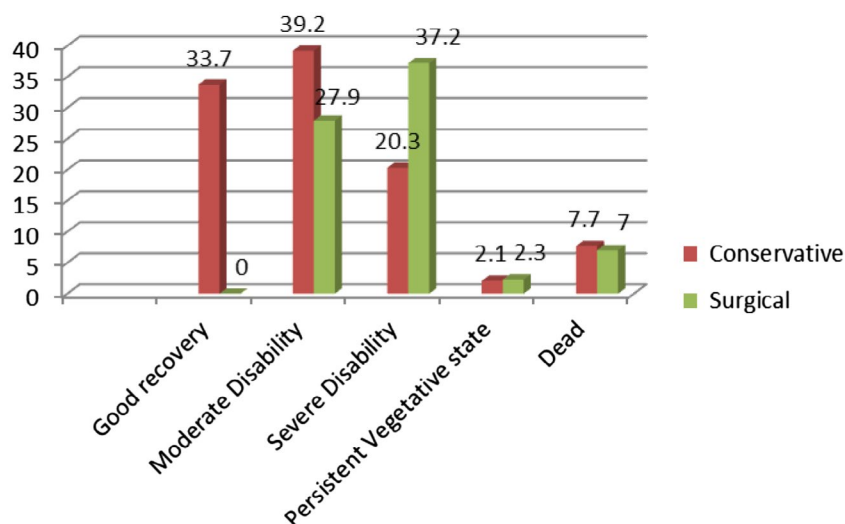
**Figure 1. Showing the dichotomisation of outcomes into favourable and unfavourable.**



**Figure 2. Showing the percentage immediate outcomes by Glasgow outcome score.**



**Figure 3. Bar graph showing cross tabulation of management with GOS.**



### 3.5. Bivariate analysis with GCS at 2 weeks

Patients with convulsions and intracerebral haemorrhage had significant  $p$ -values at bivariate analysis ( $p$ -values = 0.019 and 0.008 respectively). The rest of the characteristics did not have a significant association at bivariate analysis (Table 3).

### 3.6. Bivariate analysis for clinical and CT characteristics with GOS at 2 weeks

Patients vomiting, convulsions, extracerebral haemorrhage and intracerebral haemorrhage had a highly significant association with  $p$ -values of 0.000, 0.001, 0.000 and 0.000 respectively at two weeks. The rest of the variables did not have a significant association at bivariate analysis (Table 4).

### 3.7. Multivariate analysis

The patient characteristics with statistical significance included level of consciousness ( $p$ -value = 0.000), intracerebral haemorrhage ( $p$  = 0.003), skull fractures ( $p$  = 0.001) and surgical management ( $p$  = 0.016). The rest of the characteristics did not show any significant association on multivariate analysis (Table 5).

**Table 3. Bivariate analysis with GCS at 2 weeks**

| Variables                  | Frequency | Percentage | $p$ -value |
|----------------------------|-----------|------------|------------|
| <i>Passenger detail</i>    |           |            |            |
| Pedestrian                 | 44        | 29.3       | 0.508      |
| Cyclist                    | 64        | 42.7       |            |
| Motor cycle passenger      | 27        | 18.0       |            |
| Driver                     | 12        | 8.0        |            |
| Unknown                    | 3         | 2          |            |
| Vomiting                   | 45        | 31.5       | 0.058      |
| Convulsions                | 21        | 15         | 0.019*     |
| Alcohol influence          | 26        | 19.5       | 0.716      |
| Extra cerebral haemorrhage | 51        | 31.3       | 0.531      |
| Intra cerebral haematoma   | 79        | 48.5       | 0.008*     |

\*Indicates that the values have a significant  $p$ -value of less than 0.05.

**Table 4. Bivariate analysis for clinical characteristics and the GOS at 2 weeks**

| Variables                  | Frequency | Percentage | p-value |
|----------------------------|-----------|------------|---------|
| <i>Passenger detail</i>    |           |            |         |
| Pedestrian                 | 50        | 28.1       | 0.120   |
| Cyclist                    | 68        | 38.2       |         |
| Motor cycle passenger      | 29        | 16.3       |         |
| Car passenger              | 15        | 8.4        |         |
| Driver                     | 12        | 6.7        |         |
| Unknown                    | 4         | 2.2        |         |
| Vomiting                   | 48        | 32.4       | 0.000*  |
| Convulsion                 | 25        | 16.9       | 0.001*  |
| Alcohol influence          | 27        | 18.8       | 0.442   |
| Extra cerebral haemorrhage | 62        | 34.8       | 0.000*  |
| Intra cerebral haemorrhage | 88        | 49.4       | 0.000*  |

\*Indicates that the values have a significant p-value of less than 0.05.

**Table 5. Multivariate logistic correlation between the characteristics and the outcomes**

| Characteristics            | df | p-value | Odds ratio |
|----------------------------|----|---------|------------|
| LOC                        | 2  | 0.000*  |            |
| 9-12                       | 1  | 0.000*  | 7.354      |
| ≤8                         | 1  | 0.000*  | 121.674    |
| ENT bleeding               | 2  | 0.541   | 1.01       |
| Vomiting                   | 2  | 0.819   | 0.708      |
| Alcohol intake             | 2  | 0.869   | 1.484      |
| Extra cerebral haemorrhage | 1  | 0.918   | 1.145      |
| Intra cerebral haemorrhage | 1  | 0.003*  | 0.170      |
| Skull fractures            | 1  | 0.001*  | 0.167      |
| Surgical management        | 1  | 0.016*  | 8.977      |
| Subarachnoid haemorrhage   | 1  | 0.197   | 4.632      |
| Dizziness                  | 2  | 0.663   | 1.530      |
| Epidural haemorrhage       | 1  | 0.367   | 0.331      |
| Subdural haemorrhage       | 1  | 0.247   | 0.264      |

\*Indicates that the values have a significant p-value of less than 0.05.

#### 4. Discussions

Patient outcomes were dichotomised into favourable and unfavourable, where favourable outcome was good recovery and moderate disability whereas unfavourable outcome was severe disability, persistent vegetative state and death. Moderate recovery is defined as ability to live independently but unable to return to work or school.

Up to 37.1% of the study participants had unfavourable outcomes which translated into one in three of the study patients being unable to continue earning their daily livelihoods two weeks after RTA. This meant that they were unable to work and perform daily livelihood and home tasks. Most patients with GCS of 13–15 had moderate recovery at two weeks. Much as only 1.1% of patients had GCS of ≤8 up to nine percent of these patients died as indicated by the GOS.

Eighteen percent of study patients had operative treatment. This number was less compared to previous study by Kiguli et al. where up to 38% of patients underwent surgery following brain CT examinations (Kiguli, Kawooya, & Iga, 1998). This could be explained by the advancement in

imaging modalities with increasing number of CT scan services in Kampala, Uganda. There is now prompt and accurate diagnosis of intracranial pathology with those not requiring immediate surgical intervention being monitored by subsequent imaging.

It could also be argued that with increasing burden of head injury following RTA, the neurosurgeons are overwhelmed hence reduced output of operative surgery in relation to the patient numbers. Uganda has one neurosurgeon for every 3,600,000 million people; these can't take care of all this high burden of head injury in Uganda translating into reduced surgical output.

At bivariate analysis, GCS at 2 weeks showed significant  $p$ -values with convulsions and intracerebral haemorrhage of 0,019 and 0.008 respectively. At GOS in 2 weeks, the variables with significant  $p$ -values included vomiting, convulsion, extracerebral haemorrhage and intracerebral haemorrhage (0.000, 0.001, 0.000 and 0.000). This shows that GOS is a more reliable tool the GCS at two weeks in determination of immediate outcome at bivariate analysis.

There was statistical significance on multivariate logistic regression analysis of the level of consciousness, intracranial haemorrhage and skull fractures with  $p$ -values of 0.000, 0.003 and 0.001 respectively.

There was a 7 times more likely to have an unfavourable outcome with a GCS of 7–12 compared to a patient who had a score of 13 and above. But patients with a GCS of less or equal to 8 had up to 121 times likely to have an unfavourable outcome compared to a patient who had a GCS of 13 and above.

Patient who had surgical management where 9 times more likely to have an unfavourable outcome than those who were managed conservatively, likewise a patient with subarachnoid haemorrhage had where 5 times more likely to have unfavourable outcome as well.

## 5. Conclusions and recommendations

Both GCS and GOS are important in the assessment of immediate outcomes at 2 weeks but GOS is the more reliable tool of the two. This is a significant observation that may contribute to coming up with protocols at Mulago Hospital in the management of patients with head injury. There are no protocols for management of head injuries at the moment at the hospital. Despite these findings, a longer follow up is needed amongst the patients with unfavourable outcome in order to ascertain their long term functional status.

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### Competing Interests

The authors declare no competing interest.

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