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An Outbreak of *Brucella melitensis* among Goat Farmers in Thailand, December 2009

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Abstract

Goat farming has increased substantially in Thailand as a result of government's agricultural policies in the past. On 19 Oct 2009, the Thailand Bureau of Epidemiology received a notification of a confirmed and fatal case of brucellosis in a goat farmer. An investigation was launched to identify the magnitude and risk factors of the disease. A cross-sectional study among persons in contact with goats from the same marketing chain as the fatal case was performed. Sera samples of goats from three farms associated with the fatal case were collected. The fatal case was a 79-year-old male with hypertension, gout and renal calculi. He had been raising goats since 2007 until onset of the symptoms, without any protective equipment. He developed peritonitis and acute renal failure in June 2009, and eventually died from respiratory failure on 9 Sep 2009. Hemoculture of his specimen revealed positive for *Brucella melitensis* a month after his death. Three additional cases of human brucellosis were identified from 38 contacts (AR = 10.3%) and one goat tested positive for *Brucella*. Most of the patients experienced myalgia and arthalgia. The study showed that all cases had history of unprotected exposure to goat carcasses or meat (PR undefined, P-value = 0.006). This outbreak of brucellosis among goat farmers emphasizes the importance of health education for goat farmers and the prompt sharing of data between human and animal health professionals.

Keywords: brucellosis, goat farming, risk factors, animal and human health

Background

Brucellosis is an infectious disease caused by small, Gram-negative, non-motile, non-spore-forming rod-shaped bacteria in the genus *Brucella*. There are many species of *Brucella*, a facultative intracellular parasite capable of causing chronic disease. In humans, brucellosis can be caused by *B. abotus*, *B. melitensis*, *B. suis,* and rarely by *B. canis* or marine mammal *Brucella*.[1] The incubation period of brucellosis is variable in humans, with most infections become apparent within two to three weeks after transmission.[2] The shortest incubation period is five days, and the longest is three months or longer. For animals, the incubation period varies by species and stage of gestation.[1] In humans, the clinical picture of brucellosis is intermittent or irregular fever of variable duration, headache, weakness, profuse sweating, chills, arthralgia, depression, weight loss or generalized aching.[3] In animals, this disease mainly causes abortion, stillbirth, orchitis, epididymitis, testicular abscess, or birth of weak offspring.[1] For a confirmed diagnosis, as there are no specific signs and symptoms, laboratory test must be used.[2] Mode of transmission usually occurs through direct or indirect contact with infected animals and their secretions, tissues, blood, urine, vaginal discharges, aborted fetuses and especially placentas. In addition, ingestion of raw milk and dairy products such as unpasteurized cheese from infected animals can cause the infection too. Airborne infection can also occur among animals in pens and stables, and persons working in laboratories and abattoirs.[3] Untreated brucellosis carries a mortality rate of less than 2-5%, usually from endocarditis, meningitis or encephalitis.[2]

On 19 Oct 2009, the Bureau of Epidemiology (BOE) in Ministry of Public Health, Thailand was notified from

the National Institute of Animal Health (NIAH) about one confirmed case of human *Brucella melitensis* infection. Further verification revealed that the patient was 79 years old and lived in Village 2, Thakham Sub-district, Chondan District, Phetchabun Province. He had a history of contact with goats and died on 9 Sep 2009. The teams from BOE, Office of Disease Prevention and Control 9, Phetchabun Provincial Health Office, Chondan Hospital and District Health Office collaborated and investigated on 3-6 Nov 2009, with the objectives of verifying the cause of death, determining the extent of disease spread, identifying risk factors and initiating control and prevention measures.

Method

Descriptive Study

We conducted a descriptive study by reviewing the status of human and animal brucellosis in Thailand. For the human situation, we used reports from the BOE's database and for the animal situation, we reviewed data from the passive surveillance of NIAH and active surveillance data from the project on "Goat and sheep brucellosis free farm" which was launched by the Department of Livestock Development (DLD). The goat farms registered in this project were pre-screened for brucellosis. We also reviewed the number of goat farms in Phetchabun Province from a registry listing from the Phetchabun Livestock Health Office.

We reviewed medical records of the index patient from Phetchabun Hospital and Chondan Hospital, and interviewed his doctors. Information about clinical signs, diagnosis and treatment as well as background information was also recorded from the patient's family. This included information on his signs and symptoms, history of contact with goats and other animals, movement of goats into and out of his farm, clinical manifestations of these goats and risk factors such as contact with secretions or carcass of goat, consuming raw goat meat, drinking raw goat milk, working in goat farm and knowledge about brucellosis.

A probable case was defined as a person who had at least two of the following symptoms: fever, myalgia, headache, fatigue, night sweat, arthalgia, weight lost and scrotal swelling;[5] and had laboratory confirmation of brucellosis by Rose Bengal Agglutination and ELISA (IgM, IgG) tests.[6] A confirmed patient was a probably case with laboratory confirmation by hemoculture for *Brucella spp*.

We conducted active case finding in those who had history of contact with goats in the same marketing chain as the index patient or who lived near the index patient's farm in Village 2, Thakham Sub-district and who developed clinical symptoms compatible with brucellosis from January to December 2009. Face-to-face interviews were conducted to collect information about demographic data (age, gender and occupation), history of illness (underlying diseases, clinical signs and symptoms, duration of illness, onset time and treatment) and possible risk factors (raising carrier animals and type of animals; contact with animal secretions such as amniotic fluid, placenta, blood and animal carcass without any protective equipment; and history of consumption of meat or dairy products of animals that were not appropriately cooked, especially goats and sheep).

Environmental Study

We surveyed three goat farms in Village 2, Thakham Sub-district. In addition, we surveyed a cow farm that shared a grass field with a goat farm tested positive for brucellosis. We interviewed the owners of goats regarding their understanding on farm management such as characteristics of raising goats, households, cleaning methods, and source of food and water.

Laboratory Study

We collected blood samples from village residents whom had history of contact with goats from the same herd as the goats owned by the index patient. Serum samples were analyzed by the National Institute of Health (NIH) using Rose Bengal Agglutination and Enzyme-linked Immunosorbent Assay (ELISA) methods.[5] A positive Rose Bengal Agglutination or ELISA test was defined as an IgG titer of more than 30 U/Ml or IgM more than 20 U/Ml. In addition, we collected blood samples from goats and other animals with potential exposure to the goats cared for by the index patient for analysis by NIAH using Rose Bengal Agglutination and Complement Fixation Tests (CFT). If an animal was tested positive by both methods, it was confirmed as an animal case.[1]

Analytic Study

We conducted a cross-sectional study to identify possible factors associated with brucellosis infection. The study population was defined as any person with a history of contact with goats from the index patient's herd and living in Thakham Sub-district. A case was defined as someone with at least two of the following symptoms: fever, myalgia, headache, fatigue, night sweat, arthalgia, weight loss and scrotal swelling, with laboratory confirmation of brucellosis by Rose Bengal Agglutination and ELISA (probable case) or by hemoculture for *Brucella spp.* (confirmed

case). A non-case was a person who had negative laboratory results for brucellosis by all testing methods mentioned before.

We described median age, attack rate, symptoms and gender ratio. In addition, we analyzed possible risk factors using a univariate analysis to show potential associations by Prevalence Ratio (PR) and 95% confidence intervals using Epi Info program version 3.5.1 (US CDC).

Results

Descriptive Results

In Thailand, the first report of human brucellosis was in 2003 (nine cases from Ratchaburi Province and one case from Kanchanaburi Province).[4] From 2003 to 2009, 121 human cases of brucellosis were reported to the BOE, including three deaths from 16 provinces. The majority of animal brucellosis cases from 2003 to 2009 were reported from Nakhon Si Thammarat and Kanchanaburi provinces (Figure 1).

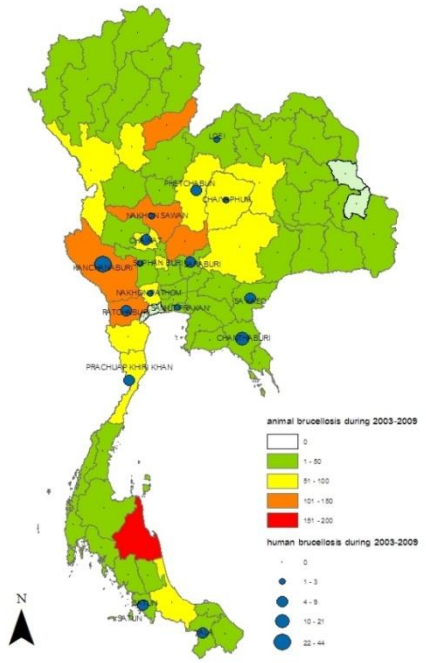

Figure 1. Map of human and animal brucellosis situation in Thailand during 2003-2009

In 2009, Phetchabun Province had 79 registered goat farms, making it the 21st most populated province in Thailand. Most of the farms are located in Chondan District (42%). Nineteen cases of animal brucellosis have been reported from Phetchabun Province (17 in 2007, one in 2008 and one in 2009 from this outbreak).

The index patient was a 79-year-old man who lived in Village 2 of Thakham Sub-district, Chondan District in Phetchabun Province. He had hypertension, gout and renal stones, and presented with backache and abdominal pain on 22 Jun 2009 to the out-patient ward of Chondan Hospital. After receiving symptomatic care for several visits, he re-presented on 14 Aug 2009 with fever, abdominal pain, vomiting and diarrhea, and was admitted. He was later transferred to Phetchabun Hospital and diagnosed with peritonitis and acute on chronic renal failure. His blood culture grew unspecified Gram-negative cocci and was sent for confirmation at NIH. He was treated with ceftriazone and metronidazole for 12 days until 25 Aug 2009, and he improved clinically. He was later referred back to Chondan Hospital for ongoing treatments.

On 29 Aug 2009, his clinical situation worsened and he developed fever, became drowsy and experienced seizure, prompting his transfer back to Phetchabun Hospital. The Computed Tomography (CT) scan demonstrated brain atrophy. On 6 Sep 2009, he again developed drowsiness and dyspnea. His laboratory results showed anemia (Hematocrit 27%) and bilateral infiltrates were found on chest X-ray. Three days later, he died of suspected Central Nervous System (CNS) infection with additional diagnoses of hospital-acquired pneumonia, respiratory failure and catheter-induced urinary tract infection. His blood culture results from NIH and NIAH were positive for *Brucella melitensis* a month after his death.

One exposure for the index patient was goats as he started raising goats since 2007 after purchasing 20 goats from Farm J. The goats from his farm did not register with the project "Goat and sheep brucellosis free farm" of the District Livestock Health Office and therefore, these goats were not screened for brucellosis. In addition, his farm was not designated as a bio-security farm as it was located in his house compound and there were no fences or disinfection of his farm. Moreover, the goats were not screened for diseases before moving in and out. In 2008, he received an additional goat from his cousin and sold other goats to Farm P located in the same village. Later this year, Farm P discovered one of the goats from the index patient to be positive for brucellosis (by Rose Bengal Agglutination and CFT tests). In March 2009, the index patient's goat developed seizures and died. He buried its carcass and slaughtered other sick goats before consuming them with his family. In April 2009, he decided to sell his remaining goats to Farm B. Soon afterwards, these goats experienced abortion and joint swelling. The index patient was discovered to have direct contact with goat blood, placentas and other secretion without using any protective equipment. However, he did not have history of consuming home-made goat milk (Figure 2).

Interviews with 39 persons in the study population identified three additional probable human brucellosis cases which generated attack rate of 10.3% (4/39). The median age of cases was 51.5 years, ranged from 37 to 79 years. Male to female ratio was 1:1. Most experienced myalgia (100%) and arthalgia (100%), with half of them reporting fever (50%) and fatigue (50%). All patients had a history of exposure to goats, or consuming goat meat or milk. Among 4 cases, 100% had history of contact with goat carcass; 75% of raising ruminant animals, contact animal secretion or consuming goat meat; and 50% of consuming goat milk (Table 1).

Prior to onset of the index patient's symptoms, his goats fell ill. Two probable cases, including one from Farm P, developed symptoms at the same time as the index patient. The last patient was a family member of the index patient and developed symptoms in the middle of October 2009 (Figure 3).

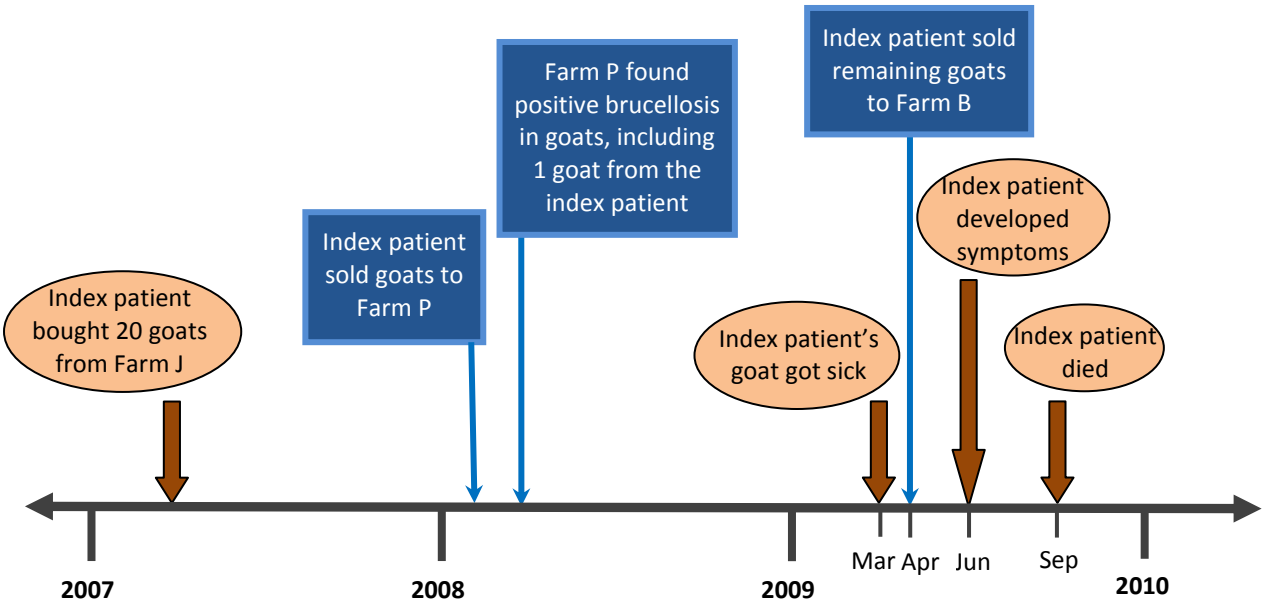

Figure 2. Diagram of possible exposure history of the index patient with brucellosis infection in Village 2, Thakham Sub-district, Chondan District, Phetchabun Province, Thailand, 2009

Table 1. Characteristics and possible exposures of brucellosis patients in Village 2, Thakham Sub-district, Chondan District, Phetchabun Province, Thailand, 2009

Patient	Demographic	Laboratory diagnosis	Sign, symptom and illness onset	History of possible exposure
Index patient	79 years, man	Hemoculture	Fever, myalgia and arthalgia in June 2009	- Contact with goat secretion - Consumption of goat meat - Goats were sick, but no laboratory testing of brucellosis
Patient 2	45 years, woman	Rose Bengal Agglutination and ELISA	Myalgia and arthalgia in mid of June 2009	- Contact with goat secretion - Consumption of home-made milk - Purchased goats from index patient's farm and found brucellosis positive
Patient 3	58 years, man	Rose Bengal Agglutination and ELISA	Fever, myalgia and arthalgia in July 2009	- Contact with goat secretion - Consumption of home-made milk - Consumption of goat meat - Purchased goats from index patient's farm and found brucellosis positive
Patient 4	37 years, woman (Index patient's daughter-in-law)	Rose Bengal Agglutination and ELISA	Myalgia, headache, depression, night sweat, arthalgia and weight loss in October 2009	- Prepared food from goat meat - Consumption of goat meat - Lived in the index patient's house

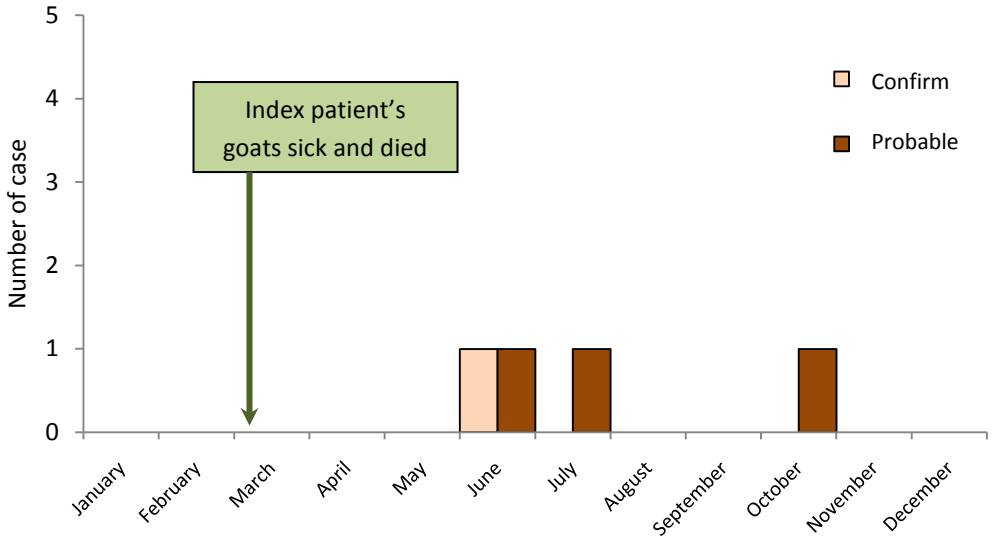

Figure 3. Number of brucellosis patients by month in Village 2, Thakham Sub-district, Chondan District, Phetchabun Province, Thailand, 2009

Environmental Results

The index patient's goat farm and other goat farms in Thakham Sub-district that bought or sold goats from the index patient's farm were surveyed during the outbreak investigation. We found that most of the farms did not take bio-security measures such as separating owners' houses and goat farms, having disinfecting system of goats before bringing them into the farms, and providing areas for disease screening and quarantine (Figure 4 and 5).

Figure 4. Pictures showing that other animals had access to the goat farms and farms were close to owner's houses in Thakham Sub-district, Chondan District, Phetchabun Province, 2009

Figure 5. Picture showing that goat farms did not have a disinfectant system in place for goats entering the farm in Thakham Sub-district, Chondan District, Phetchabun Province, 2009

Laboratory Results

Thirty eight human blood samples were collected for testing brucellosis antibody. Three (7.9%) were tested positive of brucellosis by Rose Bengal Agglutination and ELISA tests (probable cases), including one family member of the index patient (33.3%), and two persons living and working in Farm P (66.7%).

Blood samples of animals that had contact with the index patient's goat were also collected. Total 18 animal specimens were tested for brucellosis which included 10 from goats (55.6%), two from cows (11.1%), one from dog (22.2%) and two from cats (11.1%). The result revealed that one goat from Farm B (10%) and one dog from the index household were tested positive for brucellosis (Table 2).

Table 2. Results of animal laboratory testing for brucellosis in Thakham Sub-district, Chondan District, Phetchabun Province, 2009

Farm	Type of animal	Number of sample	Laboratory Result	Percent of positive samples
Index farm	Dog	2	1 negative and 1 suspected*	50
Farm J (Index patient bought goats)	Goat	5	All negative	0
	Dog	1	Negative	0
Farm B (Index patient sold goats)	Goat	5	1 sample positive	20
	Dog	1	Negative	0
Farm P** (Index patient sold goats)	Cat	1	Negative	0
Cow farm near Farm P ***	Cow	2	All negative	0

* One dog sample tested positive by Rose Bengal Agglutination and CFT, but brucella species could not be identified.

** Goat samples from Farm P were collected by Provincial Livestock Office and were found positive for brucellosis by Rose Bengal Agglutination and CFT tests

*** Cow herd that shared grass field with goats from Farm P

Table 3. Risk factors for brucellosis in Village 2, Thakham Sub-district, Chondan District, Phetchabun Province, 2009 (n=39)

Risk	Exposed		Non-exposed		Crude PR (95% CI)	P-value
	Case	Non-case	Case	Non-case		
Exposed to goat carcass without protective equipment	4	8	0	27	Undefined	0.006
Ate goat meat or drank home-made goat milk	4	11	0	24	Undefined	0.020
- Ate goat meat	3	11	1	24	5.4 (0.6-46.8)	0.120
- Drank home-made goat milk	2	2	2	33	8.8 (1.7-46.2)	0.040
Helped with parturition	3	12	1	23	4.8 (0.6-42.0)	0.140
Contacted with goat secretions	3	16	1	19	3.2 (0.4-27.8)	0.280
Worked in a goat farm	3	27	1	8	0.9 (0.1-7.6)	0.660

Analytic Results

A univariate analysis showed an association between brucellosis infection and a history of contact with goat carcass, or consuming goat meat or milk. However, we could not calculate strength of association with exposure to goat carcass because there were no cases in non-exposed population. The significant association was identified for goat milk or meat consumption, with crude PR 8.8 (95% CI 1.7-46.2). Other variables of helping parturition, contact with goat secretions and working in a goat farm were not statistically significant (Table 3).

Conclusion and Discussion

This was the first brucellosis death reported by Phechabun Province and the fourth death reported in Thailand. In spite of the cause of death being reported as hospital-acquired pneumonia, brucellosis was likely an exacerbating factor. Possible sources of infection for the index patient were direct contact with goat secretions or blood, especially the history of contact goat carcass without any protective equipment and goat meat consumption. The findings were similar to studies that identified risk factors for human brucellosis in Thailand[4] and Kyrgyzstan[7]. A person who drank goat milk and did not use protective equipment is possibly at higher risk for developing brucellosis infection from contaminated goat secretions and milk. Although other factors such as parturition assistance might be a risk factor, these were undetected by this study due to small sample size of this study.

The proportion of human brucellosis cases among persons with exposure to goats was 10.3 % (4/39), a finding similar to the previous report on brucellosis outbreak in Thailand during 2003 which found 8.1%.[4]

Chondan District of Phetchabun Province had a high frequency of reports on human and animal cases of brucellosis. This might be due to the fact that Chondan District has more goat farms (majority were unregistered) and many of them did not have screening systems for brucellosis before goats move in and out the farms. The people in this area also had little knowledge about risk factors for brucellosis and usually helped with parturition of goats without using personal protective equipment. In addition, lack of strong collaboration between livestock health officers and public health officials might have been a barrier for sharing information about brucellosis cases in both animals and humans. This might have prevented effective disease monitoring, and disease prevention and control efforts for brucellosis.

There were several limitations to our investigation such as information bias from a retrospective study design potentially causing recall bias. In addition, the disease has a long and varied incubation period and therefore, can cause challenges with collecting accurate data. Outcome identification was another limitation as we could not identify specific pathogens from a serologic study that used Rose Bengal Agglutination and ELISA (IgM, IgG) tests for antibody detection (only *Brucella spp* were identified). However, as *Brucella melitensis* is the most common cause of brucellosis in goats and we only collected data from those whom had exposure to goats, we assume that positive serology results were to *Brucella melitensis* species. This analysis could not control potential confounding factors such as underlying diseases or patient's age due to its small sample size. In addition, we could not control each factor by multivariate analysis.

For actions taken, we provided health education about brucellosis and its prevention measures to goat farmers and the public as well as provided brucellosis brochures for public distribution to Chondan Hospital. We recommended the Provincial and District Health Offices to organize regular meetings in order to provide health education about brucellosis to high risk groups such as goat farmers, butchers and consumers who prefer raw goat milk or goat meat. Our team encouraged the animal health officers from Chondan District to collaborate with the public health office and as a result, they shared information on follow-up laboratory findings of the goat farms.

Recommendations

For public and animal health authorities, recommendation is to strengthen collaboration between public health officers and livestock health officers through sharing of disease information in order to facilitate the planning and implementation of prevention efforts and control measures. In addition, we recommend strengthening the existing brucellosis surveillance system by including it in the national communicable disease surveillance (506) to increase the number of reported cases from the local level and raise awareness about brucellosis in medical doctors and public health officers from high risk areas. Recommendations for treating brucellosis from the WHO Expert Committee in 1986 are to use doxycycline 200 mg/day orally plus rifampicin 600-900 mg/day orally for six weeks. Goat farmers, including those practicing legally or illegally, should be notified of positive laboratory results on goat brucellosis immediately in order to prevent further spread. Finally, health education is needed for goat farmers to raise their awareness about farm management practices and bio-security efforts that can be taken in farms (i.e. screening goats for brucellosis before moving into farms and improvement on personal protective methods) so that spread of infectious diseases could be reduced.

Acknowledgement

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Suggested Citation

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