cmpt Canadian microbiology proficiency testing

CMPT Clinical Bacteriology Program

Innovation, Education, Quality Assessment, Continual Improvement

Challenge PC233

November 2023

HISTORY

This paper challenge was sent to category A and C1 laboratories. The following scenario was presented to participants:

You are about to ship an isolate of *E.coli* O157 to a public health laboratory for confirmation and verotoxin testing. How would you prepare the isolate for shipping?

□ A. Ship the suspected isolate with primary and secondary packaging/containment, including relevant documentation, as UN3373, category B

□ B. Send the suspected isolate with primary and secondary packaging/containment, including relevant documentation, through the post office.

□ C. Ship the suspected isolate with primary and secondary packaging/containment, including relevant documentation, as UN2814, category A

□ D. Send the suspected isolate in a sealed biohazard bag enclosed in a paper bag.

□ E. not applicable to this laboratory.

CMPT QA/QC

According to TDG regulations answer "C" is the correct answer.

SURVEY RESULTS

Reference labs: 8/13 (62%) labs reported C, 5 labs reported A

Participants: 30/54 (56%) labs reported C, 21/54 (39%) labs reported A, 3/54 (5%) labs did not report

COMMENTS ON RESULTS

Although 30/54 (56%) participating labs reported C, 21/54 (39%) labs reported A, 3/54 (5%) labs did not report, only 8/13 (62%) reference labs reported C, and 5 reference labs reported A. As a result, the 80% consensus threshold for the reference laboratories was not met and as a result the challenge was ungraded. No participating laboratories reported options B or D.

MAIN EDUCATIONAL POINTS from PC233

1. *E.coli* O157:H7 and shiga toxin producing *E.coli* (STEC), also known as verocytoxigenic *E.coli* (VTEC) or enterohaemorrhagic *E.coli* (EHEC) has been associated with severe illness
2. Always ship packages with known *E.coli* O157:H7 culture isolates as transport of dangerous goods classification, UN2814, Category A.
3. Violations or contraventions of the Canadian TDG Act of 1992, can result in serious penalties.

No consensus was reached amongst reference laboratories therefore, the challenge is not suitable for grading.

Grading

The challenge is ungraded

Escherichia coli O157H7 and TDG Regulations

E.coli O157:H7 and shiga toxin producing *E.coli* (STEC), also known as verocytoxigenic *E.coli* (VTEC) or enterohaemorrhagic *E.coli* (EHEC) has been associated with severe illness and many food and water-borne outbreaks.[1, 8]

Symptoms of STEC infections can be mild and can be self-limiting for most healthy adults. However, approximately 10% of STEC infections can result in hemorrhagic colitis and/or haemolytic-uremic syndrome (HUS),[8] which can be fatal. The infectious dose of *E.coli* O157: H7 is low with as few as ten bacteria which can cause disease in humans.[7, 8] Children, the immunocompromised and the elderly are at increased risk of severe clinical symptoms and illness.

Shiga toxins can be divided into two groups called Stx1 and Stx2. Virulent isolates of *E. coli* O157:H7 can express Stx1 only, Stx2 only, or both toxins. Stx2 is known to be more toxic and is more often associated with hemorrhagic colitis or HUS in human infections than are Stx1 strains. [2, 5] Shiga toxins can invade the mucosa cells lining the colon and those of the endothelial cells of the kidneys, resulting in the lysis of those cells.

An UN2814, Category A, Infectious substance is defined as a substance that is capable of causing permanent disability, life-threatening or fatal disease in otherwise healthy humans or animals when exposure to it occurs. Whereas, an

Table 1. Reported results

Selected response	Cat A	Cat C1	Total	Grade
A	21		21	ungraded
C	29	1	30	ungraded
E	1	3	4	ungraded
no report	2		3	ungraded
shipping delay, no report	1		1	ungraded
Total	**54**	**4**	**58**	

UN3373, Category B, Infectious substance is **NOT** in a form generally capable of causing permanent disability or life-threatening or fatal disease in otherwise healthy humans or animals when exposure to it occurs.

There is some controversy and confusion regarding the transport of *E.coli* O157:H7. Some organizations classify *E.coli* O157:H7 a Category B transport of dangerous goods organism.[10] However, Appendix 3 of the Transport of Dangerous Goods Act, 1992 classifies the *E.coli* verotoxigenic strain as an UN2814, Category A organism.[11]

The World Health Organization (WHO) considers a culture as propagating and concentrating the pathogen, increasing the potential for a dangerous organism.[4]

Due to the pathogenicity and potential public health risk, it is indicated that *E.coli* O157:H7 isolates should be shipped according to UN2814, Category A, packaging protocols. See Table 2 for a list of Category A infectious organisms. A guide to Category A and Category B Assignment classifications of infectious substances can be found at https://laws.justice.gc.ca/eng/regulations/SOR-2001-286/page-13.html#h-1228733

Table 1. Classification of infectious organisms for the purpose of transportation.[9]

UN Number and Proper Shipping Name	Microorganism Classified as Category A in any Form (Always Classified as Category A)	Microorganisms Classifies as Category B when in Patient Specimen and as Category A only when Cultured
1	2	3
UN 2814 **Infectious substances, affecting humans**	Crimean-Congo hemorrhagic fever virus Ebola virus Flexal virus Guanarito virus Hantaan virus Hantavirus causing hemorrhagic fever with renal syndrome Hantavirus causing pulmonary syndrome Hendra virus Herpes B virus (Cercopithecine Herpesvirus-1) Junin virus Kyasanur Forest disease virus Lassa virus Machupo virus Marburg virus Monkeypox virus Nipah virus Omsk hemorrhagic fever virus Russian spring-summer encephalitis virus Sabia virus Variola virus	Bacillus anthracis Brucella abortus Brucella melitensis Brucella suis Burkholderia mallei – Pseudomonas mallei – Glanders Burkholderia pseudomallei – Pseudomonas pseudomallei Chlamydia psittaci – avian strains Clostridium botulinum Coccidioides immitis Coxiella burnetii Dengue virus Eastern equine encephalitis virus Escherichia coli, verotoxigenic Francisella tularensis Hepatitis B virus Herpes B virus Human immunodeficiency virus Human Coronavirus – Severe acute respiratory Syndrome (SARS) Highly pathogenic avian influenza virus Japanese Encephalitis virus Mycobacterium tuberculosis Poliovirus Rabies virus Rickettsia prowazekii Rickettsiae rickettsii Rift Valley fever virus Russian spring-summer encephalitis virus Shigella dysenteriae type 1 Tick borne encephalitis virus Venezuelan equine encephalitis virus West Nile virus Yellow fever virus Yersinia pestis

Navigating the complexities of shipping infectious substances safely and correctly can be difficult. Several international and national agencies, as well as carriers, provide training and information on how to carry out shipping protocols to appropriately ship infectious substances. It is required that personnel responsible for handling and/or shipping dangerous goods hold a valid TDG training certificate.

In 2002, the World Health Organization, in collaboration with the United Nations, set up a committee, UNCETDG (United Nations Committee Experts on the Transport of Dangerous Goods), and made recommendations to change the classification system for the transport of infectious substances. Prior to 2002, the hazard group classification proved to be ineffective for transportation purposes as the assignment of hazard groups for certain pathogens was not consistent throughout all countries. The WHO's aim was to control and reduce the risk of exposure of dangerous goods during transport. To this end, various international groups have developed recommendations and/or regulations, that outline the way in which infectious substances should be packaged, marked, labelled and documented, to ensure safety and containment throughout the transport process.[4]

In Canada, the transport of dangerous goods is regulated by the Transport of Dangerous Goods Act, 1992, and its Regulations, which are designed to protect and promote public and environmental safety in the transportation of dangerous goods. For air transport, the International Civil Aviation Organization (ICAO)/ International Air Transport Association (IATA) have provided packing instructions, 620, for the packaging of UN2814, Category A infectious substances.

It is also important to refer to local, national protocols and restrictions when shipping infectious agents. Also, contact carriers to ensure their specific protocols are followed and to ensure that the destination/recipient is not prohibited by the carrier. Certain infectious substances that may be shipped through postal services in some countries, may be prohibited in others. In Canada, all known infectious substances are prohibited for shipping through Canada Post.[12]

Failure to comply with Transport Canada's TDG Act can result in monetary fines and/or potential imprisonment. [11, 12,13]

Category A The packaging of infectious substances as per the International Air Transport Association (IATA) packing Type 620.

The Category A specimen must be packed in a package consisting of three components, or layers of packaging:

The first layer is referred to as a primary receptacle, which must be leakproof, and contains the TDG substance. See Figures 1 and 2. If multiple fragile, primary receptacles are being packed, each must be wrapped individually to prevent contact. Primary receptacles must be glass, metal or plastic. For liquid TDG substances, the closure must be secured with tape or parafilm to ensure any vibration or movement during transport does not loosen the closure.

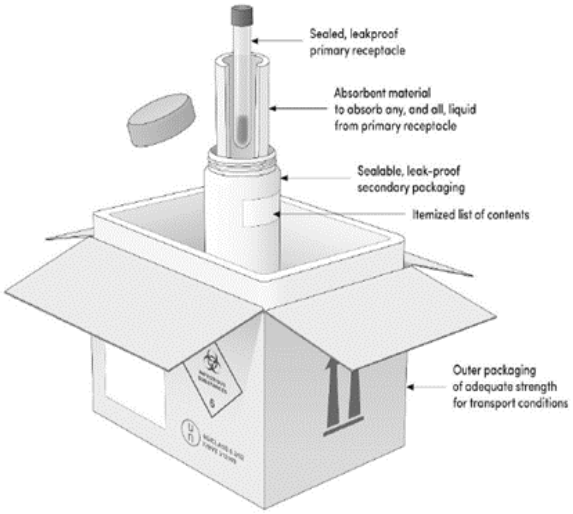


Figure 1. Example of packaging materials that may be used to comply with P620 for Category A infectious substances.[4]

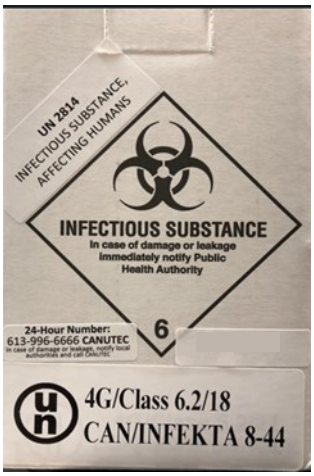


Figure 2. Example of labelling for a category A shipment box

Infectious Substance – Class "6", 4x4 inch label

UN2814, Infectious substance, affecting humans label

CANUTEC is the Canadian Transport Emergency Centre operated by the Transportation of Dangerous Goods Directorate of Transport Canada.

The UN specification mark shown in the example indicates that Transport Canada has authorized Infekta to make a package with a fibreboard outer packaging that can safely ship Category A Infectious substances.

The primary receptacle is packaged in the next layer, which is referred to as the secondary packaging, which must also be leakproof. Either the primary receptacles or secondary packaging must be able to withstand an internal pressure of 95 kPa and a temperature range of -40°C to 55°C (-40°F to 130°F). For liquid specimens, absorbent material must be placed between the primary and secondary packaging. The absorbent material must be sufficient to absorb the total contents of the primary receptacles.

The secondary packaging must be packed in the final layer, the rigid outer packaging. An itemized list of contents must be placed between the secondary and rigid outer packaging. The outer packaging must be at least 100 mm x 100 mm x 100 mm (4 x 4 x 4 inches). According to Packing Instruction 620, packages must be in good condition and present no hazard, such as external contamination.

The quantity limits for a Category A Infectious substance package is 50mL or 50 g for passenger aircraft, and 4 L or 4 kg for cargo aircraft. If the volume or weight of the TDG exceeds the limit described, the TDG substances must be divided and shipped in separate packaging.

All shipments of Category A Infectious substances must include a correctly completed Shipper's Declaration for Dangerous Goods. Complete all the information on the form and ensure that the information on the form is accurate, easy to identify, legible and durable. Figure 3 indicates the proper name of Category A, infectious substances as "UN 2814 Infectious substance, affecting humans" including the scientific/technical name in brackets.

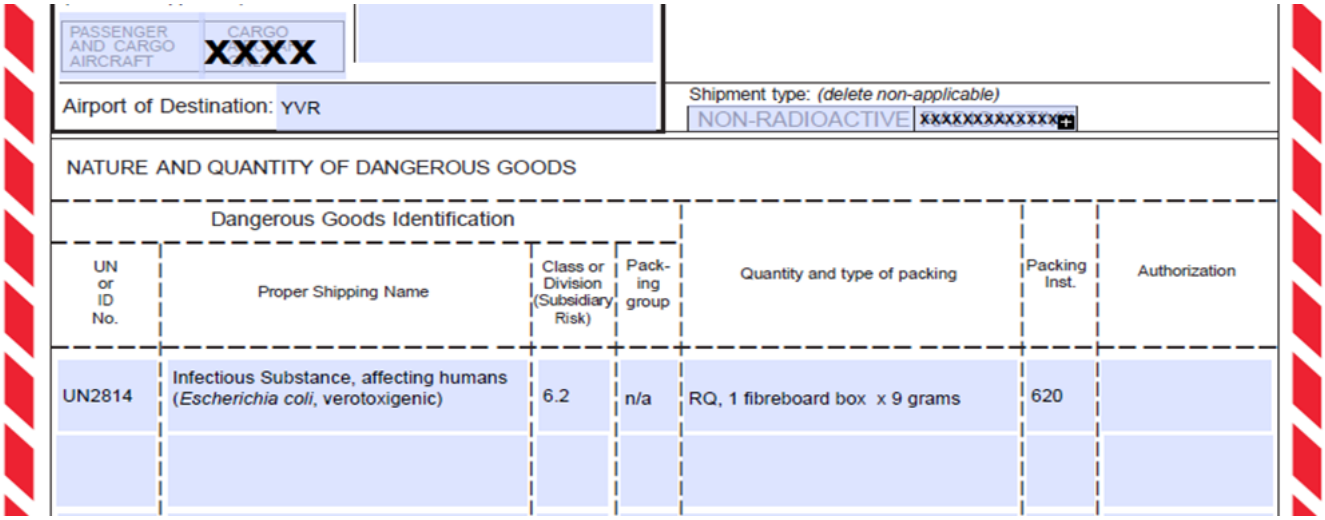
Only persons trained and certified to ship dangerous goods may sign the Shipper's Declaration. The person who signs the form does not need to be the same individual as the person listed in the shipper's address box.

Ensure that the shipment has been prepared in accordance with the regulations, as per the declaration statement at the end of the Shipper's Declaration. IATA requires that the Shipper's Declaration be printed in black or red ink on white paper, or it may be printed in red ink only on white paper. The diagonal hatchings printed vertically in the left and right margins must be printed in red ink. The shipper must retain a copy for its records (for at least 2 years) and include at least 3 copies of the Shipper's Declaration with the package.

REFERENCES

1. https://www.cdc.gov/ecoli/general/index.html
2. Ji Youn Lim, Jang W. Yoon, and Carolyn J. Hovde. J Microbiol Biotechnol. 2010 Jan; 20(1): 5–14. **A Brief Overview of *Escherichia coli* O157:H7 and Its Plasmid O157**
3. https://tc.canada.ca/sites/default/files/2022-12/TDG-bulletin-shipping-infectious-substances_0.pdf
4. WHO Guidance Document, 2021-2022. https://www.who.int/publications/i/item/9789240019720
5. https://efsa.onlinelibrary.wiley.com/doi/pdfdirect/10.2903/j.efsa.2020.5967
6. https://health.canada.ca/en/epathogen
7. Romney, MH. Faron, ML. Dekker, JP. Ledeboer, NA. Buchan, BW. Escherichia and Shigella. Manual of Clinical Microbiology, 13th edition, Carroll KC, Pfaller MA (eds). Pp 760-765. 2023. John Wiley & Sons, Inc., Hoboken, NJ, USA.
8. https://www.ncbi.nlm.nih.gov/books/NBK507845/#:~:text=Shiga%20toxin%2Dproducing%20Escherichia%20coli,syndrome%20(HUS)%20in%20humans.
9. 2022. Training Manual. Saf-T-Pak Inc. An Inmark Company. https://shop.saftpak.inmarkinc.com/products/shipping-category-a-biological-substance-and-related-materials-training-course
10. Pathogen Safety Data Sheets_ Infectious Substances – Escherichia coli, enterohemorrhagic – Canada.ca.pdf
11. https://laws.justice.gc.ca/eng/regulations/SOR-2001-286/page-13.html#h-1228733
12. https://laws-lois.justice.gc.ca/eng/regulations/SOR-2001-286/page-13.html
13. https://tc.canada.ca/en/dangerous-goods/contraventions

Figure 3. Shipper's Declaration indicating the proper shipping name, including the scientific/technical name and the weight of the infectious material being shipped.



PASSENGER AND CARGO AIRCRAFT — CARGO XXXX

Airport of Destination: YVR

Shipment type: *(delete non-applicable)* NON-RADIOACTIVE xxxxxxxxxxxxx

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification						
UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Packing group	Quantity and type of packing	Packing Inst.	Authorization
UN2814	Infectious Substance, affecting humans (*Escherichia coli*, verotoxigenic)	6.2	n/a	RQ, 1 fibreboard box x 9 grams	620	