NOVEMBER 2020

Considerations for the Development of COVID-19 Risk Reduction Measures

mining.ca

The Mining Association of Canada
L'association minière du Canada

THE MINING ASSOCIATION OF CANADA

The Mining Association of Canada (MAC) is the national organization for the Canadian mining industry. Its members account for the majority of Canada's production of base and precious metals, uranium, diamonds, metallurgical coal and mined oil sands, and are actively engaged in mineral exploration, mining, smelting, refining and semi-fabrication.

Representing members committed to sustainability, MAC's Towards Sustainable Mining® (TSM®) initiative is an award winning and world-leading standard that fosters continuous performance improvement in environmental and social mining practices.

MAC promotes the interests of the industry nationally and internationally, works with governments on policies affecting minerals, informs the public, and promotes collaboration to solve common issues and foster progress. MAC works closely with provincial and territorial mining associations and other industries, as well as with environmental and community groups across Canada.

This series of documents was developed by Think Research with the support of MAC. The purpose of these materials is to support companies in making informed decisions about COVID-19 risk reduction measures by providing information on current best practices and evidence of the effectiveness of various risk mitigation tools.

The series includes the following documents:

- **Best Practices Summary**: Information on the best practices related to COVID-19 screening, testing, quarantine, and risk reduction inside and outside of the workplace, with reference to other summary documents for additional detail.
- **Testing Summary**: Information on the types of tests available for COVID-19, when in the disease process those tests should be taken, and the effectiveness of those tests.
- **Symptom Screening Summary**: Information on the types of screening available to detect COVID-19 and the effectiveness of those types of screening.
- **Quarantine Summary**: Information on the types of quarantine, how to implement quarantine, and how long to implement quarantine measures related to COVID-19.
- **Managing Transmission Risk At and Off Work Summary**: Information on strategies to mitigate risks related to COVID-19 outside of the workplace and work hours.

Table of Contents

COVID-19 Best Practices Summary

This document has been developed by Think Research with the support of the Mining Association of Canada. The information presented is for orientation in the design of mitigation programs and is current as of the date of publication. Any measures outlined in this document should be confirmed with appropriate experts before integration into a COVID-19 risk mitigation program.

Introduction

This document provides information on the best practices related to COVID-19 screening, testing, quarantine, and risk reduction inside and outside of the workplace. This document can be used to guide policies and procedures related to COVID-19 management.

Best Practices for COVID-19 in the Workplace

Workplace Preparation

Organizations can best prepare for COVID-19 through:

- Clear, evidence-based, concise communication from management to employees
- Providing frequent pandemic training sessions focusing on describing new policies and procedures related to COVID-19, personal protective equipment (PPE) donning and doffing, social and physical distancing recommendations, and other risk mitigation strategies related to COVID-19 in the mining sector
- Ensuring those who are sick or exposed to probable or confirmed COVID-19 cases do not enter the workplace

SARS-CoV-2 and COVID-19

SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2; the specific virus that causes COVID-19

COVID-19: Coronavirus disease 2019; the disease that is caused by SARS-CoV-2

Summary on Measures

The following chart summarizes the different measures that can be used to reduce COVID-19 spread.

Measure	Details
Screening	• There are a variety of mechanisms for screening, including active screening, temperature screening, mobile apps, and laboratory-based screening, i.e. testing • A combination of screening methods can be used depending on the workplace, the community incidence of COVID-19, and accessibility to resources • Please refer to the **Think Research COVID-19 Screening Summary** for more information
Testing	• There are 3 types of testing for SARS-CoV-2: molecular (e.g. PCR), antigen, and antibody • Tests can be rapid acting (i.e. point-of-care), which produce results in minutes, or laboratory processed, which take longer to process but are often more accurate • Molecular testing is the gold standard and tests for active and early COVID-19 infection • Antigen tests also test for active COVID-19 infection but is not as accurate as PCR • Antibody testing can detect antibodies developed due to COVID-19 infection, usually an indicator for past infection or later stage of an active infection **Note**: Past infection does not necessarily indicate one has immunity; research is being conducted to better understand past infection and immunity status. • Please refer to the **Think Research COVID-19 Testing Summary** for more information
Quarantine	• Quarantine has been proven to be effective in reducing the transmission of SARS-CoV-2 when applied comprehensively and promptly [1] • Please refer to the **Think Research COVID-19 Quarantine Summary** for more information
Managing Transmission Risk At and Off Outside Work	• Risk mitigation has been proven to be effective in collaboration with screening, testing, and quarantine measures • Risk mitigation strategies include physical distancing, work crew/work bubbles, mask wearing, travel restrictions, hand washing, etc. • Please refer to the **Think Research COVID-19 Managing Transmission Risk At and Off Work Summary** for more information

COVID-19 Best Practices Summary

Summary

- There is no 'one size fits all' strategy for combatting COVID-19 in or outside the workplace
- Screening, testing, quarantine, and risk mitigation strategies will need to be implemented into every workplace plan
- A multifaceted approach has been proven to be more effective than individual strategies
- It is important to stay up to date with international, national, and regional public health guidelines regarding COVID-19 measures
- It is important to protect the health and safety of rural, remote, and isolated communities (e.g. Indigenous communities) with low prevalence of COVID-19 [2]; increased quarantine and surveillance testing may be indicated in remote areas
- It is important to educate individuals on proper respiratory etiquette, hand hygiene, and physical distancing measures
- It is essential to provide frequent educational sessions and keep employees informed on policies and procedures in an organization

Strategies to Reduce COVID-19 Transmission and Spread

Multifaceted Approach

- The most effective way to reduce COVID-19 transmission and control outbreaks is through implementing a multifaceted approach. Having multiple measures in place for screening, testing, quarantine, and risk mitigation can reduce the spread of COVID-19

Quarantine + Other Public Health Measures

- The combination of quarantine with other prevention and control measures shows the greatest effect in reducing transmission, incident cases, and mortality due to COVID-19.[1] This includes quarantine with:
  - Physical and social distancing measures
  - Travel restrictions
  - Social gathering and public event closures
  - Mask wearing
  - Respiratory etiquette and hand hygiene
- The earlier the quarantine is implemented and the more comprehensive of a process that it is, the greater the cost-savings there may be[1]
- Efficient contact tracing allows for prompt initiation of quarantine on potentially exposed individuals, allowing for the avoidance of potential outbreaks[1]
- Cost savings related to earlier quarantine are attributed to decreased hospitalizations/healthcare costs and sick days taken, as well as increased productivity due to less sick employees as a result of prompt quarantine initiation and decreased spread of infection to others[1]

Mobile Technologies[3]

- Mobile technologies can contribute to the mitigation and prevention of COVID-19 infections
- Mobile technologies are used in addition to or assist in other public health measures
- Geographical tracking using geographic information systems (GIS) through mobile devices allows for:
  - Fast-paced contact tracing
  - Real-time mapping of cases
  - Predictive risk mapping
- Mobile technologies can also be useful in efficient knowledge exchange and information dissemination to health care providers and the public
- Real time data collection can also be implemented through use of mobile technologies
- Mobile applications can also be used to monitor the health status of individuals in a community or organization
- Mobile technologies can help track symptom surveillance and allow for early detection

Strategies to Reduce COVID-19 Transmission and Spread Continued…

Multiple Public Health Interventions

Modelling studies estimate the reduction of COVID-19 transmission under different public health strategies. Compared with no public health intervention, the greatest reduction in the effective reproductive number (R_{eff}) (i.e. transmissibility) were approaches that combined strategies.[4] The following chart describes the most and least effective strategies in reducing transmissibility of SARS-CoV-2 [4]:

Note: Not all public health measures can be implemented in every setting. The following chart provides examples of some of the most effective public health strategies to reduce COVID-19 transmission.

Self-isolation: Separation of an infected individual from others to prevent the spread of disease Quarantine: Separation from others of an individual exposed or potentially exposed to a disease		Mean Reduction in R_{eff}
Most Effective Strategies	Self-isolation + household quarantine + manual contact tracing of acquaintances + app-based tracing + limit to four daily contacts with other individuals (most effective)	66%
	Self-isolation + household quarantine + manual contact tracing of all contacts	64%
	Self-isolation + household quarantine + manual contact tracing of acquaintances + limit to four daily contacts with other individuals	64%
	Self-isolation + household quarantine + manual contact tracing of acquaintances + app-based tracing	61%
Least Effective Strategies	Self-isolation + household quarantine	37%
	Self-isolation outside of home	35%
	Self-isolation within home	29%
	Mass testing of 5% of the population (i.e. whole community) per week	2%

Notes:

- Acquaintances are contacts that have met before
- Mass testing is regardless of symptoms
- For app-based tracing to be successful, both the infectious individual and their contacts need to have and use the app
- Prompt contact tracing helps reduce the possibility that a primary symptomatic case would generate more than one secondary case
- The fewer people one interacts with (e.g. four people), the more effective contact tracing is, and the fewer people are needed to be quarantined each day

Testing Strategies for COVID-19

- Routine asymptomatic testing strategies for COVID-19 are being used to prevent outbreaks in certain high-risk environments[5]
- Early mathematical modelling studies have indicated that twice-weekly routine asymptomatic viral testing for workers may be useful in preventing outbreaks in settings with high community incidence of COVID-19; less frequent testing (i.e. once-a-week testing) may be sufficient in settings with low community incidence of COVID-19 [5]
- Increased testing frequency should be combined with physical distancing measures, mask wearing, disinfection, among other public health interventions[5]

Strategies to Reduce COVID-19 Transmission and Spread Continued…

Testing Strategies for COVID-19 Continued…

Types of Test

- Clinical tests are intended for use on symptomatic individuals and require high sensitivity to provide accurate results to determine positive cases (e.g. PCR tests)[6]
- Surveillance tests are intended for use on asymptomatic individuals to reduce the population prevalence of COVID-19; these tests should be easy to execute, inexpensive, and allow for increased frequency (e.g. multiple times per week) (e.g. antigen tests)[6]
  - Surveillance tests usually do not need to be as sensitive as clinical tests, however, these tests do not replace the current clinical diagnostic tests[6]

Surveillance Testing[7]

- Surveillance testing is the widespread testing of asymptomatic individuals in a population and isolation of infected individuals with the goal to limiting the spread of infection, e.g. SARS-CoV-2 [7]
- With surveillance testing, repeat testing needs to be conducted 24 to 48 hours apart to distinguish low-viral load individuals on the upslope of infection from those in the recovery phase; this could allow for more effective quarantine decisions and a better understanding of the COVID-19 prevalence and spread in a community

Important Notes for Testing

- If an individual is symptomatic and is tested for COVID-19, they must quarantine until the results of their tests are received
- It is important to refer to public health guidelines regarding quarantine for those receiving a COVID-19 test who are asymptomatic and have no exposure history; some regions do not require quarantine while some may

Frequency of Testing

- The frequency of testing depends on what test is being used (i.e. molecular, antigen, antibody), what reason the testing is being performed (i.e. clinical diagnosis, surveillance, or past exposure), how the test results will impact the individual (i.e. to start/discontinue quarantine or isolation), and the incidence of COVID-19 in the community[6]
- Discontinuing isolation for symptomatic individuals using testing (along with symptom resolution) is often from receiving two negative respiratory specimens collected greater than 24 hours apart[8]
- For asymptomatic individuals, two negative tests is often necessary to discontinue isolation or quarantine[8]

Document Development and Implementation Considerations

Abbreviations

COVID-19 = Coronavirus Disease 2019 RT-PCR = Reverse Transcription Polymerase Chain Reaction

Additional Resources

- Government of Ontario - Resources to prevent COVID-19 in the workplace: https://www.ontario.ca/page/resources-prevent-covid-19-workplace
- Public Health Ontario - COVID-19 Workplace Resources (Non-Healthcare): https://www.publichealthontario.ca/en/diseases-and-conditions/infectious-diseases/respiratory-diseases/novel-coronavirus/workplace-resources
- Government of Canada - Risk mitigation tool for workplaces/businesses operating during the COVID-19 pandemic: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/guidance-documents/risk-informed-decision-making-workplaces-businesses-covid-19-pandemic.html
- Workplace Safety North - Workplace Safety North Guidance no mining during COVID-19: https://www.workplacesafetynorth.ca/sites/default/files/uploads/COVID-19-Workplace-Safety-North-Mining-Guidance-2020-04-08.pdf

References

Key references[1-8]

1. Nussbaumer-Streit B, Mayr V, Dobrescu AI, et al. Quarantine alone or in combination with other public health measures to control COVID-19: a rapid review. Cochrane Infectious Diseases Group, ed. Cochrane Database Syst Rev. Published online September 14, 2020. doi:10.1002/14651858.CD013574.pub2

2. Government of Canada; Indigenous Services Canada. Protecting the health and safety of Indigenous Communities in close proximity to natural resource operations: Guidance for Indigenous communities. Published June 18, 2020. https://www.sac-isc.gc.ca/eng/1592487905243/1592487940872

3. Teixeira R, Doetsch J. The multifaceted role of mobile technologies as a strategy to combat COVID-19 pandemic. Epidemiol Infect. 2020;148. doi:10.1017/S0950268820002435

4. Kucharski AJ, Klepac P, Conlan AJK, et al. Effectiveness of isolation, testing, contact tracing, and physical distancing on reducing transmission of SARS-CoV-2 in different settings: a mathematical modelling study. Lancet Infect Dis. 2020;20(10):1151-1160. doi:10.1016/S1473-3099(20)30457-6

5. Chin ET, Huynh BQ, Chapman LA, Murrill M, Basu S, Lo NC. Frequency of routine testing for COVID-19 in high-risk environments to reduce workplace outbreaks. Published online May 6, 2020. doi:10.1101/2020.04.30.20087015

6. Mina MJ, Parker R, Larremore DB. Rethinking Covid-19 test sensitivity — a strategy for containment. N Engl J Med. Published online September 30, 2020:3. doi:10.1056/NEJMp2025631

7. Larremore DB, Wilder B, Lester E, et al. Test sensitivity is secondary to frequency and turnaround time for COVID-19 surveillance. medRxiv. Published online September 8, 2020. doi:10.1101/2020.06.22.20136309

8. Centers for Disease Control and Prevention. Coronavirus disease 2019 (COVID-19). Published February 11, 2020. https://www.cdc.gov/coronavirus/2019-ncov/hcp/disposition-hospitalized-patients.html

COVID-19 Managing Transmission Risk At and Off Work Summary

This document has been developed by Think Research with the support of the Mining Association of Canada. The information presented is for orientation in the design of mitigation programs and is current as of the date of publication. Any measures outlined in this document should be confirmed with appropriate experts before integration into a COVID-19 risk mitigation program.

Introduction

This document provides information on strategies on how to mitigate risks related to COVID-19 outside of the workplace and work hours (i.e. between shifts, on breaks, between camp rotations). This document can be used to guide policies and procedures related to risk control measures for COVID-19.

Risk Mitigation Importance

What is Risk Mitigation?

Risk mitigation involves taking steps to reduce adverse effects and potential risks in a community. It involves creating policies and procedures that will help prevent negative outcomes from occurring.

What is Risk Mitigation Related to COVID-19?[1]

Risk mitigation strategies take action to prevent and/or limit the spread of COVID-19 in a community. There is more than just one mitigation strategy to reduce COVID-19 transmission. Layering multiple strategies together to reduce the risk of COVID-19 spread can strengthen the risk mitigation potential overall, e.g. social distancing, reducing workforce, enhanced cleaning strategies.

Strategies to Reduce COVID-19 Transmission and Spread

Strategies to Mitigate COVID-19 Infection

The main elements to reduce transmission and spread of COVID-19 include[2]:

- Limit interactions with people outside of one's work pod/crew
- Practice physical distancing (i.e. 2 metres or more apart) and wear a mask (especially if unable to physically distance)
- Increase hygiene and protective actions, e.g. clean frequently touched surfaces more often, improve ventilation
- Frequently monitor for signs and symptoms consistent with COVID-19 and seek help when necessary
- Encourage employees to follow the local public health authority's regulations regarding COVID-19

Strategy	Details	Effectiveness
Employee Education	• Employees need to have a clear understanding of the policies and procedures related to COVID-19 in the workplace • Employees need to perform a comprehensive checklist of symptoms and exposure history before going to the worksite (or work camp)[3] • Employers should offer workers COVID-19 training and education on arrival to work and on a regular basis thereafter[4] • Employee education needs to include risk mitigation strategies for outside of the workplace/work hours; this is not only to reduce transmission of COVID-19 among employees, but also to reduce transmission to local communities • Employee education is most effective if it presents useful and practical ways of doing things, not just prohibitions	Countries that were most successful in community response to risk mitigation strategies for controlling COVID-19 spread were those that fostered citizen awareness, social trust in authorities, and well-coordinated and communicated risk mitigation strategies[5]

COVID-19 Managing Transmission Risk At and Off Work Summary

Strategies to Reduce COVID-19 Transmission and Spread Continued…

Strategies to Mitigate COVID-19 Infection Continued…

Strategy	Details	Effectiveness
Work Pods or Crews	• When social distancing is difficult to maintain or not practical for extended periods of time, designating employees to the same small working crew or work pods (i.e. like a family unit) may be considered to limit social interactions with others and help reduce the transmission of COVID-19 to other workers[4] • Work pods or crews are to be limited in number of people and will ensure close contact only occurs within their selected crew/pod, i.e. distance from others[4]	Physical distancing in combination with restriction of mass gatherings, and fast and reliable diagnostic testing is suggested to lead to a 60% reduction in COVID-19 transmission[5]
Travel Considerations	• Travel should be discouraged unless necessary; if considered essential, appropriate infection control practices and sufficient personal protective equipment utilization should be implemented during travel[3] • When transportation is necessary, encourage employees to travel in their work pods/crews, wear masks, practice physical distancing, and implement appropriate respiratory etiquette • Encourage limited use of mass transit when possible (e.g. airplanes, buses, trains); encourage carpooling with one's work pod or work crew or use of personal vehicles[3] • If an employee is to travel individually, a detailed reporting process that informs employers on how an individual travelled (e.g. hotels stayed at, gas station stops, break, etc.) is very important[3]	In areas where COVID-19 is not actively spreading, safe travel considerations and restrictions are important to prevent the transmission of SARS-CoV-2 in a community (e.g. remote, rural, isolated communities). Internal and international travel restrictions do not necessarily prevent the spread of infection, however, these measures have been proven to delay the spread of infection, which is crucial in communities with poorer access to healthcare and testing.[6]
Distancing and Local Communities	• Accommodation that employees are staying at should provide necessary services and facilities (e.g. meals/kitchen, laundry) to enable employees to remain in the camp on days off[4] • If an employee needs to or wants to leave the camp, he or she should follow distancing measures when in the local community,[4] wash hands regularly (soap and water or hand sanitizer), practice respiratory/cough etiquette (i.e. cover nose/mouth with tissue when coughing or sneezing and if no tissue then use upper sleeve or elbow; practice proper hand hygiene post cough/sneeze), and wear a non-medical mask when practical	Physical distancing interventions are associated with reductions in COVID-19 transmission.[7] One study published in the *BMJ* found that physical distancing interventions decreased COVID-19 incidence by 13%.[7]

COVID-19 Managing Transmission Risk At and Off Work Summary

Strategies to Reduce COVID-19 Transmission and Spread Continued…

Strategies to Mitigate COVID-19 Infection Continued…

Strategy	Details	Effectiveness
Face-coverings, Masks, Hand Hygiene	• When physical distancing is not feasible, face-coverings or masks should be worn (especially in indoor environments) • Surgical masks can prevent the inhalation of large droplets and sprays; N95 respirator masks can prevent the inhalation of smaller aerosols; these are to be used in healthcare settings when aerosolized generating medical procedures are being performed[8] • Non-medical masks (cloth masks) are recommended for the public to reduce the spread of respiratory droplets[9] • Face shields may be considered in certain situations (e.g. masks are in shortage, inability to wear face mask)[9]	There is an association of lower per-capita mortality from COVID-19 in areas where there are government policies and public acceptance for mask wearing (cloth and surgical masks)[10]

Contact Tracing and Use of Mobile Apps	• If an employee tests positive for COVID-19, it is crucial that prompt contact tracing be initiated to identify any close contacts
	• Mobile apps may reduce delays in the contact tracing process and optimize contact tracing coverage
	• Government of Canada COVID Alert Notification: https://www.canada.ca/en/public health/services/diseases/coronavirus-disease covid19/covid-alert.html
	• Contact tracing incudes[11]:
	  • Identifying people who were in contact with a symptomatic case starting 48 hours prior to the case developing symptoms
	  • Identifying people who were in contact with an asymptomatic case starting 48 hours prior to the day their positive specimen was collected
	• In some contexts, the company will be supporting the local health authority while they conduct contact tracing (e.g. accounting for the individual's contact on site); in other contexts, the company may play a more active role in contact tracing
		According to a mathematical modeling study, optimizing contact tracing allows for optimizing testing, ultimately leading to a significant prevention of COVID-19 transmission (up to 80%).[12] It is also one of the most cost-effective interventions when performed quickly and combined with case isolation.[13]

Staggering of Breaks	• It is recommended to stagger start and stop times for breaks when possible to minimize employees congregating • Physical distancing should be implemented during breaks	Insufficient data to determine effectiveness, however, should be comparable to physical distancing measures

Strategies to Reduce COVID-19 Transmission and Spread Continued…

Strategies to Mitigate COVID-19 Infection Continued…

COVID-19 Managing Transmission Risk At and Off Work Summary

Strategy	Details	Effectiveness
Sleeping Arrangements	• If employees are staying in a camp with shared accommodation, there should be 2 metres separating people and head-to-toe orientation when possible • If unable to separate 2 metres, temporary barriers between beds can be used to prevent droplet spread while sleeping, e.g. curtains • If an employee becomes ill, he or she must be separated and provided isolated accommodation (no exception)	Insufficient data to determine effectiveness, however, should be comparable to physical distancing measures
Use of Fleet Vehicles[14]	• Employees are to clean high touch points in fleet/shared vehicles before and after each use; ensure each vehicle has access to appropriate disinfectants and hand sanitizer • Minimize the number of vehicles shared by each employee **Note:** If an employee is alone in a vehicle, they do not need to wear a mask or face covering as they are not interacting with other individuals.	

Risk Mitigation and Management of Cases and Contacts Associated with COVID-19

The following table provides guidance on the risk levels associated with interacting with a probable or confirmed COVID-19 case and the appropriate actions to take[11]:

Risk Level	Description	Actions	Public Health Authority Actions
High	Close direct contact(s) with a case, such as: • Provided direct care for without use of PPE (inconsistent or inappropriate) • Lived with or had close, prolonged contact (within 2 metres) • Had direct contact with infectious body fluids, e.g. coughed on or sneezed on	• Quarantine for 14 days and self-monitor for signs and symptoms consistent with COVID-19 • Isolate away from others as quickly as possible • Follow proper respiratory etiquette and hand hygiene practices • Contact the public health authority for further direction, e.g. where to go for care if needed, appropriate mode of transportation	• Individual risk assessment to be conducted • Active monitoring for symptoms
Medium	Non-close contact with a case, such as: • Provided direct care for case with consistent and appropriate use of PPE • Lived with or had prolonged contact with but was not within 2 metres of case	• Self-monitor for signs and symptoms consistent with COVID-19 for 14 days • Avoid close contact with individuals at higher risk for severe illness • Follow recommended public health practices, e.g. wear a mask in public, reduce non-essential travel, stay at home if feeling ill, practice good hygiene, physical distance of at least 2 metres from others	• Individual risk assessment may be conducted if feasible • No active monitoring
Low	Only transient interactions, such as: • Walked by a case • Was in the same room as a case (briefly)	• Follow recommended public health practices, e.g. wear a mask in public, reduce non-essential travel, stay at home if feeling ill, practice good hygiene, physical distance of at least 2 metres from others	• Provide community level information

Risk Levels and Mitigation Strategies

Activities and their Associated Risk Levels

COVID-19 Managing Transmission Risk At and Off Work Summary

The following chart provides examples of activities and their associated risk level of transmitting/contracting COVID-19.[17]
Note: These are just examples of activities; risks may be higher or lower depending on COVID-19 incidence in one's region and physical distancing and masking measures being practiced. This type of material can be used as employee education for risk mitigation outside of the workplace.

High Risk Activities	Moderate-High Risk Activities	Moderate-Low Risk Activities	Low Risk Activities
• Eating at a buffet • Attending large events with 50+ people • Indoor contact sports • Indoor exercise facilities (operating at full capacity) • Going to an amusement park, movie theatre, or casino • Going to a bar (operating at full capacity)	• Going to a hair salon or barbershop • Attending a wedding or funeral (less than 50 people) • Travelling by plane • Close contact sports (outdoors) • Dinner party at someone's house with people who are not your usual close contacts • Swimming in a public pool	• Sitting on a restaurant or bar's patio • Grocery shopping • Going for a walk, run, hike, or bike ride with your household or close contacts • Walking outside in a busy downtown	• Getting restaurant takeout • Going to a park or outdoor social events (with close contacts +/- physical distancing) • Going camping with your household or usual close contacts

Considerations for Masks

Type of Mask	Cloth Masks	Surgical/Medical Masks	Respirator Masks (e.g. N95)
When to Use	• In public when physical distancing cannot be maintained	• Healthcare workers in clinical settings[15] • Anyone feeling unwell, including people with mild symptoms[15] • People caring for suspected or confirmed COVID-19 cases outside of healthcare facilities[15]	• Healthcare workers in clinical settings providing care to COVID-19 patients where aerosol generating medical procedures are being undertaken[16]
Considerations	• Wash masks with soap and water daily[15] • Cloth masks should be made with fabric that has a high thread count and fine weave using a minimum of 2 to 3 layers, with batting between layers[15] • More research is needed to determine the effectiveness of cloth masks; difficult to determine due to variances in mask assembly and washing	• Medical masks are used in healthcare and community settings to protect from droplet infections	• Respirators may be limited in some healthcare settings and may be recommended only in high risk situation[16] • Respirators need to be fitted and require sizing to determine the correct model to use

COVID-19 Managing Transmission Risk At and Off Work Summary

Clinical Document Development and Implementation Considerations

Abbreviations

COVID-19 = Coronavirus Disease 2019

PPE = Personal Protective Equipment

SARS-CoV-2 = Severe Acute Respiratory Syndrome Coronavirus 2

References

Key references[1-17]

1. Public Health Agency of Canada. COVID-19: Risk mitigation tool for workplaces/businesses operating during the pandemic. Published September 23, 2020. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/guidance-documents/risk-informed-decision-making-workplaces-businesses-covid-19-pandemic.html

2. Government of Canada; Indigenous Services Canada. Protecting the health and safety of Indigenous Communities in close proximity to natural resource operations: Guidance for Indigenous communities. Published June 18, 2020. https://www.sac-isc.gc.ca/eng/1592487905243/1592487940872

3. Barnes M, Sax PE. Challenges of "return to work" in an ongoing pandemic. *N Engl J Med*. Published online June 18, 2020. doi:10.1056/NEJMsr2019953

4. BC Centre for Disease Control, BC Ministry of Health. Protecting industrial camp workers, contractors, and employers working in the agricultural, forestry, and natural resource sectors during the COVID-19 pandemic. Published online July 28, 2020. http://www.bccdc.ca/Health-Info-Site/Documents/COVID_public_guidance/All-sector-work-camps-guidance.pdf

5. Bruinen de Bruin Y, Lequarre A-S, McCourt J, et al. Initial impacts of global risk mitigation measures taken during the combatting of the COVID-19 pandemic. *Saf Sci*. 2020;128:104773. doi:10.1016/j.ssci.2020.104773

6. Mateus AL, Otete HE, Beck CR, Dolan GP, Nguyen-Van-Tam JS. Effectiveness of travel restrictions in the rapid containment of human influenza: a systematic review. *Bull World Health Organ*. 2014;92(12):868-880D. doi:10.2471/BLT.14.135590

7. Islam N, Sharp SJ, Chowell G, et al. Physical distancing interventions and incidence of coronavirus disease 2019: natural experiment in 149 countries. *BMJ*. Published online July 15, 2020:m2743. doi:10.1136/bmj.m2743

8. Esposito S, Principi N, Leung CC, Migliori GB. Universal use of face masks for success against COVID-19: evidence and implications for prevention policies. *Eur Respir J*. 2020;55(6). doi:10.1183/13993003.01260-2020

9. Public Health Ontario. Face shields for source control of COVID-19. Published online July 16, 2020. https://www.publichealthontario.ca/-/media/documents/ncov/main/2020/07/covid-19-face-shields-source-control.pdf?la=en

10. Leffler CT, Ing EB, Lykins JD, Hogan MC, McKeown CA, Grzybowski A. Association of country-wide coronavirus mortality with demographics, testing, lockdowns, and public wearing of masks. *medRxiv*. Published online August 5, 2020. doi:10.1101/2020.05.22.20109231

11. Public Health Agency of Canada. Public health management of cases and contacts associated with COVID-19. Published September 4, 2020. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/interim-guidance-cases-contacts.html#app1

12. Kretzschmar ME, Rozhnova G, Bootsma MCJ, van Boven M, van de Wijgert JHHM, Bonten MJM. Impact of delays on effectiveness of contact tracing strategies for COVID-19: a modelling study. *Lancet Public Health*. 2020;5(8):e452-e459. doi:10.1016/S2468-2667(20)30157-2

13. Juneau C-E, Pueyo T, Bell M, Gee G, Potvin L. Evidence-based, cost-effective interventions to suppress the COVID-19 pandemic: a rapid systematic review. *medRxiv*. Published online April 24, 2020. https://doi.org/10.1101/2020.04.20.20054726

14. Natural Resources Canada. Return to the workplace - (COVID-19) protocol for field work - use of fleet vehicles. Published online June 11, 2020. https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/pdf/Protocol%20-%20Use%20of%20Fleet%20Vehicles%20-%20COVID-19%20-%20June%2030.pdf

15. Chughtai AA, Seale H, Macintyre CR. Effectiveness of cloth masks for protection against Severe Acute Respiratory Syndrome Coronavirus 2. *Emerg Infect Dis*. 2020;26(10). doi:10.3201/eid2610.200948

16. World Health Organization. Coronavirus disease (COVID-19): masks. Published October 9, 2020. https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19-masks

17. Arizona Department of Health Services. COVID-19 risk index. Published online 2020. https://www.azdhs.gov/documents/preparedness/epidemiology-disease-control/infectious-disease-epidemiology/novel-coronavirus/communication-materials/covid-19-risk-factors-index-circle-8-5x11.pdf

COVID-19 Quarantine Summary

This document has been developed by Think Research with the support of the Mining Association of Canada. The information presented is for orientation in the design of mitigation programs and is current as of the date of publication. Any measures outlined in this document should be confirmed with appropriate experts before integration into a COVID-19 risk mitigation program.

Introduction

This document provides information about the types of quarantine available, how to implement them, and how long to implement quarantine measures related to COVID-19 disease. This document can be used to guide policies and procedures related to quarantine measures for COVID-19.

Quarantine Definition

What is Quarantine?

Quarantine is a restriction of activities and separation from others imposed on an individual exposed or potentially exposed to a disease to prevent the spread of infection.[1] Keeping an exposed or potentially exposed individual separated from others helps prevent the spread of disease as they may be infectious without having symptoms.

What is Isolation?

Isolation is the separation of an infected individual from other people to prevent the spread of disease. Individuals in isolation have a disease (not only exposure) and may or may not have symptoms.

Note: Someone who is ill with COVID-19-like symptoms should self-isolate regardless of test results; this is to reduce any other spread of illness in a community and/or account for false-negative test results.

Quarantining for COVID-19

- The goal of quarantine is to ensure early detection of COVID-19 cases through monitoring the individual in quarantine[1] or to confirm that an individual does not have COVID-19 infection so that they can move into a work or community environment
- Persons who are quarantined need access to health care and financial, social and psychological supports[1,2]
- The effectiveness of quarantine during an outbreak depends on the timing and accuracy of the quarantine period (e.g. initiation of quarantine and duration), and the ability of individuals to follow quarantine procedures[3]
- Quarantine is most successful in settings where detection of cases is prompt and contacts can be traced within a short time frame with prompt initiation of quarantine[2]
- Mathematical studies reveal that quarantine reduces the number of people with COVID-19 by 44-96%, and deaths associated with COVID-19 by 31-76%[4]
- Combining quarantine with other measures (e.g. physical distancing, remote working) may be more effective at reducing the spread of COVID-19 than quarantine alone[4]
- It is important to adhere to the quarantine period for individuals who have tested for COVID-19 as a negative test result early in the incubation period may be a false negative[5]

thinkresearch

The Mining Association of Canada | L'association minière du Canada

COVID-19 Quarantine Summary

Quarantine Indications

Implementing Quarantine

Exposure-Related Quarantine

- The World Health Organization (WHO) recommends that all contacts of individuals with a confirmed or probable COVID-19 infection are to be quarantined in a designated facility or at home
  - A contact is a person in any of the following (from 2 days before and up to 14 days after the onset of symptoms in the confirmed or probable case of COVID-19)[1]:
    - face-to-face contact with a probable or confirmed COVID-19 case within 1 metre for more than 15 minutes
    - direct physical contact with a probable or confirmed case of COVID-19
    - direct care for an individual with probable or confirmed COVID-19 without using proper personal protective equipment

Travel-Related Quarantine

- Mandatory quarantine will likely be implemented when travelling from one country to another (sometimes from a province or territory to another)
- According to the *Quarantine Act* imposed by the Government of Canada, all travellers arriving in Canada will have a mandatory 14-day quarantine period which starts the day they arrive, with the exception for some workers (e.g. workers entering congregate settings such as mining and industrial camps may not be subjected to quarantine)[6]
- Countries will each have their own regulations in place regarding quarantine periods; the WHO still recommends a 14-day quarantine period if there is a risk of contact with a probable or confirmed COVID-19 case[1]
  - Countries may adjust their quarantine durations based on the COVID-19 incidence rate one is travelling from, if one has a negative PCR test prior to arriving in a new country, if one has been infected with COVID-19 previously, the nature of one's work, and other public health measures being implemented
- Cost-benefit analyses are being conducted to determine if a shortened length of quarantine (e.g. 5 days) is effective when combined with other measures that reduce disease transmission, however, this is still being researched[7]

Work-Related Quarantine

- Some employers will require their employees to quarantine on arrival to work camp or work site
- The length of quarantine will often be determined by the government and/or the local public health authority and/or negotiation between a company and the health authority
- Some organizations can use point-of-care (i.e. rapid) testing to reduce quarantine times, however, this needs to be in conjunction with the regulations of the government/public health authority

Considerations for Quarantine Facilities

The implementation of quarantine requires the use or creation of appropriate facilities where a person can be physically separated from the community[1]

Rooms and Common Spaces

- If quarantining at home, a well-ventilated single room is preferred; if a single room is not available, a distance of at least 2 metres from other household members is recommended[1]
  - The use of shared spaces (e.g. bathroom, kitchen) should be minimized and well ventilated[1]
  - Bathroom and toilet surfaces are to be cleaned and disinfected at least once daily with appropriate solution (i.e. regular household detergent for cleaning, and then after rinsing, household disinfectant containing 0.1% sodium hypochlorite or 70% ethanol)[1]

Considerations for Quarantine Facilities Continued…

Ventilation

- If an individual is quarantining at a designated facility, they should have a private room where they can sleep and spend their time that is adequately ventilated with large quantities of fresh and clean outdoor air to control contaminants is preferred[1]
- The basic criteria for ventilation are[1]:
  - Ventilation rate: The amount and quality of outdoor air provided into the space (for quarantine facilities: 60 litres/second per person is adequate for naturally ventilated areas or 6 air changes per hour for mechanically ventilated hours)

Cross ventilation (i.e. open window + open door)	Ventilation rate (l/s) = 0.65 x wind speed (m/s) x smallest opening area (m^2) x 1000
Single-side ventilation (i.e. open window + closed door)	Ventilation rate (l/s) = 0.05 x wind speed (m/s) x smallest opening area (m^2) x 1000
Mechanical ventilation (knowing the airflow provided by the ventilation system and the volume of the room)	Air changes per hour (ACH) = [ventilation rate (l/s) x 3600 (s/hr)] x 0.001 (m^3/s)]/[room volume (m^3)]

  - Airflow direction: the direction of airflow should be from clean to less-clean zones
  - Air distribution or airflow pattern: the supply of air to each part of a space to improve dilution and removal of pollutants

Ways to Increase Ventilation

Ventilation can be increased by:

- Opening the windows to allow natural ventilation (if safe to do so)[8]
- Using fans to push air out of one window and draw it in from another
- When using mechanical systems, increase the percentage of outdoor air using economizer modes of heating, ventilation, and air-conditioning (HVAC) systems operations[8]
- Increase total airflow supply to occupied spaces, if possible[8]
- Ensure exhaust fans in restroom facilities are functional and operating at full capacity when the building is occupied[8]

Quarantine Situations Relevant to the Mining Industry

Type of Quarantine	Considerations
Home Quarantine	• Individuals may be required to quarantine in their own homes • If an individual is living with others while undergoing quarantine, it is important to try and distance as much as possible from others (or wear a mask if distancing is not possible), use a separate bathroom, sleep in a separate bedroom, and clean commonly touched surfaces frequently
Hotel Quarantine	• Individuals travelling away from home may be required to quarantine in hotel rooms • Individuals will spend the entire quarantine in their hotel room; food/meals and any other essential services will be provided to them in their rooms • Individuals will be checked up on by healthcare professionals (via phone or in person) • Testing for COVID-19 may be performed on certain days while quarantining to ensure one is negative for the virus when being released from quarantine
Camp Quarantine	• Individuals working at camps may be required to quarantine in a designated room/facility at the work camp • Rooms should be single occupancy with a private bathroom; if this is not possible, distancing and disinfecting measures need to be implemented

COVID-19 Quarantine Summary

Development of COVID-19 Signs and Symptoms While in Quarantine

- If an individual is in quarantine due to close contact with a probable or confirmed COVID-19 case and they develop signs or symptoms of COVID-19 (e.g. cough, fever, shortness of breath, runny nose, sore throat, etc.), they must isolate for a set number of days (often a minimum of 10 days from the start of symptom onset) or until symptoms resolve (whichever is longer) according to local public health or government regulations

Congregated Facility Quarantine Recommendations

- Some congregated facilities (e.g. camps, shelters) have implemented mandatory quarantine protocols when arriving to a facility regardless of exposure or travel history. This is to try and reduce spread of COVID-19, particularly amongst pre-symptomatic and asymptomatic individuals.

Guidance for Rural, Remote, and Isolated Communities[9]

- As some work sites are located near rural, remote, and isolated communities, there is risk of employees transmitting COVID-19 to these community members
- To ensure protection for the Indigenous community and employees, it is important to:
  - Practice social distancing and limit interactions
  - Increase hand hygiene and protective actions
  - Monitor for signs and symptoms of COVID-19 continuously

How to Improve Adherence to Quarantine

- Adherence to quarantine can be difficult and can be affected by perceived risk/benefits, social norms, and mental health/well-being. Presented here are some strategies that may improve the adherence to quarantine.
- The following strategies can be implemented to improve adherence to quarantine[10]:
  - Making the benefits of quarantine clear and concise
  - Providing a timely, clear rationale for quarantine
  - Ensuring sufficient supplies are provided
  - Providing financial assistance for those impacted by quarantine
  - Emphasizing that quarantining is a social norm and that this behaviour can be viewed as altruistic
  - Educating the public about the infectious disease outbreak and quarantine protocol

Strategies in Addition to Quarantine

- A combination of quarantine, isolation, contact tracing, and physical distancing is required to reduce the transmission of the SARS-CoV-2 virus[11] (please refer to the Think Research COVID-19 Summaries for Screening, Testing, Risk Mitigation for more information)
- A mathematical modelling study in the *Lancet* predicted that the most effective way to reduce the SARS-CoV-2 reproduction rate (i.e. contagiousness or transmissibility) of COVID-19 is through self-isolation, household quarantine, manual contact tracing of acquaintances, app-based tracing, and social distancing (estimated approximately a 66% decrease in transmissibility)[11]

COVID-19 Quarantine Summary

Duration of Quarantine

- The Government of Canada requires a 14-day quarantine period for individuals arriving in Canada from abroad and/or those with exposure to a confirmed or probable COVID-19 case
- The rationale for a 14-day quarantine is due to the incubation period of COVID-19 [12]
  Note: The incubation period is the time from when one is infected with a disease until one develops symptoms
- A pooled analysis study published in the *Annals of Internal Medicine* states[12]:
  - The median incubation period for COVID-19 is estimated to be **5.1 days**
  - 97.5% of those who develop symptoms will do so within **11.5 days**
  - Roughly 101 out of every 10,000 cases will develop symptoms after **14 days of quarantine** (~1.01% of cases will develop symptoms after a 14-day quarantine)
  - Increased quarantine beyond 14 days may be warranted in extreme situations (i.e. longer monitoring periods may be justified in high-risk scenarios such as health care workers caring for COVID-19 patients while not wearing personal protective equipment)

Unique Situations

- Some regions have shortened their mandatory quarantine period (e.g. from 14 days to 10 or 7 days)
- Regions offering a reduced quarantine period often have a low incidence of COVID-19 cases, and have set up their own requirements for those entering the country (e.g. travellers may be eligible for a reduced quarantine period of 7 days only if they are travelling from a low-risk country)
- These countries may also have more stringent testing protocols and policies when out of quarantine (e.g. in Taiwan, travellers in quarantine will be tested for the virus on the 5th day of their 7-day quarantine; if they test negative, they can go about their activities but must monitor their temperature and health and keep a record of all the places and people they visit until the 21st day of their visit)[13]
- Currently, the WHO, Centre for Disease Control (CDC), and Public Health Agency of Canada (PHAC), still recommend a 14-day quarantine period (due to the long incubation period of the virus) when travelling abroad and/or when exposed to a probable or confirmed COVID-19 case

Isolation Duration

- If an individual tests positive for COVID-19, they will have to isolate until discharge criteria is met as indicated by government or public health recommendations
- The WHO recommends the following regarding discontinuing isolation for COVID-19 positive individuals[14]:
  - Symptomatic cases: 10 days after symptom onset plus at least 3 additional days without symptoms (including without fever)
  - Asymptomatic cases: 10 days after positive SARS-CoV-2 test
  - Countries may choose to test cases as part of the isolation discontinuation criteria. If so, the WHO recommends two negative RT-PCR tests taken at least 24 hours apart

Helpful Resources

Management of Cases and Contacts of COVID-19 in Ontario - Ministry of Health of Ontario:
http://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/contact_mngmt/management_cases_contacts.pdf

Clinical Document Development and Implementation Considerations

Abbreviations

ACH = Air Changes per Hour
COVID-19 = Coronavirus Disease 2019
RT-PCR = Reverse Transcriptase Polymerase Chain Reaction
SARS-CoV-2 = Severe Acute Respiratory Syndrome Coronavirus 2

References

Key references[1-14]

1. World Health Organization. Considerations for quarantine of contacts of COVID-19 cases. Published online August 19, 2020. https://www.who.int/publications/i/item/considerations-for-quarantine-of-individuals-in-the-context-of-containment-for-coronavirus-disease-(covid-19)

2. Wilder-Smith A, Freedman DO. Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak. J Travel Med. 2020;27(2). doi:10.1093/jtm/taaa020

3. McCall M, Nunan D, Heneghan C. Is a 14-day quarantine effective against the spread of COVID-19? The Centre for Evidence-Based Medicine (CEBM). Published April 6, 2020. https://www.cebm.net/covid-19/is-a-14-day-quarantine-effective-against-the-spread-of-covid-19/

4. Nussbaumer-Streit B, Mayr V, Dobrescu AI, et al. Quarantine alone or in combination with other public health measures to control COVID-19: a rapid review. Cochrane Infectious Diseases Group, ed. Cochrane Database Syst Rev. Published online September 14, 2020. doi:10.1002/14651858.CD013574.pub2

5. Ontario Ministry of Health. Management of Cases and Contacts of COVID-19 in Ontario September 8, 2020 (version 9.0). Published online September 8, 2020. https://advantageontario.informz.ca/advantageontario/data/images/Attachment%20-%20Management%20of%20Cases%20and%20Contacts%20of%20COVID-19%20in%20Ontario%20v9.0.pdf

6. Government of Canada. Community-based measures to mitigate the spread of coronavirus disease (COVID-19) in Canada. Published May 30, 2020. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/public-health-measures-mitigate-covid-19.html#_Congregate_living_settings

7. Eilersen A, Sneppen K. Estimating cost-benefit of quarantine length for COVID-19 mitigation. medRxiv. Published online April 14, 2020. doi:10.1101/2020.04.09.20059790

8. World Health Organization. Coronavirus disease (COVID-19): ventilation and air conditioning in public spaces and buildings. Published July 29, 2020. https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19-ventilation-and-air-conditioning-in-public-spaces-and-buildings

9. Government of Canada; Indigenous Services Canada. Protecting the health and safety of Indigenous Communities in close proximity to natural resource operations: Guidance for Indigenous communities. Published June 18, 2020. https://www.sac-isc.gc.ca/eng/1592487905243/1592487940872

10. Webster RK, Brooks SK, Smith LE, Woodland L, Wessely S, Rubin GJ. How to improve adherence with quarantine: rapid review of the evidence. Public Health. 2020;182:163-169. doi:10.1016/j.puhe.2020.03.007

11. Kucharski AJ, Klepac P, Conlan AJK, et al. Effectiveness of isolation, testing, contact tracing, and physical distancing on reducing transmission of SARS-CoV-2 in different settings: a mathematical modelling study. Lancet Infect Dis. 2020;20(10):1151-1160. doi:10.1016/S1473-3099(20)30457-6

12. Lauer SA, Grantz KH, Bi Q, et al. The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. Ann Intern Med. Published online March 10, 2020. doi:10.7326/M20-0504

13. Taiwan Centers for Disease Control. From June 22, short-term business travelers are allowed entry and can apply for shortened home quarantine periods. Published June 17, 2020. https://www.cdc.gov.tw/En/Bulletin/Detail/a9zCFAfhICztjWXp83fQFg?typeid=158

14. World Health Organization. Criteria for releasing COVID-19 patients from isolation. Published online June 17, 2020. https://www.who.int/publications/i/item/criteria-for-releasing-covid-19-patients-from-isolation

COVID-19 Screening Summary

This document has been developed by Think Research with the support of the Mining Association of Canada. The information presented is for orientation in the design of mitigation programs and is current as of the date of publication. Any measures outlined in this document should be confirmed with appropriate experts before integration into a COVID-19 risk mitigation program.

Introduction

This document provides information about what types of screening are available to detect COVID-19 and the effectiveness of the types of screening. It can be used to guide policies and procedures related to screening for COVID-19.

Screening Definition

What is Screening?

Screening is a process that helps identify a person's risk for disease or illness based off of questions related to symptoms experienced, travel history, and exposure history.[1]

Screening Methods

Screening can be completed through tests, questionnaires, examinations, or other procedures that can be applied quickly and easily to a target population.[2] To limit the spread of COVID-19 globally, screening at airports, workplaces, shopping centres, etc. is being used to identify potential infection so that these people can then stay away from others and seek appropriate care.[1,3]

Sensitivity

Sensitivity is the ability of a test to correctly identify an individual as diseased, i.e. an individual who tests positive for COVID-19 has COVID-19.

Specificity

Specificity is the ability of a test to correctly identify an individual as disease-free, i.e. an individual who tests negative for COVID-19 does not have COVID-19.

Screening for COVID-19

- Current best practice screening for COVID-19 involves use of multifaceted screening programs to boost accuracy and efficacy. A multifaceted screening program may include staff education with symptom self-reporting, temperature detection, and laboratory-based testing[4]
- Due to the absence of detectable symptoms during the incubation period, variation in severity of disease, imperfect methods of screening due to technological or human error, and subjective responses by individuals being screened, the effectiveness of screening programs that rely on a single measure (i.e. only temperature screening, only symptom screening) of illness for COVID-19 is questionable[3]

Variations of Symptom and Exposure Screening

Temperature Screening

What is Temperature Screening

- Fever (i.e. elevation in body temperature beyond normal range), can be an early indicator of illness.
- During infectious disease outbreaks, there is increased interest in using thermal and infrared temperature devices (i.e. temperature screening) for mass screening efforts to try and detect ill individuals[5]

Types of Temperature Screening and Effectiveness

Type of Temperature Screening[5]	Effectiveness[5]
Hand-held infrared thermometers	• Low sensitivity (29.4%) (device has a poor ability to detect people who have a fever) • High specificity (96.8%) (device has a high ability to detect individuals without a fever)
Infrared skin thermometers (e.g. cameras)	• Low to high sensitivity (24 to 93%) (poor to high ability to detect fever) • Limited specificity data
Infrared thermal cameras	• Fair to high sensitivity (57 to 91%) (fair to good ability to detect fever)
Clinical thermometers, e.g. oral, axillary (armpit), tympanic (ear)	• Oral readings (taken with mouth closed while thermometer is in place) are most accurate; axillary temperatures are usually the least accurate

Considerations for Temperature Screening[5]

- Fever detection is not conclusive for infection and absence of fever is not conclusive of not having infection. Using only temperature screening for COVID-19 is problematic due to the variation in disease progress (i.e. long incubation period) and the potential for technological and human error. The effectiveness of using temperature screening with other methods is still unknown[6]
- Environmental temperature can impact the accuracy of the temperature reading for non-contact devices
- For non-contact devices, distance from individuals being tested may impact the temperature reading (too far/ too close)
- Medications such as acetaminophen and ibuprofen may suppress a fever in an infected individual
- There is variation in periods of latency or incubation and the time to onset of clinical symptoms; some infected individuals with mild or no symptoms of illness may have no fever[1]
- Detecting fever is not a conclusive test for infection[6]
- There is uncertainty if the use of screening questionnaires with temperature screening provides an improved effectiveness in infection detection, as the level of subjectivity in answers is difficult to control[6]

Best Practice Recommendations[7]

- Trained nurses or medical professionals are the optimal temperature takers; however, if not feasible, nurses/medical staff can train individuals to take temperatures accurately
- Appropriate PPE should be utilized; if contact is required to check temperature, hand sanitization and glove change is required with each temperature screen
- Create entrance queues (outside is optimal) where employees can pass through a temperature-checking line
- Create multiple such lines and entrances where physically possible to reduce crowding
- Consider placing markings (using tape or other materials) on the ground in the corridor to mark off 2 metre spacing to provide for greater social distancing

Variations of Symptom and Exposure Screening Continued…

Temperature Screening Continued…

Individual with Fever on Temperature Screening[7]

- If an individual presents with fever at temperature screening, the following should be done:
  - Inform the individual that he or she has a fever and is not permitted to enter the work environment
  - Instruct the individual to begin quarantine procedures and notify the appropriate healthcare providers and management to provide further instruction (e.g. testing, self-monitoring of symptoms, quarantine)

Active Screening in Person and Online Screening

What is Active Screening

- Active screening is when a designated and trained individual (i.e. screener) assesses the risk level of an individual entering the workplace through asking questions via a set questionnaire (paper or electronic). The answers to the questions help determine if an individual is fit to work
- Questionnaires for COVID-19 include:
  - Questions about whether the individual has (or has recently had) signs and symptoms related to COVID-19, e.g. cough, shortness of breath, fever, fatigue, headache[3]
  - Questions about whether the individual has travelled recently[3]
  - Questions about whether the individual has been exposed to a potential COVID-19 case[3]

What is Online Self-Screening

- Online self-screening is very similar to active screening, except that the questionnaire is completed by the individual (not a designated screener) on a mobile device (or computer) prior to entering a workplace

Considerations for Active Screening

- Active screening can be resource-intensive and create large amounts of staff screening reports that are difficult to manage[4]
- Responses to questions can be subjective leading to inaccurate screening results
- Active screening can be combined with temperature screening, however, the effectiveness of this strategy is unknown[6]

Considerations for Online Self-Screening

- Online screening is less resource-intensive, however, also less sensitive due to individual compliance and disclosure[4]
- Employees will not have to interact with colleagues, as they will be doing the screening online at their home/residence

Considerations for Online Self-Screening with Active Screening

- Some organizations will adopt an online self-screen prior to work and an active screen when arriving at work
- This ensures that the individuals have completed the online self-screen and are permitted to enter the workplace
- Sometimes temperature checks will also be added to this screening process

Examples of Online Self-Screening

- Government of Canada (Health Canada) - COVID-19 Self-Assessment Tool: https://ca.thrive.health/covid19/en
- Government of Ontario - COVID-19 Self-Assessment: https://covid-19.ontario.ca/self-assessment/

COVID-19 Screening Summary

Variations of Symptom and Exposure Screening Continued…

Considerations for Symptom and Exposure Screening[1]

Screening	Sensitivity (ability to correctly identify those with COVID-19)	Specificity (ability to correctly identify those without COVID-19)	Comments
Temperature Screening	Low	Moderate to High	• Although high temperatures can often indicate an infection and warrant confirmatory follow-up testing for COVID-19, the fact that this infection includes a relatively long pre-symptomatic or asymptomatic duration makes temperature screening alone a weak screening mechanism
Symptom Screening	Low	Moderate	• A major limitation of screening for COVID-19 based on symptoms is the long latency period of the virus before symptoms appear (average time of about 5 days)[1] • There is little evidence regarding the effectiveness of repeated screening (e.g. multiple times a week)
Travel History Screening	Low	Moderate to High	• Screening for travel history is impacted as the pandemic continues to grow and there is greater widespread community transmission
Exposure History Screening	Low	Moderate to High	• Screening for knowledge of exposure to known infected or suspected infected people is difficult due to the pandemic growing, community transmission becoming widespread, and limited testing prevalence in certain areas

Results of Screening

Organizations should have policies and procedures in place regarding screening tests and what to do if an individual screens positive for symptoms or exposure/travel history related to COVID-19.[8] Organizations are to have specific training and/or guidance documents to assist when providing screening and interpreting results.[8]

Positive Screening Result

- A positive screening result is not equivalent to a confirmed diagnosis of COVID-19; further molecular testing is often warranted to confirm a diagnosis[8]
- Individuals who screen positive prior to entering a workplace should contact the most appropriate person (e.g. supervisor, medical lead) and be instructed whether to be tested for COVID-19 and to self-quarantine immediately[9]
- Individuals who screen positive upon entry to a workplace should be isolated (e.g. placed in a separate room with the door closed) and avoid contact with other people; the individual should be instructed on where to get tested (if warranted), where to isolate, and any other pertinent information[9]

Negative Screening Result

- A negative screening result is not conclusive of an individual not having COVID-19 infection; individuals are to comply with their workplace/community exposure control, self-monitor and inform the appropriate personnel if any symptoms develop and/or if exposure/travel history changes[8]

Laboratory-Based Screening and Testing

More detailed information regarding COVID-19 testing can be found in the Think Research COVID-19 Testing Summary developed for The Mining Association of Canada members

COVID-19 Screening Summary

What is Laboratory-Based Screening and Testing

- Laboratory-based testing for COVID-19 consists of collecting a specimen and testing it to determine if an individual is positive or negative for SARS-CoV-2 genetic material, antigen or antibodies against the virus[10]
- Some organizations require employees to get laboratory testing done prior to entering the workplace to ensure all staff on the premise are COVID-19 negative, i.e. as a screening mechanism
- Laboratory-based screening is being implemented in some areas and organizations as other screening measures may not necessarily identify pre-symptomatic or asymptomatic cases, which may lead to outbreaks
- Rapid diagnostic testing (i.e. point-of-care testing) is being implemented in some high-risk communities/organizations to allow employers to test for COVID-19 quicker and more often[11]

Pooling Samples

- Pooling is a method of laboratory-testing a number of people all at once through testing respiratory samples together to detect SARS-CoV-2 [12]
  - If the pooled result is negative, it is presumed all tests are negative[12]
  - If the pooled result is positive, then all samples need to be re-tested individually to determine which ones are positive[12]

Types of Laboratory-Based Testing

Test	Specimen Required	What it Detects	Time for Results
Molecular tests (e.g. Reverse Transcription Polymerase Chain Reaction [RT-PCR], Nucleic Acid Amplification Tests [NAAT])[13]	• Nasal or throat swab (most tests)[10] • Saliva (some tests)[10]	• Detects the presence of viral RNA (i.e. virus' genetic material)[13] • Diagnoses active COVID-19 infection (highly accurate, often does not need to be repeated) • Cannot determine past infections of COVID-19[10]	Same day to one week[10]
Antigen Test	• Nasal or throat swab[10]	• Detect the presence of a viral antigen (e.g. surface protein)[13] • Diagnoses active COVID-19 infection[10] • Cannot determine past infections of COVID-19[10] • Cannot definitively rule out active infection (less accurate than molecular tests; may need further testing)[10]	One hour or less (rapid diagnostic test)[10]
Antibody (serology) Test (Enzyme-linked Immunosorbent Assay [ELISA], Chemiluminescence Assays [CLIA], Lateral Flow Assays [LFA])[13]	• Blood draw (serum) or finger-prick[10]	• Detects the presence of antibodies that were generated to target SARS-CoV-2, i.e. detects past infection with COVID-19 (symptomatic or asymptomatic individuals)[13] • Cannot determine active infection[10]	Same day to up to 3 days[10]

Laboratory-Based Screening and Testing Continued…

Considerations for Laboratory-Based Screening

- Laboratory-based screening is more costly, requires laboratory capacity and operation implications
- Point-of-care diagnostic tests are available in some areas that are used to diagnose individuals without having to send samples to public health facilities[14]
- Laboratory testing accuracy may be impacted by when an individual is tested; testing after initial exposure (0 to 2 days) will likely not detect SARS-CoV-2 infection[15]
- The sensitivity and specificity of laboratory-tests are not fully known, however, it is very rare for an individual to receive a false-positive test result (i.e. individual tests positive for COVID-19 but is not actually infected)[15]; there is a higher incidence of receiving a false-negative result (i.e. individual test negative for COVID-19 but is actually infected)

Results of Laboratory-Based Screening and Testing

Positive Result on Laboratory-Based Test

- A positive result on a laboratory-based test indicates that the individual is infected with SARS-CoV-2 or has been infected if using an antibody test
- If positive for COVID-19, an individual should be given instructions on how to self-isolate and be informed that public health officials will contact him/her and provide more guidance regarding isolation precautions and contact tracing

Negative Result on Laboratory-Based Test

- A negative result on a laboratory-based test likely indicates that the individual was not infected at the time a sample was collected
- Individuals who test negative are to monitor for signs and symptoms of COVID-19 infection, practice social distancing, and wear a mask in public places; if symptoms develop or exposure history changes, individuals are encouraged to get re-tested

Clinical Document Development and Implementation Considerations

Abbreviations

CLIA = Chemiluminescence Assays
COVID-19 = Coronavirus Disease 2019
ELISA = Enzyme-linked Immunosorbent Assays
LFA = Lateral Flow Assays
NAAT = Nucleic Acid Amplification Test
RT-PCR = Reverse Transcription Polymerase Chain Reaction
SARS-CoV-2 = Severe Acute Respiratory Syndrome Coronavirus 2

References

Key references[1-15]

1. Viswanathan M, Kahwati L, Jahn B, et al. Universal screening for SARS-CoV-2 infection: a rapid review. Cochrane Database Syst Rev. 2020;(9). doi:10.1002/14651858.CD013718

2. World Health Organization. Screening. WHO. Accessed September 23, 2020. http://www.who.int/cancer/prevention/diagnosis-screening/screening/en/

3. Gostic K, Gomez AC, Mummah RO, Kucharski AJ, Lloyd-Smith JO. Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. eLife. 2020;9. doi:10.7554/eLife.55570

4. Alberta Health Services. Effectiveness of screening programs for reducing the spread of COVID-19 in healthcare settings. Published online June 12, 2020. Accessed September 21, 2020. https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-sag-effectiveness-of-workplace-screening-programs-rapid-review.pdf

5. CADTH. Infrared temperature devices for infectious disease screening during outbreaks: overview of an ECRI evidence assessment. Published online May 2020. https://cadth.ca/sites/default/files/covid-19/ha0004-non-contact-ir-temperature-screening-final.pdf

6. Robertson DC, Snyder D. Temperature screening to prevent COVID-19 transmission: creating false security. https://d84vr99712pyz.cloudfront.net/p/pdf/covid-19-resource-center/covid-19-clinical-care/covid-position-paper_temperature-screening.pdf

7. Kaplan DA, Hoffman C, Parsons RN. Best practices when implementing a program for taking employee temperatures during the COVID-19 pandemic. Published online April 21, 2020. https://1npdf11.onenorth.com/pdfrenderer.svc/v1/abcpdf11/GetRenderedPdfByUrl/Best%20Practices%20Employee%20Temperatures%20COVID19.pdf/?url=https%3a%2f%2fwww.foley.com%2fen%2finsights%2fpublications%2f2020%2f04%2fbest-practices-employee-temperatures-covid19?format=pdf&attachment=false

8. Ontario Ministry of Health. COVID-19 patient screening guidance document (version 4.0). Published online June 11, 2020. http://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/2019_patient_screening_guidance.pdf

9. Ontario Ministry of Health. COVID-19 guidance: primary care providers in a community setting. Published online September 4, 2020. http://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/2019_primary_care_guidance.pdf

10. U.S. Food and Drug Administratoin (FDA). Coronavirus testing basics. FDA. Published September 9, 2020. https://www.fda.gov/consumers/consumer-updates/coronavirus-testing-basics

11. Canadian Agency for Drugs and Technologies in Health. Workplace COVID-19 prevention measures and the role of testing in workplace safety. Published online July 27, 2020. https://cadth.ca/sites/default/files/covid-19/cy0001-prevention-measures-and-role-of-testing-in-workplace-safety.pdf

12. Center for Disease Control. Interim guidance for use of pooling procedures in SARS-CoV-2 diagnostic, screening, and surveillance testing. Published August 1, 2020. https://www.cdc.gov/coronavirus/2019-ncov/lab/pooling-procedures.html

13. European Centre for Disease Prevention and Control. Diagnostic testing and screening for SARS-CoV-2. Published 2020. https://www.ecdc.europa.eu/en/covid-19/latest-evidence/diagnostic-testing

14. Udugama B, Kadhiresan P, Kozlowski HN, et al. Diagnosing COVID-19: the disease and tools for detection. ACS Nano. 2020;14(4):3822-3835. doi:10.1021/acsnano.0c02624

15. Public Health Agency of Canada. Understanding COVID-19 testing. Published August 21, 2020. https://www.canada.ca/en/public-health/services/publications/diseases-conditions/understanding-covid-19-testing.html

COVID-19 Testing Summary Document

This document has been developed by Think Research with the support of the Mining Association of Canada. The information presented is for orientation in the design of mitigation programs and is current as of the date of publication. Any measures outlined in this document should be confirmed with appropriate experts before integration into a COVID-19 risk mitigation program.

Introduction

This document provides information regarding what types of tests are available for COVID-19, when in the disease process those tests should be taken, and the effectiveness of those tests.

Testing Definition

What is Testing (related to COVID-19)?

Testing is the method of taking a specimen from an individual and analysing that specimen to determine if someone currently has or has previously had COVID-19.

Types of Tests

There are three main tests available for COVID-19 detection: molecular tests (e.g. polymerase chain reaction (PCR) tests), antigen tests, and antibody tests. Molecular tests and antigen tests determine if an individual has a current COVID-19 infection, where an antibody test determines if an individual has developed antibodies against SARS-CoV-2, indicating progressed or previous infection.[1] Testing is important to identify those with infection, where in the community the virus is spreading, and how much of the virus may be circulating in a community.[2]

Methods for Tests

Testing can be processed in laboratories, which requires samples to be collected and sent to a nearby laboratory to be processed by a trained technician, which may take several hours to several days. More recently, point-of-care (i.e. rapid) tests have become available, which allows samples to be processed on site (usually with portable machines) and results to be available much more quickly, i.e. minutes to hours. There are pros and cons to each of these methods which will be discussed in this document.

Sensitivity

Sensitivity is the ability of a test to correctly identify an individual as diseased, i.e. an individual who tests positive for COVID-19 has COVID-19.

Specificity

Specificity is the ability of a test to correctly identify an individual as disease-free, i.e. an individual who tests negative for COVID-19 does not actually have COVID-19.

thinkresearch

The Mining Association of Canada | L'association minière du Canada

COVID-19 Testing Summary Document

Summary of Tests

Test	Specimen Required	What it Detects	Time for Results
Molecular tests (e.g. Reverse Transcription Polymerase Chain Reaction [RT-PCR], Nucleic Acid Amplification Tests [NAAT])[3]	Nasal (or nasopharyngeal [NP]) or throat swab (most tests),[4] or saliva (some tests)[4]	• Detects the presence of viral RNA (i.e. virus' genetic material)[3] • Diagnoses active COVID-19 infection (highly accurate, often does not need to be repeated) • Cannot determine past infections of COVID-19[4]	Same day to one week[4]
Antigen Test	Nasal or throat swab[4]	• Detects the presence of a viral antigen (e.g. surface protein)[3] • Diagnoses active COVID-19 infection[4] • Cannot determine past infections of COVID-19[4] • Cannot definitively rule out active infection (less accurate than molecular tests; may need further testing)[4]	One hour or less (rapid diagnostic test)[4]
Antibody (serology) Test (Enzyme-linked Immunosorbent Assay [ELISA], Chemiluminescence Assays [CLIA], Lateral Flow Assays [LFA])[3]	Blood draw (serum) or finger-prick[4]	• Detects the presence of antibodies that were generated to target SARS-CoV-2, i.e. detects past infection with COVID-19 (symptomatic or asymptomatic individuals)[3] • Cannot determine active infection[4]	Same day to up to 3 days[4]

Molecular Tests

What are Molecular Tests

- Molecular tests are used to detect the presence of viral genetic material (viral RNA) through RT-PCR (e.g. nucleic acid amplification) to determine if an individual has an active COVID-19 infection.[3] Steps include[5]:
  1) Specimen swab is obtained
  2) RNA is extracted from a collected specimen and converted to DNA
  3) Specimen then amplified by PCR with SARS-CoV-2 specific primers
  4) Results interpreted: Presence of viral RNA indicates active SARS-CoV-2 infection
- Molecular tests offer a high accuracy and are recommended for acute disease detection even when individuals have mild or non-specific symptoms for COVID-19, e.g. fever, cough

Samples Required for Molecular Tests

- The following samples can be used to test for active SARS-CoV-2 infection[6]:
  - Nasopharyngeal (NP) swab (preferred)
  - Throat/oropharyngeal (OP) swab
  - Deep nasal swab
  - Saliva sample
  - Anterior nares (nasal) swab
  - Nasopharyngeal wash/aspirate
  - Nasal aspirate specimen
  - Sputum sample

Note: Some testing centres may require more than one sample to be taken[7]; some labs may not be able to process all specimen samples mentioned above.

- Upper respiratory specimens are adequate for testing early-stage infection
- Lower respiratory specimens are collected later in the course of COVID-19 infection or in individuals with a negative upper respiratory tract sample and there is a strong suspicion for COVID-19 [7]

Molecular Tests Continued…

Turnaround Time for Molecular Tests

- Turnaround time for molecular test results (i.e. time from getting tested to receiving results) varies according to geographic location and proximity to a laboratory that performs COVID-19 testing[6]; results are generally available from 24 hours to three days, but can be up to one week[2]
- The time to process the test is roughly 2-4 hours once received in a laboratory[1]
- Point-of-care or rapid molecular tests are being produced which can limit the turnaround time down to minutes, as these samples do not need to be processed in a laboratory[8]

Who Recieves Molecular Tests

Organizations are to follow public health suggestions and guidance regarding molecular testing for COVID-19. This can include testing:

- Individuals who meet the suspect case definition, i.e. symptomatic or positive travel/exposure history[9]
- Individuals who have had ongoing exposure to an active COVID-19 case[9]
- Individuals who have had a similar exposure history as a COVID-19 case[9]
- Individuals who are part of an outbreak investigation[9]
- Individuals who are from high-risk populations[9]
- Individuals travelling from an area with a high incidence of COVID-19 cases
- Individuals travelling in or out of an extended period in an isolated or semi-isolated location, e.g. work camp

Types of Molecular-Based Tests

The following provides more information on a variety of molecular tests used to diagnosis SARS-CoV-2 infection. RT-PCR is the most common type of test done, but the table describes other potentials[1,10]:

Test	Time to Result	What Results Mean	Pros	Cons
RT-PCR	2-4 hours	The presence of active COVID-19 infection by targeting specific gene sequences of SARS-CoV-2	• Highly sensitive and specific	• Requires trained personnel and special equipment to run test and analyze results • Time needed to complete the test
RT-LAMP (reverse transcription loop-mediated isothermal amplification)	15-60 minutes	The presence of active COVID-19 infection by targeting specific gene sequences of SARS-CoV-2	• Highly sensitive and specific • Point-of-care appropriate as it can be conducted in minutes	• Difficult to quantify the results, i.e. level of viral infection
RPA (recombinase polymerase amplification)	30 minutes	The presence of active COVID-19 infection by targeting specific gene sequences of SARS-CoV-2	• Highly sensitive and specific • Point-of-care appropriate as it can be conducted in minutes • Less equipment required	• Difficult to quantify virus • Debris can interfere with reaction (impacting analysis of results)
CRISPR (clusters of regularly interspaced short palindromic repeats)	15-60 minutes	Locates specific part of the SARS-CoV-2 RNA sequence	• Highly sensitive and specific • Less equipment required • Rapid results	• Requires expert design of components

Molecular Tests Continued…

What to do with Test Results

- As molecular tests for COVID-19 are very sensitive and reliable, it is very likely that an individual who tests positive is currently infected with SARS-CoV-2 (true positive) (**Note:** False positives are unlikely with PCR tests)[2]
- Regardless if a positive COVID-19 case is asymptomatic or symptomatic, they should isolate to prevent the spread to others and prevent outbreaks as per organization's policies and procedures[2]
- Public health officials will follow up with close contacts (i.e. contact trace) of positive cases so they can quarantine, monitor for symptoms, and get tested[2]
- As the incubation period is up to 14 days for COVID-19 disease after exposure, a negative PCR test result in an asymptomatic person cannot guarantee that one is not infected with COVID-19 and it is important to monitor for signs and symptoms of COVID-19, especially if there has been a positive exposure history[6]

Note: an individual who shows no symptoms of COVID-19 and receives a negative PCR is considered negative for SARS-CoV-2 infection at that moment in time, however, if symptoms develop, it is important to get re-tested.

- If a test is inconclusive, a re-test may be indicated[2]

Considerations for Molecular Tests

- Molecular tests for SARS-CoV-2 detect during active infection, so it is possible to miss individuals who have cleared the virus from their system and have recovered from disease[1];testing is most useful during the first 7 days of symptoms, before the virus is cleared by the immune system and/or low levels of the virus are present that cannot be detected[11]
- Molecular tests require trained personnel and special equipment to run test and analyze results[10]
- As turnaround for test results varies, prolonged quarantine may occur

Pooling of Specimens for Molecular Tests

What is Pooling of Specimens

- Pooling is a testing method by which respiratory samples from several people are combined and then tested together to detect SARS-CoV-2 [12]
- Pooling of samples from multiple individuals can increase the diagnostic capacity for detecting SARS-CoV-2 when the rate of testing cannot meet the demand[7]

When to Perform Pooling

- Pooling can be considered in settings where there is a very low or very low expected prevalence of SARS-CoV-2 infection[7] (e.g. work camps)

What to do with Test Results

- If a pooled test result is negative, then it can be presumed that all individual samples are negative for SARS-CoV-2 infection[12]
- If a pooled test result is positive, each of the individual specimens will need to be tested to determine which sample is positive for SARS-CoV-2 infection[12]

Consideations for Pooling

- Pooling is not recommended when there is a high incidence or suspected incidence rate of SARS-CoV-2 infection[7]
- Before any sample pooling protocols can be implemented, they must be validated in the appropriate populations and settings as an inappropriate testing strategy may lead to missed cases or other laboratory errors[7]

COVID-19 Testing Summary Document

Antigen Tests

What are the Antigen Tests to Detect COVID-19

- Antigen tests detect the presence of a specific viral antigen, indicating a current viral infection[13]
- Antigen tests are relatively inexpensive, easy to operate and can be used at the point-of-care; results can be available in approximately 15 minutes[13]
- The clinical performance of rapid antigen diagnostic tests depend on the circumstances in which they are used; yield best results when the person is tested in the early stages of infection with SARS-CoV-2 when viral load is generally highest (e.g. within the first few days of being symptomatic)[5,13]

Samples Required for Antigen Tests

- NP or nasal swab specimens are used for detecting COVID-19 for antigen tests[13]

Who Recieves Antigen Tests

- Rapid antigen tests can be used for screening and testing in high-risk congregate settings (e.g. camps) to quickly identify persons with a SARS-CoV-2 infection; this could allow quick infection prevention and control measures to be implemented to reduce infection transmission[13]

What to do with Test Results

- A positive test result indicates SARS-CoV-2 infection[5]
- A negative test result may not be able to rule out infection as antigen tests are not as accurate as RT-PCR[3]; further testing may be indicated

Considerations for Antigen Tests

- Antigen tests for SARS-CoV-2 are generally less sensitive than RT-PCR[13]
- Antigen tests may be useful during an active outbreak, when access to more sensitive molecular testing is unavailable (e.g. rural, remote communities)
- Antigen tests are not as readily available in Canada (i.e. approved by Health Canada) at the date of publication

Antibody Tests

What are Antibody Tests to Detect COVID-19

- Antibody testing (also known as serology assays) detects the presence of antibodies developed by the host immune system in response to SARS-CoV-2 infection[14]
- Antibodies most commonly become detectable 1 to 3 weeks after symptom onset, thus testing for antibodies can indicate past infection or later onset of infection
- Antibody tests detect the following host antibody isotypes: immunoglobulin M (IgM), IgG, and total antibody[14]
- A positive antibody result does not necessarily correlate with immunity; more research is being developed in this area if immunity develops and if serological assays can measure/capture immunity[14]

Antibody Isotype[14]	Stage of Infection Presentation[14]
IgM	• Detectable in the first week of infection, peak at 12 days post-symptom onset and persist for approximately 32 days, then levels decline
IgG	• Usually develops later in infection compared to IgM and IgA and continues to circulate in blood after IgM and IgA levels drop • Usually detectable by third week after symptom onset; unsure how long IgG persists (unsure if IgG antibody levels correlate with immunity)

Samples Required for Antibody Tests

- Antibody tests require blood samples (venous blood sample or finger-prick blood)[1]

COVID-19 Testing Summary Document

Antibody Tests Continued…

Types of Antibody Tests to Detect COVID-19 [1,15]

Type of Antibody Test	Description	Time to results	Pros	Cons
Neutralization Assay	Detects binding of antibody from patient's blood to antigen	3 to 5 days	• Considered the gold-standard for antibody detection because of high sensitivity and high specificity	• Not readily available
Lateral Flow Immunoassay	Detects IgM or IgG alone or together	15 minutes	• Very simple to read • Requires very little training to perform and does not rely on specialist laboratories or scientists to analyse • Can be used at the point-of-care	• More expensive than ELISA testing • Can only test one sample at a time (more time consuming for batch testing)
Laboratory Based Immunoassays	Common biochemical technique that uses enzymes to detect antibodies	1 to 5 hours	• Can perform tests on up to 96 samples at the same time • Inexpensive and time efficient	• Uncertainty regarding the accuracy

Example results for a Lateral Flow Immunoassay Test [16]

IgM	IgG	Interpretation
Positive	Negative	The immune system is actively producing antibodies to a recent infection
Negative	Positive	The immune system has produced longer acting antibodies to the target viral antigen; the individual likely had the infection several weeks ago even if no symptoms were present
Positive	Positive	The immune system is actively producing antibodies to an ongoing infection that likely began more than 14 days ago
Negative	Negative	The individual has not produced any antibodies to the target viral antigen; it is not likely the individual has had the infection in the past

Antibody Tests Continued…

Who Recieves Antibody Tests

- Antibody tests have different implications as to who should receive them. Examples of when antibody tests may be appropriate include:
  - To identify fully recovered individuals who may be asked to donate their antibodies to critically ill patients[17]
  - To identify individuals included in vaccination programs where those who do not have COVID-19 antibodies may be prioritized for vaccination[17]
  - By public health, to determine the scope of COVID-19 infection, transmissibility, virulence, and to validate if infection control measures and societal implications were/are effective
  - To rule out possible false negative results for individuals who have received negative PCR or antigen test results, but have symptoms and exposure history consistent with SARS-CoV-2 infection[18]
  - To support the diagnosis of acute COVID-19 illness for individuals who present late with symptoms[19]
    - Antibody tests may be offered in addition to PCR and antigen tests as the sensitivity of those tests decreases with time and sensitivity of antibody testing increases[19]
- In areas that have limited access to molecular testing, rapid antibody tests provide an alternative solution to quickly identify suspected COVID-19 cases, provided that the test is highly specific for SARS-CoV-2
  - A positive IgM result in individuals with symptoms congruent with COVID-19 strongly suggests current SARS-CoV-2 infection; however, antibodies (IgM) may take one to two weeks to develop[20]
  - If an individual has symptoms and tests negative on an antibody test for COVID-19, they may be tested with a PCR test to confirm they are not infected with SARS-CoV-2 [20]

What to do with a Positive Test

- A positive antibody test indicates presence of SARS-CoV-2 antibody; this can indicate current or past infection (depending on antibodies tested, symptoms present, and timing of the test)[15]
- Presence of SARS-CoV-2 antibody should not be used to imply the infectious status of an individual or presence of immunity[15]

Considerations for Antibody Tests

- In mild and asymptomatic COVID-19 cases, less antibodies may be generated than those with severe infection, potentially impacting the results of an antibody test, i.e. antibody responses may not develop or reach levels sufficient to be detectable on an antibody test[14,15]
- Evaluations of the various COVID-19 antibody tests have shown variable performance, with sensitivity and specificity analysis ranging from 0 to 100%[14]; sensitivity may be impacted by where the test is conducted (i.e. laboratory-based tests have higher sensitivity than point-of-care tests) and where the laboratory cut-off is set (i.e. a lower cut off may increase sensitivity but at the expense of specificity)[14]

COVID-19 Testing Summary Document

Comparison of Testing Methods

The following table provides some basic information on the differences in the three tests used to determine COVID-19 infection (current or past)[1,13]:

	PCR (Molecular) Tests	Antigen Tests	Antibody Tests
What it detects	Detects current infection	Detects current infection	Detects past infection Detects infection after antibody development (within first week)
When it detects SARS-CoV-2	Within the first few days of infection *(usually when symptomatic, about 4-8 days after exposure to virus; can be detected prior to symptom onset or in asymptomatic cases)*[*11,21]	Within the first few days of infection *(best results when symptomatic)*	Within first week to months after infection
Specimen type(s)	NP swab, nasal swab, throat swab, oropharyngeal swab, saliva, sputum	NP swab, nasal swab	Serum (from vein [venipuncture] or finger prick)
Sensitivity	High *(when tested when showing symptoms for COVID-19)*	Moderate *(lower than molecular tests)*	Varies
Specificity	High	High	Varies
Test complexity	Varies	Relatively easy	Varies
Point-of-care ability(e.g. rapid test)	Yes (starting to in Canada)	Yes	Yes
Turn-around time	1 hours to few days	Approximately 15 minutes	15 minutes to few hours
Cost	Moderate	Low	Low

*A literature review and pooled-analysis determined that the probability of a false-negative RT-PCR test result is extremely variable. The false-negative probability is highest in the first 5 days after exposure to SARS-CoV-2 (up to 67%) and lowest on day 8 after exposure (roughly 21%) then rises again.[21]

How to Determine Which Testing Device to Use

When determining what testing device (e.g. RT-PCR, antigen test, antibody test, rapid-acting test, etc.) to use, it is important to consider the following:

- Is it authorized for use/available in your area?
- How accurate is the device, i.e. sensitivity/specificity?
- What role is testing intended to play in an overall mitigation plan?
- What is the prevalence of COVID-19 in the community the test will be used in?
- Do you have the personnel/resources to operate the device, i.e. nurses, laboratory technologists?
- Do you need a test that will provide rapid results?
- Do you need a test that provides evidence that an individual has had SARS-CoV-2 infection at some point?
- How many people are you planning on testing with this device?

thinkresearch

The Mining Association of Canada | L'association minière du Canada

COVID-19 Testing Summary Document

Testing in the Private Sector

- Rapid diagnostic tests (i.e. point-of-care tests) allow for more frequent testing in high-risk industries[22]
- Large employers may want to acquire their own diagnostic testing equipment or partner with private providers that can provide regular testing of their employees[22]
- Testing regimens for high-risk environments may require employees to be tested multiple times per week[22]
- Government and public health authorities across Canada need to ensure that employer or third-party led testing results are appropriately reported and included in local and provincial COVID-19 statistics[22]

Testing Considerations for Rural, Remote and Isolated Communities

Group Screening

- High volume, community-wide COVID-19 testing is feasible, but requires intense organization, robust data management, proficient testing units, adequate personal protective equipment, and trained staff[23]

Surveillance Testing

- Surveillance testing is the widespread testing of asymptomatic individuals in a population and isolation of infected individuals with the goal to limit the spread of infection, e.g. SARS-CoV-2 [24]
- With surveillance testing, repeat testing needs to be conducted 24 to 48 hours apart to distinguish low-viral load individuals on the upslope of infection from those in the recovery phase; this could allow for more effective quarantine decisions and a better understanding of the COVID-19 prevalence and spread in a community

Point-of-Care Testing

- Point-of-care testing is available for nucleic acid, antigen, and antibody tests; however, it may not be readily available in all locations
- Some point-of-care tests may require a trained healthcare provider to run and analyze tests, which may not be readily available in all communities
- No one test is perfect; point-of-care tests have the potential for false-negative and false-positive results[25]
- Using point-of-care testing may assist those living/working in rural, remote and/or isolated communities who have limited access to laboratory testing measures and/or need more efficient testing to be done (e.g. work camps)

Rapid PCR (Molecular) Tests

- Early evidence for rapid PCR (molecular) tests reveal these tests have high sensitivity and specificity[25]
- Rapid molecular tests detect the virus' genetic makeup, often using small portable or table-top devices[25]
- These tests require nasal, throat, or oropharyngeal samples[25]

Rapid Antigen Tests

- Early evidence for rapid antigen tests reveal moderate sensitivity but high specificity[25]
- Rapid antigen tests identify the proteins on the SARS-CoV-2 virus, often through disposable devices[25]
- These tests require nasal, throat, or oropharyngeal samples[25]

Frequency of Testing

- The frequency of testing depends on what the test is being used (i.e. PCR, antigen, antibody), what reason the testing is being performed (i.e. clinical diagnosis, surveillance, or past exposure), how the test results will impact the individual (i.e. to start/discontinue quarantine or isolation), and the incidence of COVID-19 in the current community[26]
- Discontinuing isolation for symptomatic individuals using testing (along with symptom resolution) is often from receiving two negative respiratory specimens collected greater than 24 hours apart[27]
- For asymptomatic individuals, two negative tests is often necessary to discontinue isolation or quarantine[27]

COVID-19 Testing Summary Document

Pre-Test Probability and Positive and Negative Predictive Values

Definitions[13]

- **Pretest Probability:** Probability of an individual having an infection before the test result is known; this is based on the prevalence of the disease in a community and the clinical presentation of the individual (pre-test probability is high in someone with typical symptoms of COVID-19, high occupational risk of exposure, and works/lives in a high prevalence region)[28]
- **Positive Predictive Value:** Probability that an individual who has a positive test result truly does have the infection
- **Negative Predictive Value:** Probability that an individual who has a negative test result truly does not have an infection
- **False Positive Result:** When a test result indicates infection is present when it is not
- **False Negative Result:** When a test result indicates infection is not present when it is
- **True Positive Result:** A test result correctly identifying that infection is present
- **True Negative Result:** A test result correctly identifying that infection is not present

Correlation Between Pretest Probability and Test Results

Pretest Probability[13]	Negative Predictive Value[13]	Positive Predictive Value[13]	Impact on Test Results[13]
Low	High	Low	• Increased likelihood of *False Positive* results • Increased likelihood of *True Negative* results
High	Low	High	• Increased likelihood of *True Positive* results • Increased likelihood of *False Negative* results

Main Points

- Interpreting the result of a test for COVID-19 depends on two things[28]:
  1) The accuracy of the test, i.e. sensitivity, specificity
  2) The pretest probability or estimated risk of disease before testing
- No single test is 100% accurate
- A single negative COVID-19 test result should not be used as a rule-out in an individual with symptoms/exposure history suggestive of COVID-19 (repeat testing is warranted and self-isolation until then is advised)[28]
- A good tool to visualize COVID-19 test results is the BMJ's COVID-19 test calculator: https://www.bmj.com/content/369/bmj.m1808

COVID-19 Testing Summary Document

Document Development and Implementation Considerations

Abbreviations

CLIA = Chemiluminescent Immunoassays
COVID-19 = Coronavirus Disease 2019
CRISPR = Clustered Regularly Interspaced Short Palindromic Repeats
ELISA = Enzyme-linked Immunosorbent Assays
LFA = Lateral Flow Assays
NAAT = Nucleic Acid Amplification Test
RPA = Recombinase Polymerase Amplification
RT-LAMP = Reverse Transcription Loop-Mediated Isothermal Amplification
RT-PCR = Reverse Transcriptase Polymerase Chain Reaction
SARS-CoV-2 = Severe Acute Respiratory Syndrome Coronavirus 2

References

Key references[1-28]

1. Green K, Winter A, Dickinson R, et al. What tests could potentially be used for the screening, diagnosis and monitoring of COVID-19 and what are their advantages and disadvantages? Cent Evid-Based Med. Published online April 20, 2020. https://www.cebm.net/wp-content/uploads/2020/04/CurrentCOVIDTests_descriptions-FINAL.pdf

2. Public Health Agency of Canada. Testing for COVID-19. Published September 18, 2020. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/symptoms/testing.html#a1

3. European Centre for Disease Prevention and Control. Diagnostic testing and screening for SARS-CoV-2. Published 2020. https://www.ecdc.europa.eu/en/covid-19/latest-evidence/diagnostic-testing

4. U.S. Food and Drug Administratoin (FDA). Coronavirus testing basics. FDA. Published September 9, 2020. https://www.fda.gov/consumers/consumer-updates/coronavirus-testing-basics

5. American Society for Microbiology. COVID-19 testing FAQs. Published August 19, 2020. https://asm.org/Articles/2020/April/COVID-19-Testing-FAQs

6. Public Health Ontario. Coronavirus disease 2019 (COVID-19) – PCR. Published online July 23, 2020. https://www.publichealthontario.ca/en/laboratory-services/test-information-index/covid-19

7. World Health Organization. Diagnostic testing for SARS-CoV-2. Published online September 11, 2020. https://www.who.int/publications/i/item/diagnostic-testing-for-sars-cov-2

8. Abbott. Abbott launches molecular point-of-care test to detect novel coronavirus in as little as five minutes. Published March 27, 2020. https://abbott.mediaroom.com/2020-03-27-Abbott-Launches-Molecular-Point-of-Care-Test-to-Detect-Novel-Coronavirus-in-as-Little-as-Five-Minutes

9. Ontario Ministry of Health. COVID-19 Provincial Testing Guidance Update (version 8.0 - September 24. 2020). Published online September 24, 2020. http://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/2019_testing_guidance.pdf

10. Johns Hopkins Center for Health Security. Molecular-based tests for COVID-19. Published May 2020. https://www.centerforhealthsecurity.org/resources/COVID-19/molecular-based-tests/

11. Public Health Laboratory Netowrk. Public Health Laboratory Network evidence review on the utility of COVID-19 testing to reduce the 14-day quarantine period. Published online May 25, 2020. https://www.health.gov.au/sites/default/files/documents/2020/07/phln-evidence-review-on-the-utility-of-covid-19-testing-to-reduce-the-14-day-quarantine-period.pdf

12. Center for Disease Control. Interim guidance for use of pooling procedures in SARS-CoV-2 diagnostic, screening, and surveillance testing. Published August 1, 2020. https://www.cdc.gov/coronavirus/2019-ncov/lab/pooling-procedures.html

13. Center for Disease Control. Interim guidance for rapid antigen testing for SARS-CoV-2. Centers for Disease Control and Prevention. Published September 4, 2020. https://www.cdc.gov/coronavirus/2019-ncov/lab/resources/antigen-tests-guidelines.html

14. Public Health Ontario. Serology testing and COVID-19 – what we know so far. Published online July 6, 2020. https://www.publichealthontario.ca/-/media/documents/ncov/covid-wwksf/2020/07/what-we-know-serology-testing-covid.pdf?la=en

15. Van Caeseele P, for the Canadian Public Health Laboratory Network, Bailey D, et al. SARS-CoV-2 (COVID-19) serology: implications for clinical practice, laboratory medicine and public health. Can Med Assoc J. 2020;192(34):E973-E979. doi:10.1503/cmaj.201588

16. Jacofsky D, Jacofsky EM, Jacofsky M. Understanding antibody testing for COVID-19. J Arthroplasty. 2020;35(7):S74-S81. doi:10.1016/j.arth.2020.04.055

17. Morrison A, Li Y, Loshak H. Serological Tests for COVID-19. Published online May 28, 2020. https://cadth.ca/sites/default/files/covid-19/eh0085-serology-for-covid-tests-final.pdf

18. BC Centre for Disease Control. Antibody testing (serology). Published August 11, 2020. http://www.bccdc.ca/health-professionals/clinical-resources/covid-19-care/covid-19-testing/antibody-testing-(serology)

19. Centers for Disease Control and Prevention. Interim guidelines for COVID-19 antibody testing. Coronavirus disease 2019 (COVID-19). Published August 1, 2020. https://www.cdc.gov/coronavirus/2019-ncov/lab/resources/antibody-tests-guidelines.html

20. Peeling RW, Wedderburn CJ, Garcia PJ, et al. Serology testing in the COVID-19 pandemic response. Lancet Infect Dis. 2020;20(9):e245-e249. doi:10.1016/S1473-3099(20)30517-X

21. Kucirka LM, Lauer SA, Laeyendecker O, Boon D, Lessler J. Variation in false-negative rate of reverse transcriptase polymerase chain reaction–based SARS-CoV-2 tests by time since exposure. Ann Intern Med. Published online May 13, 2020. doi:10.7326/M20-1495

22. Canadian Agency for Drugs and Technologies in Health. Workplace COVID-19 prevention measures and the role of testing in workplace safety. Published online July 27, 2020. https://cadth.ca/sites/default/files/covid-19/cy0001-prevention-measures-and-role-of-testing-in-workplace-safety.pdf

23. Appa A, Chamie G, Sawyer A, et al. SARS-CoV-2 PCR and antibody testing for an entire rural community: methods and feasibility of high-throughput testing procedures. medRxiv. Published online May 30, 2020. doi:10.1101/2020.05.29.20116426

24. Larremore DB, Wilder B, Lester E, et al. Test sensitivity is secondary to frequency and turnaround time for COVID-19 surveillance. medRxiv. Published online September 8, 2020. doi:10.1101/2020.06.22.20136309

25. Dinnes J, Deeks JJ, Adriano A, et al. Rapid, point-of-care antigen and molecular-based tests for diagnosis of SARS-CoV-2 infection. Cochrane Infectious Diseases Group, ed. Cochrane Database Syst Rev. Published online August 26, 2020. doi:10.1002/14651858.CD013705

26. Mina MJ, Parker R, Larremore DB. Rethinking Covid-19 test sensitivity — a strategy for containment. N Engl J Med. Published online September 30, 2020:3. doi:10.1056/NEJMp2025631

27. Centers for Disease Control and Prevention. Coronavirus disease 2019 (COVID-19). Published February 11, 2020. https://www.cdc.gov/coronavirus/2019-ncov/hcp/disposition-hospitalized-patients.html

28. Watson J, Whiting PF, Brush JE. Interpreting a covid-19 test result. BMJ. 2020;369(1808):7. doi:10.1136/bmj.m1808