National Collaborating Centre for Methods and Tools

Centre de collaboration nationale des méthodes et outils

School of Nursing | McMaster University

Revue rapide évolutive, mise à jour 3: Que sait-on du risque de transmission de la COVID-19 dans les établissements postsecondaires et des stratégies permettant de limiter les éclosions sur les campus?

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Veuillez noter : Cette revue a peut-être été mise à jour. Consultez la version la plus récente de cette revue en visitant le Service rapide de données probantes sur la COVID-19 du Centre de collaboration nationale des méthodes et outils, au lien ci-dessus.

Le Centre de collaboration nationale des méthodes et outils (CCNMO) est hébergé par l'Université McMaster et financé par l'Agence de la santé publique du Canada. Les vues exprimées dans ce document ne représentent pas nécessairement celles de l'Agence de la santé publique du Canada. Cette revue a été rendue possible par un soutien financier de nib Health. Ce bailleur de fonds n'a joué aucun rôle dans la collecte ou l'interprétation des données.

Les auteures déclarent n'avoir aucun conflit d'intérêts à divulguer.

Résumé

Contexte

La majorité des établissements postsecondaires situés dans des communautés touchées par le coronavirus-2019 (COVID-19) ont fermé leurs campus pendant l'année scolaire 2019-2020 afin de tenter d'endiguer la propagation du virus. L'apprentissage s'est déplacé en ligne, les activités et les options de logement sur les campus ont été restreintes ou simplement éliminées, tandis que les activités parascolaires et les programmes de sports ont été annulés. Certains établissements postsecondaires ont rouvert pour l'année scolaire 2020-2021 et ont mis en place diverses stratégies visant à réduire la transmission et les éclosions sur les campus.

Cette revue rapide résume les données probantes issues d'établissements postsecondaires qui ont repris et ensuite poursuivi leurs activités sur le campus en 2020-2021, alors que la pandémie se poursuivait, pour guider des plans de réouverture de campus qui seront sécuritaires et efficaces. Elle vise à trouver, à évaluer et à résumer les nouvelles données probantes issues de la recherche, et ce, afin de compléter les conclusions d'une consultation d'experts publiée en décembre 2020 (voir ci-dessous), pour soutenir la prise de décision éclairée par des données probantes.

Une consultation rapide d'experts réalisée aux États-Unis a conclu qu'un ensemble complet de stratégies d'atténuation supposait généralement : des tests de dépistage rapides et fréquents dont les résultats sont communiqués rapidement; l'isolement rapide des personnes dont le résultat est positif et la quarantaine de celles qui ont potentiellement été exposées; la recherche des contacts; le port du masque; la distanciation physique; la gestion de l'environnement (les procédures de nettoyage, ainsi que les systèmes de chauffage, de ventilation et de climatisation); et la collaboration avec les responsables de la santé publique. Ces stratégies aidaient à minimiser la propagation de la COVID-19 (O'Toole, Burke et Denny, 2020). Parmi les éléments importants dont on a démontré qu'ils contribuent au succès des stratégies d'atténuation, mentionnons : l'analyse quotidienne des données pour guider la prise de décision; l'adoption d'une infrastructure des technologies de l'information qui respecte la transparence des données et la vie privée, tout en fournissant rapidement des renseignements exacts; l'inclusion des étudiants et des étudiantes dans l'élaboration et la mise en œuvre de la stratégie; et la promotion d'une culture de responsabilité partagée.

Cette revue se fonde sur les données probantes issues de la recherche les plus récentes auxquelles il était possible d'avoir accès au moment de sa publication. Une version précédente a été terminée le 6 juillet 2021. Cette version mise à jour inclut les données probantes disponibles au 29 juillet 2021, pour répondre à la question : **Que sait-on du risque de transmission de la COVID-19 dans les établissements postsecondaires et des stratégies permettant de limiter les éclosions sur les campus?**

Qu'est-ce qui a changé dans cette version?

- Cette version inclut trois nouvelles études issues des États-Unis (n = 2) et du Canada (n = 1). Les résultats de ces études sont conformes aux résultats précédemment rapportés, y compris le fait que les établissements postsecondaires ayant mis en place un ensemble complet de mesures de prévention et de contrôle des infections déclarent généralement des taux d'infection plus faibles, même lorsqu'ils offrent beaucoup d'apprentissage en présentiel et de logement sur le campus.
- De plus, les résultats de deux études démontrent que la surveillance des eaux usées est une stratégie efficace permettant d'identifier et d'isoler rapidement les cas et leurs proches, ce qui permet de réduire ou d'éliminer les risques de transmission ultérieure.
- Une étude rapporte qu'un ensemble complet de mesures de prévention et de contrôle des infections a été efficace pour limiter à 1 % le nombre de cas chez les étudiants vivant sur le campus et chez le personnel, alors que l'établissement reprenait l'apprentissage en présentiel à 75 % de la capacité d'accueil, rouvrait le logement sur le campus à 100 % de la capacité d'accueil, et recommençait entièrement les activités parascolaires.
- Une étude ne rapporte aucune différence en ce qui concerne le nombre de cas trouvés chez les athlètes étudiants et le personnel sportif lorsqu'elle compare les sports où les athlètes sont en contact étroit aux autres sports. Cette même étude rapporte une incidence moyenne de 14,7 % chez les athlètes étudiants et le personnel sportif, comparativement à 1,5 % chez les non-athlètes.

Points clés

- Dans l'ensemble, le degré de certitude des données probantes au sujet du risque de transmission dans les établissements postsecondaires est très faible (GRADE); il est très probable que les conclusions changeront à mesure que de nouvelles données probantes apparaîtront. Toutes les études concluent que le retour aux activités en présentiel est possible pour les établissements postsecondaires dans le contexte de pandémie actuel. Cependant, toutes les études rapportent des cas positifs et/ou des éclosions sur les campus. Le pourcentage d'étudiants et/ou de membres du personnel ayant obtenu un résultat positif pendant l'année scolaire 2020-2021 variait de 0,27 % à 23 %. Une étude sur la séroprévalence dans des établissements postsecondaires du Royaume-Uni rapporte une séropositivité de 17,5 % dans cinq établissements ayant eu des éclosions (variation de 7,6 % à 29,7 %). Une deuxième étude, américaine, examinant quatre établissements postsecondaires rapporte une séropositivité de 11 % après un contact étroit avec un cas. Une troisième étude, allemande, rapporte un taux de séropositivité de 0,6 % après la mise en œuvre d'une stratégie complète d'atténuation. Neuf études rapportent des taux en deçà de 3,9 %, dont plusieurs sont de ou en deçà de 2 %. Cinq études rapportent des taux supérieurs à 7,7 %, ce qui était, selon certaines études, plus élevé que les taux rapportés pour le comté ou le territoire.
- Quand elles sont déclarées, les stratégies d'atténuation de la plupart des études sont semblables, ce qui rend difficile d'expliquer la variation dans le pourcentage des cas positifs ou de déterminer la combinaison de stratégies qui entraîne les taux de transmission les plus bas. En général, les études qui rapportent des taux positifs de ou inférieurs à 3,9 % portent sur des établissements ayant réalisé le dépistage des personnes symptomatiques avec des résultats rapides (<24 heures), la recherche de contacts et l'isolement sur le campus des cas positifs et de leurs proches. Dans plusieurs

études, les établissements ont aussi effectué du dépistage de surveillance (dépistage des personnes asymptomatiques et/ou surveillance des eaux usées). Les établissements ayant les taux de cas les plus faibles faisaient aussi du dépistage actif et prenaient la température des gens. Toutes les mesures ont été mises en œuvre par le personnel de l'établissement.
- Les établissements ayant ≤2 % de cas positifs avaient mis en œuvre les mesures de PCI suivantes, en plus des stratégies d'atténuation déclarées plus haut : port du masque, distanciation physique et dédensification. La plupart avaient aussi mis en place des mesures de lavage des mains et un nettoyage plus assidu, et un établissement avait mis en place une formation obligatoire sur la COVID-19. Comparativement aux établissements rapportant ≥7,7 % de cas, ceux qui avaient des taux plus faibles avaient généralement rapporté avoir mis en œuvre un plus grand nombre de mesures de PCI.
- Les données probantes sont partagées en ce qui a trait à l'effet de l'occupation simple ou multiple sur la transmission. Certaines données probantes indiquent que les rassemblements non sécuritaires ont été associés à une plus grande transmission que les conditions physiques de logement.

Survol des données probantes et lacunes dans les connaissances

Mesures d'atténuation et de PCI

- Des mesures multidimensionnelles d'atténuation et de PCI ont été mises en œuvre dans plusieurs milieux. Celles-ci peuvent être décrites en utilisant le modèle du « fromage suisse », par lequel les risques sont réduits grâce à plusieurs couches de protection : on s'attend à ce qu'une faiblesse (un « trou ») dans une couche soit compensée par la force d'une autre couche. Parmi les éléments importants de cette approche selon plusieurs études, en plus de ceux énumérés dans les Points clés ci-haut, mentionnons un leadership interdisciplinaire coordonné, l'adhésion des étudiants et leur respect des mesures de PCI (c.-à-d. un assentiment formel à suivre les mesures de PCI), la communication, et/ou des approches de modélisation fondées sur les données.
- De nombreuses études de qualité élevée-modérée concluent que le dépistage ciblé, l'isolement des cas positifs et la quarantaine de leurs proches peuvent contenir et/ou réduire efficacement la transmission, surtout à la suite d'augmentations rapides du nombre de cas et des éclosions.
- De plus en plus d'études démontrent que la surveillance des eaux usées issues des résidences sur le campus et des structures d'isolement pourrait être une stratégie utile pour trouver et isoler rapidement les cas positifs asymptomatiques ou présymptomatiques, lesquels sont ensuite soumis à un test de dépistage et à la recherche de contacts étroits, en plus d'indiquer lorsqu'une éclosion est terminée.
- Une meilleure ventilation a été notée comme étant une mesure de PCI dans deux études de qualité modérée, mais celles-ci ne l'ont pas décrite en détail; son influence sur le risque de transmission est inconnue.

Résidences sur le campus

- Les données probantes sont partagées en ce qui a trait au fait de déterminer si les risques sont plus élevés dans les situations de cohabitation sur le campus (p. ex., avec des compagnons de chambre) et dans les aires communes (cuisines, salles de bain, etc.). Selon trois études de qualité élevée-modérée, le risque de transmission était plus

élevé pour les étudiants habitant dans des chambres à occupation multiple, tandis qu'une quatrième étude de qualité modérée n'a trouvé aucune corrélation entre les risques et l'occupation. Une étude de haute qualité estime que la propagation entre colocataires se produisait 20 % du temps. Une étude de haute qualité rapporte un taux statistiquement significatif plus élevé dans les chambres de résidences à double occupation que dans les chambres à occupation simple. Deux études de qualité modérée notent que la majorité des cas index venaient de sources à l'extérieur du campus. Une étude de haute qualité conclut que les comportements des individus (p. ex., les rassemblements non sécuritaires) étaient plus susceptibles d'être associés à des éclosions que les conditions physiques de logement.
- Une quarantaine stricte des contacts étroits entraînait une légère réduction des séroconversions comparativement aux établissements n'imposant pas de quarantaine stricte. De plus, les contacts ayant été sortis de quarantaine sept jours après leur exposition à un cas étaient peu susceptibles d'entraîner des transmissions additionnelles.

Approches en matière d'enseignement

- La plupart des études rapportent une approche hybride en matière d'apprentissage (en présentiel et en ligne), mais peu d'entre elles analysent l'association entre l'approche et le risque de transmission. Une étude de qualité modérée ne montre aucun effet du mode d'instruction sur le taux d'infection cumulatif. Une étude de haute qualité et trois études de qualité modérée n'ont pas relevé de données probantes au sujet de la transmission dans les salles de classe. Une étude de qualité modérée portant sur un établissement offrant l'apprentissage en présentiel à 75 % rapporte un taux de positivité de 1 %.

Sports et clubs

- Une étude de haute qualité réalisée auprès d'athlètes de sports de contact note qu'un programme optimal de dépistage inclut soit un dépistage quotidien des antigènes, soit un test RT-PCR de deux à trois fois par semaine. Si les tests RT-PCR sont réalisés quatre fois par semaine, le dépistage quotidien des antigènes n'améliore pas la sensibilité. Toutefois, les résultats indiquent que le dépistage ne permettra pas de trouver tous les cas avant la contagiosité, ce qui illustre l'importance des stratégies de PCI additionnelles, comme le port du masque et la distanciation.
- Une étude de qualité modérée note que même avec un dépistage quotidien obligatoire, des éclosions se produisent et ont pour origine des athlètes asymptomatiques dont les résultats aux tests de dépistage des antigènes étaient faussement négatifs. Il n'existe que peu ou pas de données probantes au sujet des cafétérias, des bibliothèques ou des clubs universitaires situés sur les campus. Plus d'études sont nécessaires pour savoir si les sports et les activités des clubs peuvent reprendre de façon sécuritaire sur les campus.
- Une étude de qualité modérée rapporte des taux de positivité semblables entre les athlètes étudiants de sports où les athlètes sont en contact étroit et les athlètes des autres sports. Les athlètes étudiants étaient 5 fois plus susceptibles de devenir infectés que les étudiants non athlètes.

Études de modélisation

- Selon les résultats d'études de modélisation mathématique, le fait de donner des cours en ligne à de grands groupes est susceptible de réduire les risques de transmission.
- Le respect du port du masque et de la distanciation est important pour réduire les risques de transmission.
- Le dépistage (au moins hebdomadaire), dont les résultats sont traités rapidement, et la recherche de contacts réalisée rapidement entraînent une réduction de la transmission.
- L'importance de l'isolement des personnes séropositives (par exemple, dans une résidence du campus réservée à cette fin) et de la quarantaine des contacts directs a été démontrée dans les résultats de modélisation.
- Aucune étude ne tenait compte du facteur des vaccins dans les modèles.

Lacunes dans les connaissances et recherches futures

- Une seule étude de cette mise à jour rend compte des variants préoccupants. Dans celle-ci, un seul cas a été associé à un variant préoccupant. On ignore encore de quelle manière les variants préoccupants influenceront les risques de transmission sur les campus et l'efficacité des stratégies d'atténuation et de PCI.
- Cette mise à jour n'a relevé aucune étude rendant compte de l'effet de la disponibilité des vaccins sur la transmission de la COVID-19. On ignore encore la nature et l'ampleur des mesures d'atténuation et de PCI qui seront nécessaires pour prévenir la transmission sur les campus à mesure que les étudiants et le personnel deviendront pleinement vaccinés.
- Peu d'études rapportent les taux relevés dans la collectivité, comparent les taux dans les établissements postsecondaires aux taux relevés dans la collectivité, ou abordent l'influence possible des taux relevés dans la collectivité sur la transmission sur les campus. Or, ces éléments pourraient être une importante source de variation d'une étude à l'autre.

Méthodologie

Question de recherche

Que sait-on du risque de transmission de la COVID-19 dans les établissements postsecondaires et des stratégies permettant de limiter les éclosions sur les campus?

Recherche

Le 29 juillet, les bases de données suivantes ont été interrogées en utilisant les termes clés (colleg* OR "post secondary" OR "post-secondary" OR "vocational school" OR "technical school" OR campus OR universit* OR dormitor* OR residence* OR sororit* OR fraternit*) AND (open* OR reopen* OR outbreak* OR transmit* OR spread OR risk* OR seroprevalen* OR return OR "in person" OR "in-person"). Cette recherche s'appuie sur la recherche précédente réalisée dans la deuxième mise à jour de cette revue rapide.

- MEDLINE database
- Trip Medical Database
- World Health Organization's Global literature on coronavirus disease
- Joanna Briggs Institute COVID-19 Special Collection
- COVID-19 Evidence Alerts from McMaster PLUS™
- COVID-19 Living Overview of the Evidence (L·OVE)
- McMaster Health Forum
- Cochrane Rapid Reviews
- Prospero Registry of Systematic Reviews
- NCCMT COVID-19 Rapid Evidence Reviews
- MedRxiv preprint server
- NCCDH Equity-informed Responses to COVID-19
- NCCEH Environmental Health Resources for the COVID-19 Pandemic
- NCCHPP Public Health Ethics and COVID-19
- NCCID
- NCCID Disease Debrief
- NCCIH Updates on COVID-19
- Institute national d'excellence en santé et en services sociaux (INESSS)
- Uncover (USHER Network for COVID-19 Evidence Reviews)
- Morbidity and Mortality Weekly Report (MMWR)
- Institut national de santé publique du Québec (INSPQ)
- BC Centre for Disease Control (BCCDC)
- Public Health England

Une copie de la stratégie de recherche complète peut être consultée à lien.

Critères de sélection des études

Les résultats de la recherche ont d'abord été examinés pour y trouver des lignes directrices et des synthèses récentes. Une ligne directrice a été trouvée et évaluée à l'aide de l'outil AGREE II. L'absence de la méthodologie utilisée pour élaborer la ligne directrice a fait en sorte que celle-ci a été évaluée comme n'étant pas convenablement applicable. Elle n'a donc pas été examinée plus en profondeur.

Lorsqu'il y en a, les résultats des synthèses et des lignes directrices pour les pratiques cliniques sont présentés en premier. En effet, ceux-ci tiennent compte de l'ensemble des données probantes disponibles et peuvent donc être appliqués de façon large aux populations et aux contextes.

Les études uniques ont été incluses si aucune synthèse n'était disponible, ou si ces études uniques avaient été publiées après la date de la recherche réalisée dans les synthèses incluses. Les sources incluses ont été publiées en anglais et ont été soit révisées par des pairs, soit diffusées avant l'impression et avant leur révision par des pairs. Les sources de surveillance ont été exclues.

Dans une mise à jour précédente, 42 études de modélisation trouvées soit dans la recherche du 19 mars (pour la revue initiale), soit dans la mise à jour du 3 mai, ont été analysées en fonction des critères d'inclusion. Parmi celles-ci, 15 ont été considérées comme répondant à des lacunes dans les connaissances trouvées dans la revue originale et ont été incluses dans la mise à jour du 3 mai. Aucune recherche de nouvelles études de modélisation à inclure dans la présente mise à jour n'a été réalisée.

	Critères d'inclusion	Critères d'exclusion
Population	Établissements postsecondaires (comprenant des étudiants, des professeurs et du personnel) qui étaient ouverts ou avaient repris leurs activités sur le campus	Programmes de formation en résidence Hôpitaux universitaires Stages coopératifs Stages d'apprentissage
Intervention	Stratégies d'atténuation	-
Comparaison	-	-
Résultats	Transmission de la COVID-19 (y compris les cas confirmés de COVID-19, la séropositivité, les éclosions et les infections secondaires)	-
Contexte	Activités sur le campus	Activités à l'extérieur du campus (logements pour étudiants à l'extérieur du campus) Activités non universitaires sur le campus (p. ex., location d'espaces à des groupes communautaires, services de garde sur le campus, camps de jour)

Extraction et synthèse des données

Les données qui concernent la question de recherche, comme le modèle d'étude, le contexte, le lieu, les caractéristiques de la population, les interventions ou l'exposition et les résultats, ont été extraites lorsqu'elles étaient rapportées. Pour les études de modélisation, les données suivantes ont également été extraites : l'objectif de l'étude, le type de modèle et les postulats du modèle. Nous avons synthétisé les résultats sous forme narrative en raison de la variété des méthodologies et des conclusions des études incluses. Les résultats des études de modélisation sont rapportés séparément.

Évaluation de la qualité des données probantes

Nous avons évalué la qualité des données probantes incluses en utilisant des outils d'évaluation critique, comme nous le décrivons ci-dessous. L'évaluation de la qualité a été réalisée par un examinateur et vérifiée par un deuxième examinateur. Les conflits ont été résolus par la discussion.

Méthodologie de l'étude	**Outils d'évaluation critique**
Lignes directrices	Appraisal of Guidelines for Research and Evaluation (AGREE-II) Instrument
Rapport de cas	Joanna Briggs Institute (JBI) Checklist for Case Reports
Cohorte	Joanna Briggs Institute (JBI) Checklist for Cohort Studies
Étude transversale	Joanna Briggs Institute (JBI) Checklist for Analytical Cross-Sectional Studies
Prévalence	Joanna Briggs Institute (JBI) Checklist for Prevalence Studies

Les évaluations de la qualité effectuées pour chaque étude incluse sont disponibles sur demande.

Comme nous ne connaissions pas d'outil d'évaluation critique validé pour les études de modélisation, nous avons communiqué avec des experts du laboratoire MacTheobio de l'Université McMaster, qui ont une grande expérience en matière de réalisation d'études de modélisation mathématique dans le domaine des maladies infectieuses. Ces examinateurs experts ont réalisé une évaluation semi-structurée de chaque étude, notant les postulats de chaque modèle, ses limites et ses incohérences, le cas échéant. L'évaluation de la qualité a été réalisée par un examinateur et discutée avec l'équipe. Les conflits ont été résolus par la discussion.

L'approche GRADE (Grading of Recommendations, Assessment, Development and Evaluations) a été utilisée pour évaluer la certitude des résultats sur la base de huit domaines clés.

Selon l'approche GRADE en matière de qualité des données probantes, les **études observationnelles**, telles que celles incluses dans cette revue, fournissent des données probantes de **faible qualité**. Cette évaluation peut être réduite encore davantage en fonction d'autres domaines :

- un risque de biais élevé;
- l'incohérence des effets;
- le caractère indirect des interventions/résultats;
- des imprécisions dans l'estimation de l'effet;
- un biais de publication.

À l'inverse, elle peut être rehaussée sur la base des domaines suivants :

- un effet important;
- une relation dose-effet;
- une prise en compte des variables confusionnelles.

Pour chaque résultat, la certitude globale des données probantes a été déterminée en tenant compte des caractéristiques des données probantes dont on dispose (des études observationnelles, dont certaines n'ont pas été évaluées par les pairs, des variables confusionnelles potentielles qui n'ont pas été prises en compte, des essais et des protocoles d'essais différents, et une absence de groupes de comparaison valides). Un jugement selon lequel « la certitude globale est très faible » signifie que les résultats risquent fort de changer à mesure que de nouvelles données probantes apparaissent.

Résultats

Synthèse de la qualité des données probantes

Dans cette mise à jour, trois nouvelles études uniques ont été ajoutées. La présente revue inclut donc 44 publications au total. La qualité des données probantes incluses dans cette revue est la suivante :

Résultat	Données probantes incluses			Certitude globale des données probantes (GRADE))
	Méthodologie de l'étude	n	Points clés	
Transmission de la COVID-19 (nombre de cas, nombre d'éclosions, nombre de cas par 100 000 personnes, nombre ou pourcentage d'individus séropositifs)	Observationnelle	28	Les établissements ayant mis en place un ensemble complet de mesures de PCI rapportent généralement des taux d'infection en deçà de 3,9 %, comparativement à ceux ayant appliqué moins de mesures Certains établissements ayant mis en place plusieurs mesures avaient des taux d'infection égaux ou inférieurs à 1 %.	⨁◯◯◯ Très faible*
Transmission de la COVID-19 (cas, R_0)	Modélisation	15		Pas évalué

*Dans l'approche GRADE en matière de qualité des données probantes, les **études observationnelles**, telles que celles incluses dans cette revue, offrent des données probantes de **faible qualité**, et cette évaluation a été modifiée à la baisse pour devenir **très faible** en raison d'un risque élevé de biais, d'incohérence des effets et d'imprécisions dans l'estimation de l'effet.

L'approche GRADE n'a pas été appliquée aux études de modélisation mathématique.

Attention

Comme il faut rendre rapidement disponibles les nouvelles données probantes sur la COVID-19, plusieurs études émergentes n'ont pas été révisées par des pairs. Pour cette raison, nous vous conseillons la prudence quand vous utilisez et interprétez les données probantes incluses dans cette revue rapide. Nous avons fourni une synthèse de la certitude globale des données probantes afin de soutenir le processus de prise de décision. Lorsque c'est possible, nous vous recommandons de fonder vos décisions sur les données probantes de la plus haute qualité possible.

Table 1: Single Studies

Reference	Date Released	Study Design	Location, Context	Description of Virus Control	Summary of Findings	Quality Rating
New evidence reported on August 13, 2021						
Hertel, A.T., Heeter, M.M., Wirfel, O.M., Bestram, M.J., & Mauro, S.A. (2021). Athletes drive distinctive trends of COVID-19 infection in a college campus environment. *International Journal of Environmental Research and Public Health, 18*(14), 7689.	Jul 20, 2021	Case report	Gannon University in Erie, Pennsylvania, United States * * * Learning modality/on-campus living • Blended learning (75% classes in-person, 20% hybrid and 5% online)	Surveillance/testing plan: • Surveillance (daily real time testing; results in 8-12 hrs of sample collection) • Testing (RT-PCR) Other IPAC measures: • Masks • Physical distancing • Temperature checks • Symptom screening • Daily testing • Enhanced cleaning	From Aug 2020 – May 12, 2021, 23,227 tests were completed with 235 confirmed cases (1.01%). Daily positivity rate closely reflected daily case count. There was no correlation (R^2 = 0.052) between the number of tests performed and the incidence of positive cases and there was no significant correlation (R^2 = 0.048) between the frequency of testing days and the incidence of positive cases in athletic teams. Increases in cases were not driven by changes in the volume of testing (exceptions were on days where total volume of testing was low). Temporal trends of new positive cases on-campus varied from state-wide trends with small outbreaks largely linked to student-athletes (100%, 40%, 90% respectively). Authors concluded that state guidance and enhanced protocols are necessary but not sufficient in preventing the spread of COVID-19 on a university campus. These trends are also not largely due to the number of daily tests, but instead arise from the unique features of the campus community. Student-athletes were nearly 5 times more likely to contract COVID-19 compared with non-athletes (45.9% of all positive cases on campus were student-athletes). Athletes were separated into high-risk and low/intermediate risk	Moderate

					based on the risk of transmission while participating in the activity. The percent of positive cases was comparable between high-risk athletes (incidence of 14.3) and low/intermediate risk athletes (incidence of 14.9). The average incidence of positive cases in athletic teams and staff was 14.7 compared to an incidence of 1.5 in non-athletes.	
Karthikeyan, S., Nguyen, A., McDonald, D., Zong, Y., Ronquillo, N., Ren, J. … Knight, R. (2021). Rapid, large-scale wastewater surveillance and automated reporting system enabled early detection of nearly 85% of COVID-19 cases on a university campus. *Preprint.*	Jun 27, 2021	Case report	The University of California San Diego California, United States * * * Learning modality/on-campus living • On-campus living (approximately 9,700 students) • On-campus employees (approximately 4,000 employees)	Surveillance/testing plan: • Surveillance (continuous autosampling in 1 hr intervals, 24 hrs/day), mandated bi-weekly testing for on-campus residents • Testing (RT-qPCR) Other IPAC measures: • Masks • Enhanced cleaning • Hand hygiene • De-densification • Quarantine • Contact tracing	From Nov 23 – Dec 31, 2020, 1574 wastewater samples were collected from 68 randomly selected manholes associated with 239 campus buildings (with a focus on residential buildings). Samples were collected at one of two times (end of Nov or end of Dec 2020). • 692 (44.0%) were positive • 878 (55.8%) were negative • 34 (0.2%) were inconclusive • 96 were from isolation dorms 84.5% (n=50) of positive individual cases were preceded by a positive wastewater sample in the days prior to or on the day of testing. In 8% (n=5) of positive individual cases wastewater samples were negative preceding the positive case and 7% (n=4) of individual cases were missed because a wastewater sample was not taken prior to the positive case. Testing rates increased by 1.5-13 times following wastewater notifications of positive samples. The authors concluded that wastewater sampling could be an efficient and cost-effective surveillance system to reduce infection rates on university campuses.	Moderate ***PREPRINT***

Corchis-Scott, R., Geng, Q., Seth, R., Ray, R., Beg, M., Biswas, N. … McKay, R.M.L. (2021). Averting an outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in a university residence hall through wastewater surveillance. *Preprint.*	Jun 25, 2021	Case report	University of Windsor Windsor, Ontario, Canada * * * Learning modality/on-campus living: • Remote learning • On-campus (n= 1 dorm, 198 students and staff)	Surveillance/testing plan: • Surveillance (wastewater monitoring 3x/week; continuous autosampling 24 hrs/day) • Testing (RT-qPCR; B.1.1.7 assay) A typical monitoring timeline: • Collection (09:00 – 11:00 • Detection (12:00) • Report to University (17:00) • Public health unit response (no later than 20:00) • PCR/antigen testing for entire dormitory; shelter in place • Results; isolation for positive case and close contact Other IPAC measures: • De-densification (dorms) • Quarantine dorm	From Feb – Mar 2021, wastewater samples were taken from a wing (n=86) of a single utilized student campus residence hall housing 186 students. Initial testing revealed no presence of COVID-19. From Mar – Apr 2021, surveillance changed to passive autosampling for the full dorm (n=186) which detected the presence of COVID-19 within two days of implementation. Subsequent testing of all on-campus residents (n=198), resulted in 2 (1%) positive cases of the B.1.1.7 VOC. Cases were moved into isolation within 48 hours; no additional cases identified. Community cases of VoCs were also low at this time. Return to campus after a holiday weekend identified presence of COVID-19 in wastewater, resulting in 1 new case. Case was quarantined; no additional cases identified.	Low ***PREPRINT***
Previously reported evidence						
Schön, M., Lindenau, C., Böckers, A., Altrock, C.M., Krys, L., Nosanova, A., … Boeckers, T.M.	Jul 29, 2021	Cohort	Ulm University, Germany * * *	Surveillance/testing plan: • Surveillance (pre-semester, return to campus and post semester)	From Nov 2020 – Mar 2021, 402 staff (n=75) and students (n=327) of an in-person laboratory setting were tested at the beginning of the semester, after winter break and at the end of the winter semester. At baseline, there were 2/327 (0.6%) asymptomatic confirmed cases,	High ***PREPRINT***

(2021). Longitudinal SARS-CoV-2 infection study at Ulm University. *Preprint*.			Learning modality/on-campus living: • Blended learning • On-campus living not reported	• Testing (RT-PCR, antigen, and serology) Other IPAC measures: • Social distancing (>1.5m) • Masks • PPE – gloves, protective coats • Hand washing • Disinfection • Ventilation • Screening and self-isolation • Contact tracing • Information • Cohort	22/345 (6.4%) seropositive students; all staff tested negative. No new staff or student cases were identified on return to campus after winter break. End of semester testing revealed 2/342 (0.6%) students had seroconverted due to infection over the course of the semester. No further infection or active cases were detected. Authors concluded that with IPAC measures in place face-to-face events with more than 100 people and practical courses with less than 1.5m physical distancing are possible without an increased infection rate.	
Bjorkman, K. K., Saldi, T. K., Lasda, E., Bauer, L. C., Kovarik, J., Gonzalez, P. K., … Parker, R. (2021). Higher viral load drives infrequent SARS-CoV-2 transmission between asymptomatic residence hall roommates. *Journal of Infectious Diseases,* jiab386.	Jul 24, 2021	Cohort	University of Colorado Boulder Boulder, Colorado, United States * * * Learning modality/on-campus living: • Blended learning • On-campus living (6408 students) *Students provided proof of negative test result at move-in.	Surveillance/testing plan: • Surveillance (asymptomatic; mandatory, weekly for students living on-campus (exempt after a COVID-19 diagnosis)) • Testing (symptomatic, exposed) • Contact tracing IPAC measures: Isolation facilities	From Aug 17 – Nov 25, 2020, 1058 (16.5%) students living on-campus tested positive for COVID-19: • 198/1916 (10.3%) of students in single residence rooms • 860/4492 (19.1%) of students in multiple occupancy residence rooms • Cases usually asymptomatic at time of diagnosis While students in multiple occupancy residence rooms had a greater infection rate than those in single rooms, only 116/574 multiple occupancy rooms had likely in-room transmission (i.e., roommate-to-roommate; secondary attack rate (SAR): 20.2%), suggesting transmission occurred elsewhere the majority of the time.	High
Travis, S. A., Best, A. A., Bochniak, K. S., Dunteman, N.	Jun 23, 2021	Case report	Hope College Holland, Michigan, United States	Surveillance/testing plan:	Between Jul 29 – Nov 24, 2020, 10,700 tests were conducted among students and staff (2.2% positive test percentage):	Moderate

D., Fellinger, J., Folkert, P. D., … Schuitema, A. J. (2021). Providing a safe, in-person, residential college experience during the COVID-19 pandemic. *Frontiers in Public Health, 9*, 672344.			* * * Learning modality/on-campus living: • In-person learning • On-campus living (unknown %)	• Wastewater monitoring (residences) • Surveillance (asymptomatic; random and identified by wastewater monitoring) • Testing (symptomatic and on arrival, i.e., baseline) • Contact tracing (household and social close contacts only) • Screening Other IPAC measures: • Adapted instructional spaces • Isolation facilities Other components of approach: • Communication • Earlier class start, reduced break days for earlier class completion Mathematical modelling	• 38/3878 baseline tests (0.98% positivity rate*) • 57/5696 random and targeted asymptomatic tests (from wastewater identification) (1% positivity rate) • 124/960 symptomatic tests (12.9% positivity rate) • Additional subset testing (e.g., athletes) not reported here (*Compared to national (6.1%) and state (2.5%) positivity rates, at the time). Contact tracing identified 670 contacts (average 4-5 per positive case); 21 tested positive (SAR: 3.1%).	
Harmon, K.G., de St Maurice, A.M. Brady, A.C., Sankar, S., Douglas, F.A., Rueda, M.A., … Kliethermes, S.A. (2021). Surveillance testing for SARS-CoV-2 infection in an asymptomatic	Jun 18, 2021	Prevalence	High risk of transmission (HROT) university athletic programs 11/12 Pacific Coast Conference schools Pacific Coast, United States * * *	Surveillance/testing plan: • Antigen testing on days where high risk of transmission activities occurred (6/7 days) • Diagnostic testing (1 test/week paired with the daily antigen test) Other IPAC measures: • Quarantine / isolation • Contact tracing	From Sep 29, 2020 – Feb 28, 2021, 81,175 antigen and 42,187 RT-PCR tests were conducted among 1931 HROT college athletes. 346/1931 (17.95%) tested positive with RT-PCR: • Football 258/1306 (19.8%) • Women's basketball 16/147 (10.9%) • Men's basketball 32/176 (18.1%) • Women's water polo 6/112 (5.4%) • Men's water polo 13/100 (13.1%) • Wrestling 21/90 (23.3%) Results by reasons for testing were:	High

athlete population: A prospective cohort study with 123,362 tests and 23,463 paired RT-PCR/Antigen samples. *BMJ Open Sport & Exercise Medicine, 7*(2), e001137.			Learning modality/on-campus living: • Not reported		• Initial screening/re-entry after time away: 32/1526 (2.1%) • Contact tracing: 24/502 (4.8%) • Symptomatic: 74/405 (18.2%) • Surveillance: 172/39,293 (0.4%) Daily antigen testing produced similar results to RT-PCR 2-3x/week. Daily antigen testing did not increase sensitivity vs. RT-PCR 4x/week. 89/172 (52%) of surveillance cases were identified through antigen testing prior to RT-PCR, preventing an estimated 234 athlete days of infectiousness. Two football-related outbreaks at two schools occurred, resulting in 48/346(13.8%) of all athletic cases; 86% of cases were community-acquired. There was no transmission from one team to another team. Testing will not catch all cases before they are infectious and demonstrates the need for continued masking and social distancing when possible.	
Tian, D., Lin, Z., Kriner, E.M., Esneault, D.J., Tran, J., DeVoto, J.C., … Yin, X.M. (2021). Ct values do not predict Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) transmissibility	Jun 5, 2021	Cohort	Tulane University New Orleans, Louisiana * * * Learning modality/on-campus living: • On-campus living	Surveillance/testing plan: • Surveillance (2x/week) • Testing (RT-PCR) Other IPAC measures: • Quarantine for cases and contacts	From Sep 1 – Oct 31, 2020, 7,440 students were tested twice per week. There were 602 confirmed cases (8.1%) (262 symptomatic, 113 asymptomatic): • 195 index cases ○ 94/195 (48.2%) had ≥1 contact who tested positive ○ 101/195 (51.8%) had no positive contacts Those who tested positive were more likely to be younger (freshman and	Moderate

in college students. *The Journal of Molecular Diagnostics*. Epub ahead of print.					sophomore; data not provided) and male (10.65% vs. 6.56% female).	
Liu, C., Vyas, A., Castel, A.D., McDonnell, K.A., & Goldman, L.R. (2021). Implementing mandatory testing and a public health commitment to control COVID-19 on a college campus. *Preprint*.	Jun 3, 2021	Case report	George Washington University Washington, D.C., United States * * * Learning modality/on-campus living: • 4,435/25,000 (18%) students, faculty and staff on-campus • On-campus living; 500 students	Surveillance/testing plan: • Surveillance (weekly and symptomatic testing) • Testing (RT-PCR; anterior nasal swab) Other IPAC measures: • Contract between on-campus students and university to not gather in groups >10 • De-densification (class sizes and dorms) • Masks • Mandatory COVID-19 training and influenza vaccination for on-campus students, faculty and staff • Mass screening campaigns • Physical distancing • Quarantine policies for cases and close contacts and students returning to on-campus living • Temperature checks	From Aug 17 – Dec 4, 2020, 38,288 tests were conducted among students (21,573; 79.5%) and staff (16,713; 43.7%); 220 were positive: • 175/220 (79.5%) students • 45/220 (20.5%) staff Overall positivity rates for students (0.81%) and staff (0.27%) were much lower than the surrounding community positivity rates (not provided). Temporal clusters of positive cases mirrored community spread with increases after holiday gatherings.	Moderate ***PREPRINT***

Hamer, D. H., White, L. F., Jenkins, H. E., Gill, C. J., Landsberg, H. N., Klapperich, C., … Brown, R. A. (2021). Assessment of a COVID-19 control plan on an urban university campus during a second wave of the pandemic. *JAMA Network Open, 4*(6), e2116425.	Jun 1, 2021	Case report	Boston University (BU) • Large, urban campus • 40,000 students Boston, United States * * * Learning modality/on-campus living: • Hybrid learning • On-campus living (7131 students at 67% capacity)	Surveillance/testing plan: • Surveillance (asymptomatic) • Testing (symptomatic) • Contact tracing • Screening (daily self-report symptoms) Other IPAC measures: • De-densification (classrooms, common areas, residences) • Enhanced ventilation • Hand hygiene • Isolation facilities • Masks • Physical distancing Other components of approach: • Coordinated leadership and management structures • Communication • Mathematical modeling Multiple data systems / data-driven strategy refinements	From Aug – Dec 2020, 719/>500,000 COVID-19 tests at BU were positive • 496 students (69%) • 11 faculty (1.5%) • 212 staff (29.5%) Approximately 1.8% of the 40,000 BU community tested positive; 37.7% of total cases were asymptomatic. Test positivity rate for those with self-reported symptoms was higher (4.9%) than those who were asymptomatic (0.10%). Incidence rate was less than but followed trends in county. Contact tracing identified: • 86/837 positive contacts (10.3%) • 51.5% of total 719 cases had a known source (non-BU source, 55.7% of known exposures) • No classroom transmission Isolation facility occupancy peaked at 12.9%. Multi-pronged response (surveillance / testing, contact tracing, isolation) controlled campus spread.	Moderate

Wong, S.T., Romney, M., Matic, N., Haase, K., Ranger, M., Dhari, R., … Sin, D. (2021). Feasibility and utility of rapid antigen testing for COVID-19 in a university residence: A cross sectional study. *Preprint*.	May 26, 2021	Cross-sectional	University of British Columbia; Orchard Commons Dormitory Vancouver, British Columbia, Canada * * * Learning modality/on-campus living: • Blended learning • On-campus living (n=1500, unknown %)	Surveillance/testing plan: • Surveillance (random testing) • Testing (rapid antigen testing with immediate nasopharyngeal testing for positive tests) Typical testing timeline: • Rapid antigen test collection (any time throughout the day) • Result ≤ 60 minutes • Positive rapid test result triggers PCR test • Students self-isolate • PCR result (8-10 hrs)	From Feb – Apr 2021, 3536 tests were provided to 1141 students. 25 cases were confirmed (2.2%), all of whom were asymptomatic. Each index case resulted in ±7 secondary cases. Positive tests identified 6 clusters with 5-16 cases/cluster. These clusters were found among: • Students playing musical instruments • Varsity athletes • On-campus dormitories	Moderate ***PREPRINT***

Rennert, L., & McMahan, C. (2021). Risk of SARS-CoV-2 reinfection in a university student population. *Clinical Infectious Diseases*. Epub ahead of print.	May 16, 2021	Cohort	Clemson University
			
			South Carolina, United States
			
			* * *
			
			Learning modality/on-campus living:
			• Blended learning
			• On-campus living: 5,313 (% unknown)
				Testing/surveillance plan:
				• Surveillance (weekly testing for non-residential students; two weeks of daily testing for residential students followed by repeated weekly testing)
				• Testing (PCR testing; anterior nasal swabs or saliva tests)
				
				Other IPAC measures:
				• Negative test or positive serologic antibody test prior to return to campus (≤40 days)
					From Aug 19 – Oct 5, 2020, on-campus and residential students aged 17-24 years were tested for COVID-19. Of those testing positive:
					• On-campus; 2021/16 101 (12.55%) tested positive
					• Residential students; 682/4,829 (14.12%)
					
					Students were re-tested from Dec 28 – May 5, 2021. In comparison to infection rates in the Fall of 2020:
					• On-campus re-infection rate; 44/2021 (2.2%)
					  ○ RR=0.16 (95%CI=0.12. 0.22)
					• Residential students re-infection rate; 20/982 (2.9%)
					  ○ RR=0.23 (95%CI=0.15,0.37)
					
					Estimated protection from previous infection was 84% for on-campus and 77% for residential students.
						High

Liu, A.B., Davidi, D., Landsberg, H.E., Francesconi, M., Platt, J.T., Nguyen, G.T., … Springer, M. (2021). Seven-day COVID-19 quarantine may be too short: Assessing post-quarantine transmission risk in four university cohorts. *Preprint*.	May 15, 2021	Cohort	4 universities (Boston, Duke, Harvard, Northeastern) Northeast, United States * * * Learning modality/on-campus living: • In-person learning • On-campus living: n, % unknown	Testing/surveillance plan: • Surveillance (varied among universities; minimum was twice weekly testing for on-campus undergraduates • Testing (varied among universities; rapid antigen or PCR testing) Other IPAC measures not reported. Other considerations: • Non-strict quarantine included interactions with household members • Strict quarantine; single room, single washroom, meal delivery	From Sep – Feb 2021 3,641 students and staff identified as close contacts were quarantined, of which 418 (11.5%) eventually tested as seropositive. Conversion time was estimated to be 4 days in 78% of cases. 132 (10%) in strict quarantine converted and 286 (12%) in non-strict converted (10% vs. 12%, p=0.041). Overall 9% of conversions occurred after day 10. Significantly more conversions after day 10 occurred in those in non-strict quarantine than strict quarantine (11% vs 3%) p<0.01. Follow up data for those in non-strict quarantine who converted after day 10, found these individuals were re-exposed to a person with COVID-19 during quarantine. Strict quarantine was associated with shorter conversion times: 5.9%, 2.4% and <1% converted after days 7,10 and 14 respectively. Whereas for those in non-strict quarantine, 14%, 4.9% and 1.7% converted after days 7, 10 and 14.	Moderate ***PREPRINT***

Fox, M.D., Leiszler, M.S., Seamon, M.D., & Garmin, B.L. (2021). Results of a shortened quarantine protocol on a Midwestern college campus. *Clinical Infectious Diseases*, *73*(Suppl 1), S38-S41.	May 12, 2021	Case report	Midwestern University United States Learning modality/on-campus living: • On-campus living (% unknown)	Surveillance/testing plan: • Surveillance (on-campus daily dashboard; methods not reported) • Testing (RT-PCR. Rapid antigen) *A shortened quarantine protocol is the focus of this study A typical monitoring timeline for asymptomatic quarantined students: • Day 4: RT-PCR testing; results ≤36 hours. Positive cases no longer eligible for short quarantine • Day 7 rapid antigen testing; negative cases were released from quarantine • Day 8: follow-up phone call from staff to assess for subsequent symptoms or exposure to potential cases Other IPAC measures not reported.	From Sep 1 – Nov 11, 2020, 1310 close contact students participated in a shortened quarantine release protocol (QRP). By day 7 158 tested positive:143/1310 (10%) tested positive on day 4, and 15/1167 (1.3%) tested positive on day 7. 1152 students were released from quarantine on day 7 and an additional 74 (6.4%) subsequently tested positive: • 18 (24%) within 14 days ○ 9 on routine screening tests ○ (5 reported new exposure, 4 had no known exposure) ○ 9 sought testing for symptoms and/or exposure • 56 (76%) after 14 days • Of the 176 testing positive within 14 days of initiation of quarantine, 9 (5.1%) tested positive the week following release from quarantine without additional known exposure There is no evidence of additional transmission attributed to individuals released on day 7 (these individuals were not identified as probable source of exposure based on contact tracing interviews).	Low

Moreno, G. K., Braun, K. M., Pray, I. W., Segaloff, H. E., Lim, A., Poulson, K., … O'Connor, D. H. (2021). Severe acute respiratory syndrome coronavirus 2 transmission in intercollegiate athletics not fully mitigated with daily antigen testing. *Clinical Infectious Diseases, 73* (Suppl 1), S45-S53.	May 12, 2021	Case report	University athletics program (de-identified data) United States * * * Open/available: • Athletic programs: ○ Indoor meetings ○ Practices ○ Scrimmages ○ Intercollegiate competitions *Some sports were considered "high-risk" due to frequent contact / collision.	Surveillance/testing plan: • Antigen testing (daily) • Diagnostic testing (if positive antigen test) • Contact tracing (household and social close contacts only) Other IPAC measures: • Masks • Physical distancing • Program suspension • Quarantine / isolation	Outbreaks occurred affecting high-risk sport programs: Outbreak 1: • 32 cases (22 students, 10 staff) • Index case (antigen test negative) attended meeting infectious; IPAC measures were followed • 4 contacts developed symptomatic infection • Contact tracing identified: ○ 13 (40%) attended team meeting with a case ○ 6 (13%) were roommates ○ 8 (25%) no identified exposure • 24 of 26 (92%) sequences were closely related, suggesting a single viral introduction Outbreak 2: • 12 cases occurred among athletes during a two-team competition: ○ Sequences were closely related and unique from strains circulating in the community Antigen testing, as a sole surveillance measure, may not be sufficient to prevent outbreaks.	Moderate

Currie, D.W., Moreno, G.K., Delahoy, M.J., Pray, I.W., Jovaag, A., Braun, K.M., … Killerby, M.E. (2021). Description of a university COVID-19 outbreak and interventions to disrupt transmission, Wisconsin, August – October 2020. *Preprint*.	May 10, 2021	Case report	University of Wisconsin Madison, Wisconsin, United States Learning modality/on-campus living: • Blended learning (45,540 enrolled students 23,917 staff) • On-campus living (19 residence halls, n=26-1195)	Surveillance/testing plan: • Surveillance (testing prior to move-in; screening test every 2 weeks) • Testing (RT-PCR) Other IPAC measures: • Suspending in-person classes and other events (upon identified outbreak) • Additional mass testing • Quarantine facilities in local hotels • Isolation facilities in designated residence halls • Masks • Physical distancing • Screening	From Aug 1 – Oct 31, 2020, 3485/45,540 (7.7%) students and 245/23,917 (1%) staff had a confirmed positive test At baseline (move-in week), 34/6162 (0.6%) students in residence tested positive Over the course of the semester (Aug 25 – Oct 31, 2020) 856/6162 (13.9%) resident students tested positive (81.4% symptomatic, 18.6% asymptomatic) Clusters (not defined) were affiliated with residence halls (25.9%) and fraternities/sororities (13.2%). Remaining clusters were off-campus Attack rates in residence halls ranged from 1.9% - 31.9% (15: ≤10%; 2:10-20%; 2>20%) Two residences accounted for 586/856 (68.5%) cases representing 2119/6162 (34.4%) of all residence students Percent positivity was higher in those with a roommate compared to those without (15.4% vs. 7.3%), p<0.001 • 32/33 (97.0%) roommate pairs had identical consensus sequences compared to the 3.1% randomly assigned pairs (p<0.0001)	High ***PREPRINT***

Vusirikala, A., Whitaker, H., Jones, S., Tessier, E., Borrow, R., Linley, E., … Amirthalingam, G. (2021). Seroprevalence of SARS-CoV-2 antibodies in university students: Cross-sectional study, December 2020, England. *Journal of Infection, 83*(1), 104-111.	Apr 28, 2021	Cross-sectional	5 universities with COVID-19 outbreaks following Sep 2020 re-opening United Kingdom * * * Learning modality/on-campus living: • On-campus living (30% of participants)	Rapid serological evaluation (i.e., serosurveillance) to assess prior infection (captures asymptomatic, symptomatic, and mild transient infections) and provide estimate of spread of infection. IPAC measures not reported.	In Dec 2020, seroprevalence in 2905 students (aged ≤ 25) from universities that had experienced outbreaks was 17.8% (95% CI=16.5,19.3) (range across universities: 7.6 – 29.7%). This was higher than age-matched healthy community blood donors (13.7%, 95%CI=11.1,16.9) and across England (12.1%, 95%CI=11.6,12.7). 49% of students who lived in residences that had reported infection rates >8% were seropositive, suggesting widespread transmission in this setting. Seropositivity was associated with: • 1st year students (adjusted OR=3.16, 95%CI=2.02,4.93) • On-campus living (adjusted OR=2.14, 95%CI=1.7,2.68) • Shared kitchen with: ○ 4-7 people (adjusted OR=1.43, 95%CI=1.12,1.82) ○ 8+ people (adjusted OR=1.53, 95%CI=1.04,2.24) • Being symptomatic (adjusted OR=4.3, 95%CI=3.43,5.38) • Confirmed case within shared accommodation (adjusted OR=3.57, 95%CI=2.86,4.44) Sharing a bedroom (adjusted OR=0.73, 95%CI=0.45,1.19) or bathroom (adjusted OR=0.73, 95%CI=0.57,0.95) had lower odds.	Moderate

Schmitz, B.W., Innes, G.K., Prasek, S.M., Betancourt, W.Q., Stark, E.R., Foster, A.R., … Pepper, I.L. (2021). Enumerating asymptomatic COVID-19 cases and estimating SARS-CoV-2 fecal shedding rates via wastewater-based epidemiology. *Preprint*.	Apr 18, 2021	Prevalence	University of Arizona Tuscon, Arizona, United States * * * Learning modality/on-campus living: • On-campus living (3528 students at 82% capacity)	Surveillance/testing plan: • Surveillance (wastewater monitoring, 3x/week per residence) • Testing (positive detection of N1 and N2 gene regions resulting in RT-PCR testing for symptomatic and antigen testing for asymptomatic cases) *Wastewater surveillance is the focus of this study A typical monitoring timeline: • Collection (09:00 – 10:30) • Detection (11:00) • PCR/antigen testing for entire dormitory; shelter in place • Results; isolation for positive case only; not roommate Other IPAC measures: • De-densification (residences; 2/room) Isolation facilities for cases	From Aug 17 – Nov 17, 2020, 364 wastewater samples from 13 dormitories were processed (81 positive, 22.2%); 711 clinical cases were reported; 563 (79.2%) asymptomatic and 148 (20.8%) symptomatic. 68/81 (83.9%) of positive wastewater samples were associated with new reported cases of infection within a 6-day period.	High ***PREPRINT***
Gibas, C., Lambirth, K., Mittal, N., Juel, M. A. I., Barua, V. B., Brazell, L. R., … Munir, M. (2021).	Mar 30, 2021	Prevalence	University of North Carolina at Charlotte • Large, urban campus * * *	Surveillance/testing plan: • Surveillance (wastewater monitoring, 3x/week per residence)	From Sep 28 – Nov 23, 2020, 332 wastewater samples from 19 building sites were processed; 40 were positive (12.1%) and 15 were labeled as “suspicious” (i.e., probable positive).	Moderate

Implementing building-level SARS-CoV-2 wastewater surveillance on a university campus. *The Science of the Total Environment*, *782*, 146749.			Learning modality/on-campus living: • On-campus living (unknown %)	• Testing (symptomatic; athletes) • Contact tracing • Screening (daily symptom self-reporting) *Wastewater monitoring is the focus of this study. A typical monitoring timeline: • Collection • Detection • Testing, sheltering-in-place • Results, resolution Other IPAC measures: • De-densification (residences) • Isolation facilities	Over the study period, the number of positive samples gradually increased (as did the positivity rates in the surrounding county, Pearson correlation coefficient=0.769). Wastewater monitoring identified smaller clusters than were reported in other types of cluster events ($p<0.001$); able to detect asymptomatic individuals in residences of 150-200 students. Wastewater monitoring detected pre-symptomatic cases, corroborated contact tracing cases, and indicated when an outbreak had been contained.	

Rennert, L., McMahan, C., Kalbaugh, C.A., Yang, Y., Lumsden, B., Dean, D., … Colenda, C.C. (2021). Surveillance-based informative testing for detection and containment of SARS-CoV-2 outbreaks on a public university campus: An observational and modelling study. *The Lancet Child & Adolescent Health, 5*(6), 428–436.	Mar 19, 2021	Cohort	Clemson University • Large, rural campus Clemson, South Carolina, United States * * * Learning modality/on-campus living: • In-person learning • On-campus living	Surveillance/testing plan: • Daily surveillance based-informative testing (SBIT) followed by weekly targeted testing • SBIT included random tests, followed by targeted tests in residences or residence floors, if threshold for positive cases was identified from random samples Other IPAC measures: • Staggered residence arrival • In residence students must provide a negative COVID-19 test within 10 days of arrive and a negative test upon arrival • Restricted access • Quarantine/isolation	From Aug 19 – Sep 20, 2020 (pre-in-person learning) 326/6273 (5.2%) on-campus students tested positive. From Sept 21 – Nov 20, 2020, prevalence of COVID-19 in residence dropped from 8.7% (week 1) to 0.8% (week 9). The greatest decrease took place between weeks 1 (8.7%) and 3 (5.6%), weeks 5-8 were stable (1.4-1.2) to week 9 (0.8%). From Sep 23 – Oct 5, 2020, SBIT was implemented across 8 residence buildings and 45 residence halls: • Random tests (n=3420, 63.6%) identified 179/3420 (5.2% positivity rate) • Targeted tests (n=1959, 36.4%) identified 208/1959 (10.6%) ○ Outbreaks in 8 residence halls ○ 5/8 residence halls had a case positivity rate >10% ○ 13/45 residence hall floors with a positivity rate >10% ○ Targeted tests were 2.03 times more likely to detect a COVID-19 positive case (95%CI= 1.67-2.47) Random surveillance testing alone would have resulted in 24% more infections throughout the semester. Voluntary testing alone would have resulted in 154% more infections throughout the semester. Weekly testing would have resulted in 36% fewer infections, and twice weekly testing would have resulted in 72% fewer infections. However, weekly testing would have required two times the number of	Moderate

					daily tests, and twice weekly would have required four time the number of daily tests compared to SBIT.	
Weil, A. A., Sohlberg, S. L., O'Hanlon, J. A., Casto, A. M., Emanuels, A. W., Lo, N. K., … Chu, H. Y. (2021). SARS CoV-2 epidemiology on a public university campus in Washington State. *Preprint.*	Mar 17, 2021	Cohort	Large, urban public university • 60,000 students • 30,000 staff Seattle, Washington, United States * * * Learning modality/on-campus living: • Hybrid learning • On-campus living (unknown %)	Surveillance/testing plan: • Testing (symptomatic, exposure) • Screening (daily self-report symptoms) • Contact tracing Other IPAC measures: • De-densification (on-campus living) • Enhanced cleaning and disinfection • Hand hygiene • Isolation facilities • Masks • Physical distancing	From Sep 24 – Dec 18, 2020, 29,783 tests were performed on 11,644 individuals; 265 tested positive (0.80%). • Fraternities/sororities (1.5%; 1,796/12,045) • Students living on-campus (1.2%; 43/3,507) • Staff / faculty (0.4%; 23/5,884) Among the 265 positive cases, 60.8% were symptomatic, 19.6% pre-symptomatic, 3.4% asymptomatic, and 16.2% possible asymptomatic. 34.7% reported exposures and 21.5% reported high-risk behaviours. Risk factors for testing positive: • Fraternity/sorority affiliation (OR=2.71, 95%CI=1.84,4.00) • Latinx/Hispanic ethnicity (OR=2.12, 95%CI=1.28,2.18) • Self-reported symptoms (OR=1.86, 95%CI=1.43,2.41) 88.1% of viral genomes sequenced from fraternity/sorority-affiliated students were genetically identical, vs. 37.9% of genomes from non-fraternity/sorority students. Transmission was thought to have then occurred within outbreaks (i.e., within groups), with no evidence of further spread.	Moderate ***PREPRINT***

Betancourt, W. Q., Schmitz, B. W., Innes, G. K., Prasek, S. M., Pogreba Brown, K. M., … Pepper, I. L. (2021). COVID-19 containment on a college campus via wastewater-based epidemiology, targeted clinical testing and an intervention. *Science of the Total Environment, 779,* 146408.	Mar 13, 2021	Case report	University of Arizona Arizona, United States * * * Learning modality/on-campus living: • In-person learning (limited) • On-campus living (unknown %)	Surveillance/testing plan: • Wastewater monitoring (residences) • Testing (upon arrival, symptomatic, or if identified through wastewater) • Contact tracing Other IPAC measures: • Isolation data platforms and communication • Isolation facilities • Shelter-in-place policy	Between Aug – Nov 2020: • 91/111 (82.0% positive predictive value) positive wastewater samples lead to targeted identification of at least one positive case • 185/208 (88.9% negative predictive value) negative wastewater samples concurred with no positive tests • 43/319 total wastewater samples were discordant with clinical testing (suggesting samples not provided during testing or non-residents using washrooms) From Sep 15 – 29, 2020, students remained on campus, but a shelter-in place policy was implemented, due to increasing cases, resulting in a decrease of new cases and virus detections in wastewater. Cases remained low (often zero) thereafter.	Moderate

Ryan, B. J., Muehlenbein, M. P., Allen, J., Been, J., Boyd, K., Brickhouse, M., … Brickhouse, N. (2021). Sustaining university operations during the COVID-19 pandemic. *Disaster Medicine and Public Health Preparedness.* Epub ahead of print.	Mar 8, 2021	Case report	Baylor University • 19,297 students (14,399 undergrad, 4898 grad) • ~3400 staff Waco, Texas, United States • Population: 256,600 * * * Learning modality/on-campus living: • Hybrid learning (25% of classes) • In-person learning (39% of classes) • Online learning (36% of classes) • On-campus living (4,736 students)	Surveillance/testing plan: • Surveillance (asymptomatic; random, surge (i.e., increased temporary testing capacity with government-provided tests), targeted) • Wastewater monitoring (on-campus living, isolation facilities) • Testing (symptomatic, exposed) • Contact tracing • Screening Other IPAC measures: • Compliance monitoring • De-densification (athletics crowd capacities) • Enhanced cleaning and disinfecting • Isolation facilities • Limited non-university events • Masks • Physical distancing Other components of approach: • Communication • In-house dashboard • Multisectoral systems approach • Population-based management • "Swiss Cheese" risk mitigation model	From Aug 1 – Dec 8, 2020, 1435/62,970 individuals tested positive (2.28% positivity rate) and 235 self-reported (total 1670 cases): • 1416 students • 140 staff/faculty • 90 athletes • 22 contractors • 2 others Testing completed: • Pre-arrival (135/13,621; 0.99%) • Clinic (i.e., symptomatic/exposed) (798/11,188; 7.13%) • Surveillance (360/21,435; 1.68%) • Surge (29/4362; 0.66%) • Athletics (91/8901; 1.02%) • Contractor (22/3463; 0.64%) 246 positive students used isolation facilities (peaked at 30% of capacity). All staff cases and 76% of student cases were from off-campus sources.	Moderate

Gibson, G., Weitz, J. S., Shannon, M. P., Holton, B., Bryksin, A., Liu, B., … García, A. J. (2021). Surveillance-to-diagnostic testing program for asymptomatic SARS-CoV-2 infections on a large, urban campus - Georgia Institute of Technology, Fall 2020. *Preprint.*	Jan 31, 2021	Case report	Georgia Institute of Technology Georgia, United States * * * Learning modality/on-campus living: • On-campus living (7370 students) • On-campus visiting, 5000/day; staff, non-resident students • Online learning	Surveillance/testing plan: • Surveillance • Testing (focused case cluster) • Contact tracing Other IPAC measures: • Isolation facilities • Masks • Physical distancing	In Fall 2020, 1508/18,029 individuals providing 112,500 saliva samples tested positive (8.4% cumulative positive): • Students: 1351 (90%); 9.7% cumulative positive • Staff: 157 (10%); 3.8% cumulative positive Targeted testing after two outbreaks (Aug return to campus, Oct high community levels) steadily reduced peak asymptomatic positivity rates from 2-4% to <0.5%. Students in shared double rooms had higher positivity risk (30% of double roommates tested positive; half of cases in Aug-Sep were in doubles).	Moderate ***PREPRINT***

Fox, M.D., Bailey, D.C., Seamon, M.D., & Miranda, M.L. (2021). Response to a COVID-19 outbreak on a university campus - Indiana, August 2020. *Morbidity and Mortality Weekly Report, 70*(4), 118-122.	Jan 29, 2021	Case report	Indiana University
			• 12,000 students (8000 undergrad)
			• Medium-sized
			
			Indiana, United States
			
			* * *
			
			Learning modality/on-campus living:
			• In-person learning
			• On-campus living (85% of undergrad)
				Surveillance/testing plan:
				• Testing (symptomatic, athletes)
				• Contact tracing
				
				Other IPAC measures:
				• De-densification (classrooms, common areas)
				• Education
				• Enhanced cleaning and disinfection
				• Isolation facilities
				• Masks
				• Physical distancing (6 feet)
				
				Other components of approach:
				• Communication
				• Enhanced data systems
				• Outbreak control measures:
				  ○ Switch to online learning
				  ○ Restricting on-campus access
				  ○ Additional testing, tracing, IPAC
					Baseline student testing prior to semester start:
					• 11,836 tested; 33 (0.28%) positive
					
					From Aug 3-15, 2020:
					• 56 tested positive (4.3 cases per day, 11.7% of all tests performed)
					• 90% of cases were symptomatic
					
					From Aug 16-22 an outbreak occurred:
					• 371 confirmed cases (26.5 per day, 15.3% of all tests performed)
					  ○ 355 (96%) undergrad
					  ○ 13 (3%) grad students
					  ○ 1 faculty and 2 staff
					• 62% of undergrad cases lived off-campus
						Moderate

O'Donnell, C., Brownlee, K., Martin, E., Suyama, J., Albert, S., Anderson, S., … Williams, J. (2021). SARS-CoV-2 control on a large urban college campus without mass testing. *Preprint.*	Jan 25, 2021	Prevalence	University of Pittsburgh • Large, urban campus • 28,234 students • 13,264 staff Pittsburgh, United States • 1.2 million in neighbourhood * * * Learning modality/on-campus living: • Hybrid learning • In-person final exams • On-campus living (6300 students) • Organized student activities	Targeted plan: • Mitigation (with emphasis on student commitment) • Communication • Containment ○ Testing (symptomatic; focused cluster) ○ Surveillance (asymptomatic, random) ○ Contact tracing ○ Isolation Other IPAC measures: • De-densification (residences) • Enhanced cleaning • Enhanced ventilation • Hand hygiene • Isolation facilities • Masks • Physical distancing • PPE • Staggered re-entry with shelter-in-place requirements	In Fall 2020, 445/11,505 students tested positive (3.9%, 95%CI=3.5,4.2): • 383/3102 symptomatic students (12.3%, 95%CI=11.2,13.6) • 31/7389 asymptomatic students (0.42%, 95%CI=0.29,0.59); slight increase during arrival, remained low throughout semester • 15/228 close contacts (0.31%, 95%CI=0.11,0.68) • 16/786 focused testing (e.g., cluster) (0.46%, 95%CI=0.30,0.68) During 2 case surges in the community, campus count also increased but 5-day rolling average did not exceed 20 cases/day. Use of isolation facilities peaked at 33.6% occupancy (97/289 beds). Bathroom type (communal vs. private) had no impact on infection incidence; no classroom transmission. Clusters occurred in association with unsafe gatherings or within shared residences not observing IPAC measures (e.g., behaviours greater risk than physical arrangements).	Moderate ***PREPRINT***

Stubbs, C.W., Springer, M., & Thomas, T.S. (2020). The impacts of testing cadence, mode of instruction, and student density on Fall 2020 COVID-19 rates on campus. *Preprint.*	Dec 9, 2020	Cohort	9 colleges / universities (Boston-area), 4 comparison schools • Small, large; rural, urban United States * * * Learning modality/on-campus living: • Hybrid learning • Online learning • % On-campus living unknown	Surveillance/testing plan: • Weekly high-cadence PCR testing of all students living on-campus (asymptomatic and/or symptomatic) • Isolation • Contact tracing Other specific IPAC measures not described.	From Aug 15 – Nov 22, 2020, estimated COVID-19 prevalence in Boston-area schools, based on publicly available data, was 16 ± 3 new cases/100,000 person-days; the mean case rate for the surrounding county was 10.8/100,000. There was no correlation between positive cases and total number of students living on-campus or dormitory occupancy density. There was no significant impact of mode of instruction (online, hybrid) on cumulative infection rate. Testing more frequently (e.g., 2-3x/week vs. 1x/week) was correlated with lower infection rates (p=0.017).	Low ***PREPRINT***

Denny, T. N., Andrews, L., Bonsignori, M., Cavanaugh, K., Datto, M. B., Beckard, A., … Wolfe, C. R. (2020). Implementation of a pooled surveillance testing program for asymptomatic SARS-CoV-2 infections on a college campus-Duke University, Durham, North Carolina, August 2-October 11, 2020. *Morbidity and Mortality Weekly Report, 69*(46), 1743-1747.	Nov 20, 2020	Cohort	Duke University
			
			Durham, North Carolina, United States
			
			* * *
			
			Learning modality/on-campus living:
			• Hybrid learning
			• On-campus living (unknown %)
			  ○ Quarantine before arrival
			  ○ Staggered arrivals
				Surveillance/testing plan:
				• Testing (symptomatic, entry)
				• Surveillance (asymptomatic; pooled testing; 1-2x/week, focus on cohorts where data suggested an increased risk for transmission)
				• Contact tracing
				• Screening (daily symptom self-monitoring (smartphone app; results linked to testing))
				
				Other IPAC measures:
				• De-densification (residences, all single; classrooms, common areas)
				• Hand hygiene
				• Masks
				• Physical distancing
				• Quarantine policy
				
				*Students signed formal agreement to follow IPAC measures; testing was mandatory (could lose access to campus facilities / services).
					From Aug 2 – Oct 11, 2020, 68,913 tests from 10,265 students identified 84 positive cases:
					• 17 (20.2%) upon entry (8873 tests)
					• 29 (34.5%) pooled (59,476 tests)
					• 15 (17.9%) symptomatic (185 tests)
					• 23 (27.4%) close contacts (379 tests)
					
					51% of positive cases were asymptomatic.
					
					Weekly per-capita infection incidence averaged 0.08% (vs. 0.1% in the county, at the time).
					
					Asymptomatic and testing of close contacts accounted for 73% of identified positive COVID-19 cases.
					
					Student compliance for testing was 95%.
					
					No classroom transmission; no substantial outbreaks.
						Moderate

Table 2: In-progress Single Studies

Title	Anticipated Release Date	Setting	Description of Document
Previously reported evidence			
Fretheim, A., Flatø, M., Helleve, A., Helseth, S., Jamtvedt, G., Løyland, B., … Walte, S.S. V. (2020). Relationship between in-person instruction and COVID-19 incidence among university students: A prospective cohort study. *Preprint.*	Aug 31, 2021	Universities and university-colleges in Norway	This study will explore whether on campus learning, with infection control measures in place, is associated with higher COVID-19 incidence than online instruction.

Table 3: Modelling Studies

Reference	Date Released	Model Type	Model Assumptions	Summary	Limitations	Quality Rating
Previously reported evidence						
Syntheses						
Christensen, H., Turner, K., Trickey, A., Booton, R.D., Hemani, G., Nixon, E., … Brooks-Pollock, E. (2020). COVID-19 transmission in a university setting: A rapid review of modelling studies. *Preprint.*	Sep 9, 2020	5 included modelling studies: • 4 compartmental • 1 ABM	N/A; assumptions vary among models considered	Rapid review authors suggest effective outbreak control requires: • Rapid testing of symptomatic individuals • Screening of asymptomatic individuals • Rapid contact tracing • Support for students to adhere to isolation and quarantine • Other established mitigation measures, e.g., hand hygiene, physical distancing	Included studies completed prior to vaccine availability.	Low ***PREPRINT***
Modelling Studies exploring Testing Strategies						
Hambridge, H.L., Kahn, R., & Onnela, J.-P. (2021). Examining SARS-COV-2 interventions in residential colleges using an empirical network. *Preprint.*	Apr 10, 2021	Compartmental SEIR separating symptomatic and asymptomatic individuals	• Empirical network based on pre-pandemic Bluetooth signal data from 692 Danish students • Baseline exposure rate 0.002/day • 50% infections asymptomatic • No longer infectious after 7 days if asymptomatic and 12 days if symptomatic • Zero mortality • Mask wearing reduced transmission probability 15% • Distancing reduced transmission probability by 18%	Testing every 3 days can reduce percentage of infected individuals during an outbreak event from 25% to 10% when mask-wearing and distancing are not widely implemented. Mask wearing and distancing can reduce percentage of infected individuals during an outbreak event from 25% to 10% without testing. Combining frequent testing with mask wearing and distancing has largest effect on percentage of infected individuals reducing percentage to 5%.	Assumption that asymptomatic and symptomatic infections are equally likely is not consistent with other evidence.	Moderate ***PREPRINT***

Lopman, B., Liu, C. Y., Le Guillou, A., Handel, A., Lash, T. L., Isakov, A. P., & Jenness, S. M. (2021). A modeling study to inform screening and testing interventions for the control of SARS-CoV-2 on university campuses. *Scientific Reports*, *11*(1), 5900.	Mar 15, 2021	Compartmental SEIR separating students and staff/faculty	• 15,000 students and 15,000 staff/faculty • Off campus students at greater risk of acquiring infection in community • 65% student cases and 49% staff/faculty cases asymptomatic • Public health measures, e.g., mask wearing, distancing, reduced transmission probability by 35%	Limiting transmission during an outbreak requires effective quarantine and contact tracing. Monthly screening of students reduced number of infections by 59%, while weekly screening of students reduced number of infections by 87%.	Model uses relatively small population of students and staff/faculty.	Moderate

Rogers, W., Ruiz-Aravena, M., Hansen, D., Madden, W., Kessler, M., Fields, M.W., … Plowright, R.K. (2021). High-frequency screening combined with diagnostic testing for control of SARS-CoV-2 in high-density settings: An economic evaluation of resources allocation for public health benefit. *Preprint.*	Mar 9, 2021	Compartmental SEIR with stochastic transition rates	• 20,000 students on campus for 15-week term • Screening with rapid tests • Diagnostic testing with rapid and standard tests • Any positive rapid tests confirmed with standard tests	4 screening strategies were modelled: 1. Screening only symptomatic 2. Screening asymptomatic and symptomatic, but only during the first 30 days of the term 3. "Front-loaded" screening where the same number of screens were performed in the first 30 days as in the last 120 days 4. Uniform screening throughout the term Screening frequency had largest effect on outbreak size, compared to test sensitivity, compliance, contact tracing capacity, and test return time. Testing only symptomatic individuals resulted in largest outbreaks. The cost of increased screening frequency is initially higher, however a daily screening rate of >10% throughout the semester maintains a low number of infections and the resulting cost of the testing program is lower than the cost of a testing program without rapid screening.	The effect of increasing vaccine coverage in the population on rapid test sensitivity was not considered (vaccination is thought to increase the likelihood of an asymptomatic infection, if an infection occurs, which may impact rapid test sensitivity)". It's not that "Rapid test sensitivity for asymptomatic or pre-symptomatic infections was not considered" at all, it's that the proportions of asymptomatic, pre-symptomatic, and symptomatic infections in an unvaccinated population are relatively fixed, and that gets embedded into test sensitivity estimates, but increasing vaccine coverage could change these proportions, which could then change rapid test sensitivity.	High ***PREPRINT***

Rennert, L., Kalbaugh, C.A., Shi, L., & McMahan, C. (2020). Modelling the impact of presemester testing on COVID-19 outbreaks in university campuses. *BMJ Open*, *10*(12), e042578.	Dec 15, 2020	SEIR	• 17,500 students on campus, 7500 students off campus • Initial infection rate 2% • 10% students infected and recovered prior to attendance • 50% infections asymptomatic; only 2/3 symptomatic cases detected	Mandated testing 7-days prior to attendance delayed the peak number of infections and reduced the peak number of infections by 1.5% when public health measures are not implemented and 7.8% when public health measures are implemented.	Effect of public health measures were included in modelling but not described. Transmission amongst staff/faculty and between students and staff/faculty not considered. Vaccine coverage was not considered.	Low-Moderate
Rennert, L., Kalbaugh, C.A., McMahan, C., Shi, L., & Colenda, C. C. (2020). The urgent need for phased university reopenings to mitigate the spread of COVID-19 and conserve institutional resources: A modeling study. *Preprint.*	Aug 31, 2020	SEIR	• 17,500 students on campus, 7500 students off campus • Initial infection rate 2% • 10% students infected and recovered prior to attendance • 50% infections asymptomatic; only 2/3 symptomatic cases detected	A 3-phase reopening where 1/3 of the student population arrives on campus 1-month apart was compared to non-phased re-opening. Phased reopening reduced the peak number of infections by 18% when public health measures are implemented.	Effect of public health measures were included in modelling but not described. Transmission amongst staff/faculty and between students and staff/faculty not considered.	Low-Moderate ***PREPRINT***

Modelling Studies exploring On-Campus Pedestrian Traffic and Crowding						
Johnson, S. S., Jackson, K. C., Mietchen, M. S., Sbai, S., Schwartz, E. J., & Lofgren, E. T. (2020). Excess risk of COVID-19 to university populations resulting from in-person sporting events. *International Journal of Environmental Research and Public Health, 18*(16), 8260.	Aug 4, 2021	SEIAR and ST	• Students have equal chance of exposure to visitors during sporting events • 10,000 visitors during 6 scheduled 2-day sporting events • Size of student population not specified •	On-campus sporting events where visitors mixed lightly with the campus community results in a 25% increase in cases on campus. On-campus sporting events where visitors mixed heavily with the campus community resulted in an 822% increase in cases on campus. When transmission rates in community are high, median number of infections following an event was approximately 1.5 times higher than when community transmission rates are low.	Partial vs. full capacity of events was not considered.	Low
Yeo, S. C., Lai, C., Tan, J., & Gooley, J. J. (2021). A targeted e-learning approach for keeping universities open during the COVID-19 pandemic while reducing student physical interactions. *PLoS One*, *16*(4), e0249839.	Apr 8, 2021	Natural experiment	• Empirical network based on WiFi data on campus with 24,000 students during pandemic • Cluster of students defined as >25 students connected to single WiFi access point • Potential for transmission driven by mixing of students	In-class learning accounted for 91% of the variance in the daily number of students on-campus; 9% accounted for variance due to other on-campus activities. Implementation of remote learning reduced spatiotemporal overlap of students and duration of student clustering.	Individuals not connected to local WiFi are not captured in network. Locations of each WiFi access point not determined. No confirmed cases of COVID-19 during study period to validate model.	Moderate
Ambatipudi, M., Gonzalez, P. C., Tasnim, K., Daigle, J. T., Kulyk, T., Jeffreys, N., … Koh, E. (2021). Risk quantification for SARS-CoV-2 infection through airborne transmission in	Apr 6, 2021	Quantitative model of infection probability	• Maximum risk of infection 1% • Cases exhale 35-70 viral particles/minute • Adherence to masking except while eating in dining hall or alone in dormitory room	Probability of infection increases as number of students on campus increases. Probability of infection decreases as indoor air exchange rate increases, and as face mask efficiency (e.g., N95 vs. surgical mask) increases.	Non-adherence or partial adherence to public health measures, e.g., masking, distancing, not considered. Size of classrooms and	Moderate ***PREPRINT***

university settings. *Preprint.*			• Adherence to physical distancing • No virus particles linger in classroom air between classes		feasibility of distancing not considered. Shared dormitory rooms not considered, especially if one roommate is infected.	
Das Swain, V., Xie, J., Madan, M., Sargolzaei, S., Cai, J., De Choudhury, M., ... Prakash, B. A. (2021). WiFi mobility models for COVID-19 enable less burdensome and more localized interventions for university campuses. *Preprint.*	Mar 24, 2021	ABM	• Empirical network based on pre-pandemic WiFi data from Georgia Institute of Technology campus with 25,000 students and 7600 staff/faculty. • Mobility behaviour, movement equal for all individuals	WiFi-based analysis of mobility used to develop contact networks allowed for localized closures (e.g., buildings) rather than campus-wide closures. Localized closures based on WiFi mobility data had equal reduction in transmission as campus-wide closure.	Individuals not connected to local WiFi are not captured in network. Individual mobility patterns not considered.	Moderate ***PREPRINT***
D'Orazio, M., Bernardini, G., & Quagliarini, E. (2021). A probabilistic model to evaluate the effectiveness of main solutions to COVID-19 spreading in university buildings according to proximity and time-based consolidated criteria. *Building Simulation, 27,* 1-15.	Feb 27, 2021	ABM	• 5000 students and staff/faculty • Probably of infection increases with proximity and exposure time • Some asymptomatic infections	Multiple mitigation strategies, e.g., masking, limiting population density, must be combined to limit transmission to <25% of the population during an outbreak.	Transmission amongst staff/faculty and between students and staff/faculty not considered.	Moderate

Borowiak, M., Ning, F., Pei, J., Zhao, S., Tung, H. R., & Durrett, R. (2020). Controlling the spread of COVID-19 on college campuses. *Mathematical Biosciences and Engineering, 18*(1), 551–563.	Dec 14, 2020	Reed-Frost	• All rooms and residences of equal size • Individuals attend 3 classes each with between 10 and 120 classmates	Probability of outbreak is lower when students reside in single-occupancy dormitory rooms instead of double-occupancy dormitory rooms. Outbreak incidence and size can be limited if maximum class size is limited.	Reed-Frost assumptions based on household vs. community contacts and may not accurately represent contacts on campuses.	Low
Romero, V., Stone W. D., & Ford, J. D. (2020). COVID-19 indoor exposure levels: An analysis of foot traffic scenarios within an academic building. *Transportation Research Interdisciplinary Perspectives, 7*, 100185.	Aug 6, 2020	Simple Case Model	• Probably of infection increases with proximity and exposure time • Adherence to masking • Adherence to distancing	This model compares 1-way and 2-way pedestrian traffic within buildings. Minimizing the time spent travelling within buildings had a greater impact on reducing transmission risk than adopting a 1-way traffic flow pattern.	Only linear travel considered. Spacing between individuals traveling in same direction not considered.	Low
Modelling Studies exploring Other Factors related to On-Campus Transmission of COVID-19						
Jarvis, K. F., & Kelley, J. B. (2021). Temporal dynamics of viral load and false negative rate influence the levels of testing necessary to combat COVID-19 spread. *Scientific Reports*, *11*(1), 9221.	Apr 28, 2021	Stochastic ABM	• Likelihood of transmission proportional to viral load • Likelihood of accurate detection of infection proportional to viral load • No longer infectious after 14 days if asymptomatic	This model explores how viral load could affect transmission and accurate detection of infection. False negatives may occur during early infection when viral load is low.	Possible contradiction in assumptions where likelihood of transmission and detection of virus are both proportional to viral load, that there can be cases of increased transmission when the viral load is so small as to be undetected by PCR.	High

Linka, K., Peirlinck, M., Schäfer, A., Tikenogullari, O. Z., Goriely, A., & Kuhl, E. (2021). Effects of B.1.1.7 and B.1.351 on COVID-19 dynamics. A campus reopening study. *Preprint.*	Apr 27, 2021	Network SEIR with Bayesian inference	• 6500 students on campus • B.1.1.7 variant 56% more transmissible • B.1.351 variant 50% more transmissible	This model explores effects of introducing variants of concern during campus reopening. Introduction of new variants of concern results in a much steeper infection rate curve, peaking at much higher total numbers of infections, between 15 and 57 times greater depending on the semester or variant.	Public health measures, e.g., masking, distancing, not considered.	Moderate ***PREPRINT***

ABM: Agent-based model

SEIR: Susceptible-Exposed-Infectious-Removed

SEIAR: Susceptible-exposed-infected-asymptomatically infected-removed

ST: Susceptible/Transmitting

References

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