

Prevention and Control of the Spread of Pathogens in a University of Naples Engineering Classroom through CFD Simulations

Maria Portarapillo *, Salvatore Simioli, Almerinda Di Benedetto

Department of Chemical, Materials and Production Engineering, University of Naples Federico II Naples,
80125 Naples, Italy

*Corresponding author, e-mail: maria.portarapillo@unina.it

Grid independence test

To demonstrate the reliability of the results, four meshes of different resolutions were built. In particular, CO₂ concentration expressed in ppm was evaluated along a cut line positioned 1.63 m above the ground and with an overall length of 1 m (**Figure S1**).

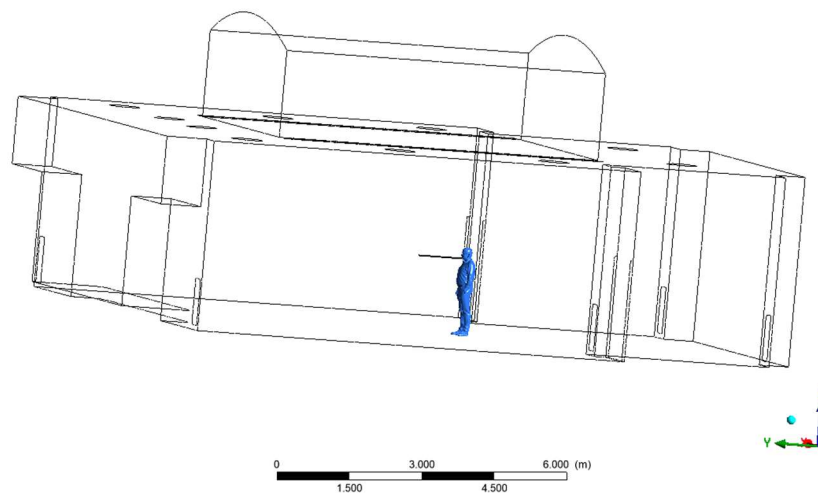


Figure S1. Graphical representation made with Ansys 2021R2 of the cut line positioned at the height of the breathing plane of the infected individual.

Figure S2 shows a comparative representation of the four meshes in which the variation in CO₂ concentration (ppm) can be analyzed as a function of distance in meters. Taking into account a

maximum relative error of 4% compared to the denser mesh, the sparse mesh was used for all the following calculations.

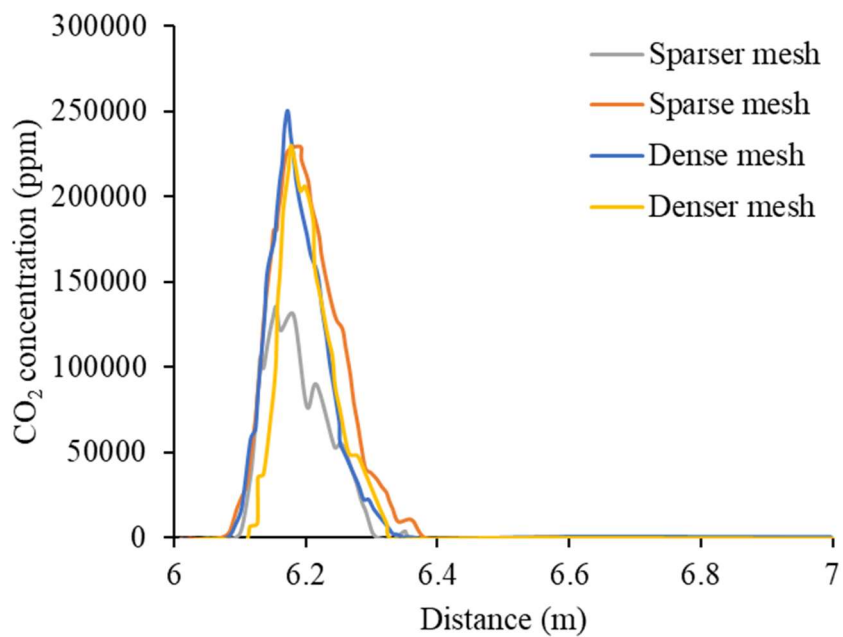


Figure S2. Graphical representation made with Ansys 2021R2 of the cut line positioned at the height of the breathing plane of the infected individual.

Table S1. Probability calculation performed for Case 1 at an interval of 30 minutes in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	600	100	13.9%	10%	3.7%
b	750	80	17.1%	12.3%	4.6%
c	950	63	21.1%	15.3%	5.8%
d	300	200	7.2%	5.1%	1.9%
e	50	1200	1.2%	0.9%	0.3%
f	300	200	7.2%	5.1%	1.9%
g	750	80	17.1%	12.3%	4.6%
h	300	200	7.2%	5.1%	1.9%
i	600	100	13.9%	10.0%	3.7%

Table S2. Probability calculation performed for Case 1 at an interval of 1 hour in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	600	100	25.9%	18.9%	7.2%
b	750	80	31.3%	23.1%	8.9%
c	950	63	37.8%	28.3%	11.2%
d	300	200	13.9%	10.0%	3.7%
e	50	1200	2.5%	1.7%	0.6%
f	300	200	13.9%	10.0%	3.7%
g	600	100	25.9%	18.9%	7.2%
h	300	200	13.9%	10.0%	3.7%
i	600	100	25.9%	18.9%	7.2%

Table S3. Probability calculation was performed for Case 1 at an interval of 2 hours in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with a surgical mask	Probability with FFP2 mask
a	950	63	61.3%	48.6%	21.1%
b	950	63	61.3%	48.6%	21.1%
c	950	63	61.3%	48.6%	21.1%
d	700	86	50.3%	38.7%	16.1%
e	150	400	13.9%	10.0%	3.7%
f	600	100	45.1%	34.3%	13.9%
g	800	75	55.1%	42.9%	18.1%
h	300	200	25.9%	18.9%	7.2%
i	700	86	50.3%	38.7%	16.1%

Table S4. Probability calculation performed for Case 2 at an interval of 30 minutes in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	2000	30	39.3%	29.5%	11.8%
b	2000	30	39.3%	29.5%	11.8%
c	2000	30	39.3%	29.5%	11.8%
d	2000	30	39.3%	29.5%	11.8%
e	1800	33	36.2%	27.0%	10.6%
f	1900	32	37.8%	28.3%	11.2%
g	1900	32	37.8%	28.3%	11.2%
h	1800	33	36.2%	27.0%	10.6%
i	1800	33	36.2%	27.0%	10.6%

Table S5. Probability calculation performed for Case 2 at an interval of 1 hour in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	4000	15	86.5%	75.3%	39.3%
b	4000	15	86.5%	75.3%	39.3%
c	4000	15	86.5%	75.3%	39.3%
d	3000	20	77.7%	65.0%	31.3%
e	3000	20	77.7%	65.0%	31.3%
f	3800	16	85.0%	73.6%	37.8%
g	4000	15	86.5%	75.3%	39.3%

h	3000	20	77.7%	65.0%	31.3%
i	3000	20	77.7%	65.0%	31.3%

Table S6. Probability calculation performed for Case 2 at an interval of 2 hours in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	120	9	99.9%	98.9%	80.3%
b	120	9	99.9%	98.9%	80.3%
c	120	9	99.9%	98.9%	80.3%
d	120	9	99.8%	98.9%	79.8%
e	120	10	99.8%	98.5%	77.7%
f	120	9	99.8%	98.9%	79.8%
g	120	9	99.8%	98.9%	79.8%
h	120	9	99.8%	98.9%	79.8%
i	120	9	99.8%	98.9%	79.8%

Table S7. Probability calculation performed for Case 3 at an interval of 30 minutes in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	950	63	21.1%	15.3%	5.8%
b	950	63	21.1%	15.3%	5.8%
c	950	63	21.1%	15.3%	5.8%
d	850	71	19.1%	13.8%	5.2%
e	50	1200	1.2%	0.9%	0.3%
f	300	200	7.2%	5.1%	1.9%
g	600	100	13.9%	10.0%	3.7%
h	300	200	7.2%	5.1%	1.9%
i	300	200	7.2%	5.1%	1.9%

Table S8. Probability calculation performed for Case 3 at an interval of 1 hour in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	950	63	37.8%	28.3%	11.2%
b	950	63	37.8%	28.3%	11.2%
c	950	63	37.8%	28.3%	11.2%
d	150	400	7.2%	5.1%	1.9%

e	50	1200	2.5%	1.7%	0.6%
f	600	100	25.9%	18.9%	7.2%
g	600	100	25.9%	18.9%	7.2%
h	150	400	7.2%	5.1%	1.9%
i	300	200	13.9%	10.0%	3.7%

Table S9. Probability calculation performed for Case 3 at an interval of 2 hours in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	950	63	61.3%	48.6%	21.1%
b	950	63	61.3%	48.6%	21.1%
c	950	63	61.3%	48.6%	21.1%
d	150	400	13.9%	10.0%	3.7%
e	50	1200	4.9%	3.4%	1.2%
f	700	86	50.3%	38.7%	16.1%
g	700	86	50.3%	38.7%	16.1%
h	150	400	13.9%	10.0%	3.7%
i	300	200	25.9%	18.9%	7.2%

Table S10. Probability calculation performed for Case 4 at an interval of 30 minutes in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	950	63	21.1%	15.3%	5.8%
b	950	63	21.1%	15.3%	5.8%
c	950	63	21.1%	15.3%	5.8%
d	150	400	3.7%	2.6%	0.9%
e	50	1200	1.2%	0.9%	0.3%
f	500	120	11.8%	8.4%	3.1%
g	150	400	3.7%	2.6%	0.9%
h	50	1200	1.2%	0.9%	0.3%
i	200	300	4.9%	3.4%	1.2%

Table S11. Probability calculation performed for Case 4 at an interval of 1 hour in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	950	63	37.8%	28.3%	11.2%
b	950	63	37.8%	28.3%	11.2%

c	950	63	37.8%	28.3%	11.2%
d	300	200	13.9%	10.0%	3.7%
e	150	400	7.2%	5.1%	1.9%
f	500	120	22.1%	16.1%	6.1%
g	150	400	7.2%	5.1%	1.9%
h	50	1200	2.5%	1.7%	0.6%
i	150	400	7.2%	5.1%	1.9%

Table S12. Probability calculation performed for Case 4 at an interval of 2 hours in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	950	63	61.3%	48.6%	21.1%
b	950	63	61.3%	48.6%	21.1%
c	950	63	61.3%	48.6%	21.1%
d	950	400	61.3%	48.6%	21.1%
e	150	1200	13.9%	10.0%	3.7%
f	700	86	50.3%	38.7%	16.1%
g	200	86	18.1%	13.1%	4.9%
h	50	400	4.9%	3.4%	1.2%
i	300	200	25.9%	18.9%	7.2%

Table S13. Probability calculation performed for Case 5 at an interval of 30 minutes in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	950	63	21.1%	15.3%	5.8%
b	950	63	21.1%	15.3%	5.8%
c	950	63	21.1%	15.3%	5.8%
d	300	200	7.2%	5.1%	1.9%
e	50	1200	1.2%	0.9%	0.3%
f	150	400	3.7%	2.6%	0.9%
g	50	1200	1.2%	0.9%	0.3%
h	50	1200	1.2%	0.9%	0.3%
i	50	1200	1.2%	0.9%	0.3%

Table S14. Probability calculation performed for Case 5 at an interval of 1 hour in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
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a	950	63	37.8%	28.3%	11.2%
b	950	63	37.8%	28.3%	11.2%
c	500	120	22.1%	16.1%	7.1%
d	950	63	37.8%	28.3%	11.2%
e	50	1200	2.5%	1.7%	0.6%
f	150	400	7.2%	5.1%	1.9%
g	50	1200	2.5%	1.7%	0.6%
h	50	1200	2.5%	1.7%	0.6%
i	50	1200	2.5%	1.7%	0.6%

Table S15. Probability calculation performed for Case 5 at an interval of 2 hours in the absence of PPE, in the presence of a surgical mask, and in the presence of an FFP2 mask.

Position	E(ppm)	DR	Probability without DPI	Probability with surgical mask	Probability with FFP2 mask
a	950	63	61.3%	48.6%	21.1%
b	950	63	61.3%	48.6%	21.1%
c	300	63	25.9%	18.9%	7.2%
d	800	400	55.1%	42.9%	18.1%
e	50	1200	4.9%	3.4%	1.2%
f	150	86	13.9%	10.0%	3.7%
g	50	86	4.9%	3.4%	1.2%
h	50	400	4.9%	3.4%	1.2%
i	100	200	9.5%	6.8%	2.5%