Les principes de dispersion en kinésithérapie respiratoire (distance de dispersion des particules)

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Déclaration de liens d'intérêts

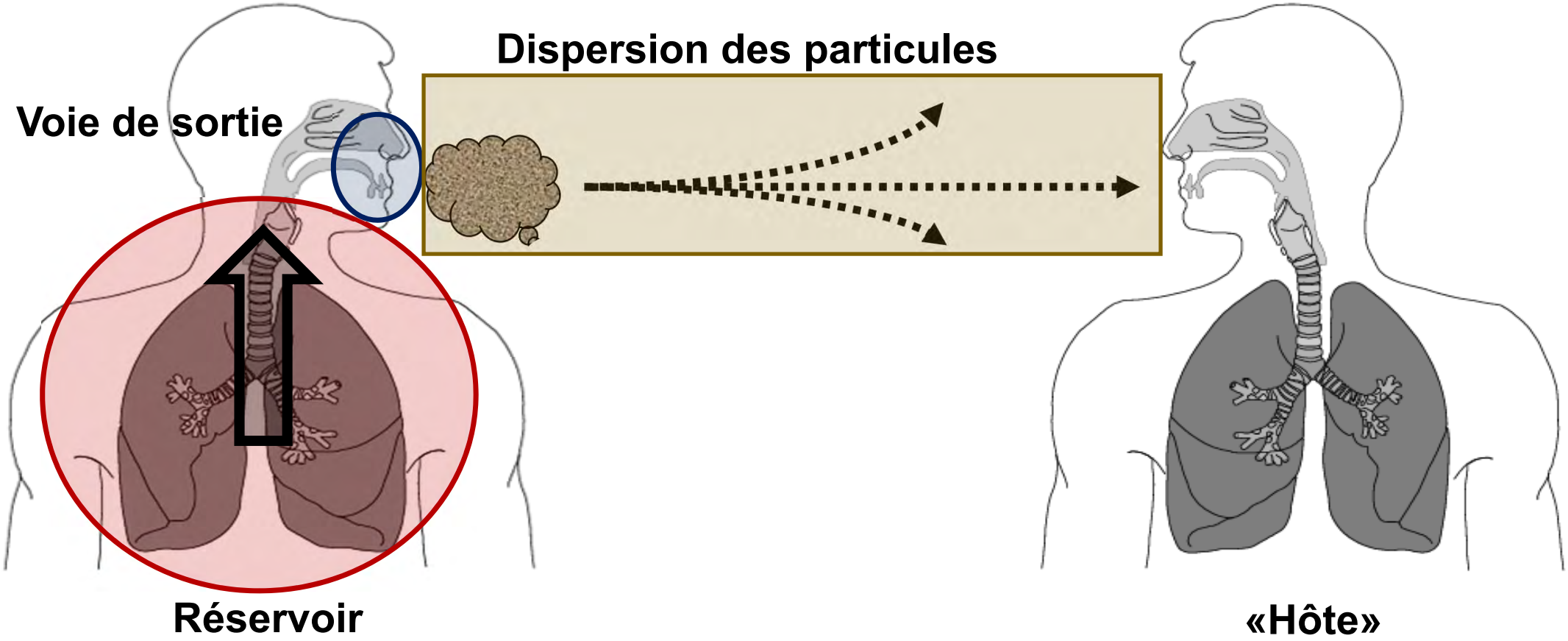
- Liens d'intérêt :

  Aerogen

- Liens d'intérêt en relation avec la présentation :

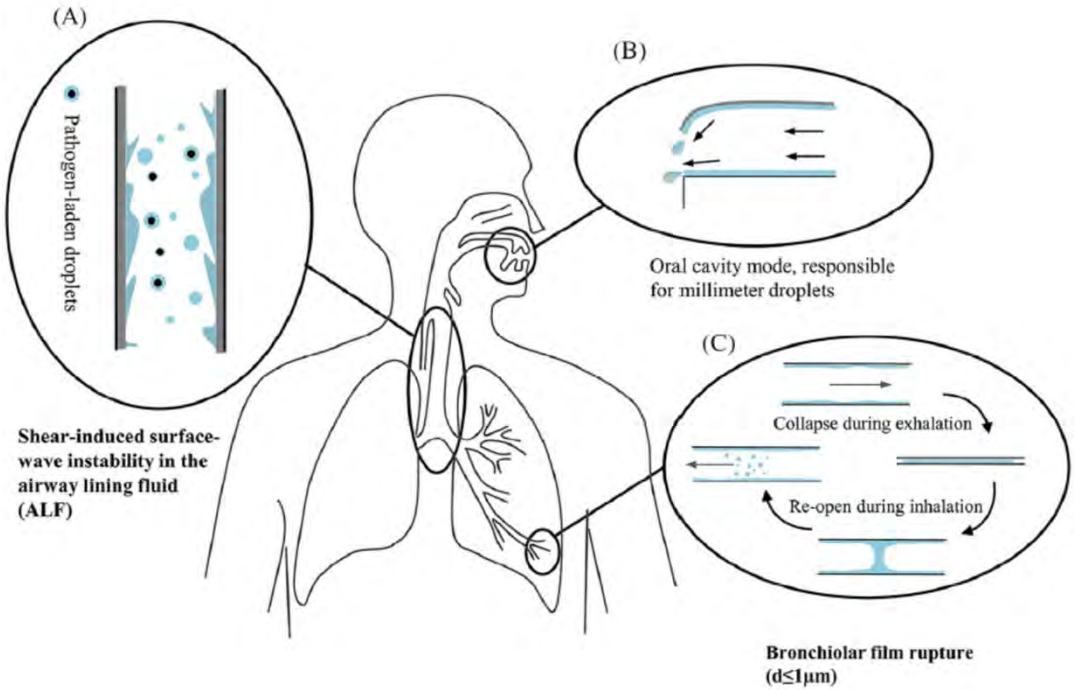
  Absence de liens d'intérêts

Introduction : Dynamique de la dispersion des particules



+ aérosolisation (processus actif) = particules

Introduction : Principaux réservoirs en kinésithérapie



Le patient – Le kinésithérapeute

Nébulisation

VNI

Oxygénothérapie
Humidification

.....

Le matériel

Caractéristiques de la dispersion

Caractéristiques de la dispersion : angle de dispersion

Caractéristiques de la dispersion : taille des particules

Caractéristiques de la dispersion : distance de dispersion

Angle de dispersion

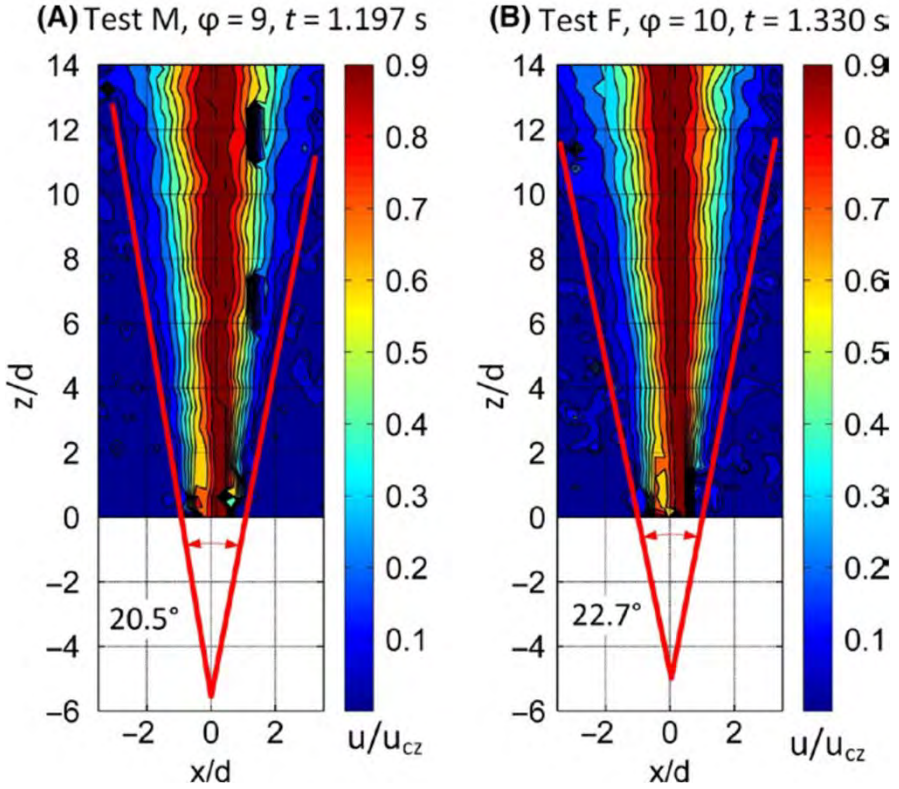
ORIGINAL ARTICLE

Indoor Air. 2017;27:803–815.

Experimental analysis of the air velocity and contaminant dispersion of human exhalation flows

F. A. Berlanga | I. Olmedo | M. Ruiz de Adana

Etude in vitro
Mesure par camera thermique et CO_2



Débit expiratoire 22 litres/min

Débit expiratoire 18 litres/min

Angle de dispersion horizontale = effet de la vélocité

Human Cough as a Two-Stage Jet and Its Role in Particle Transport

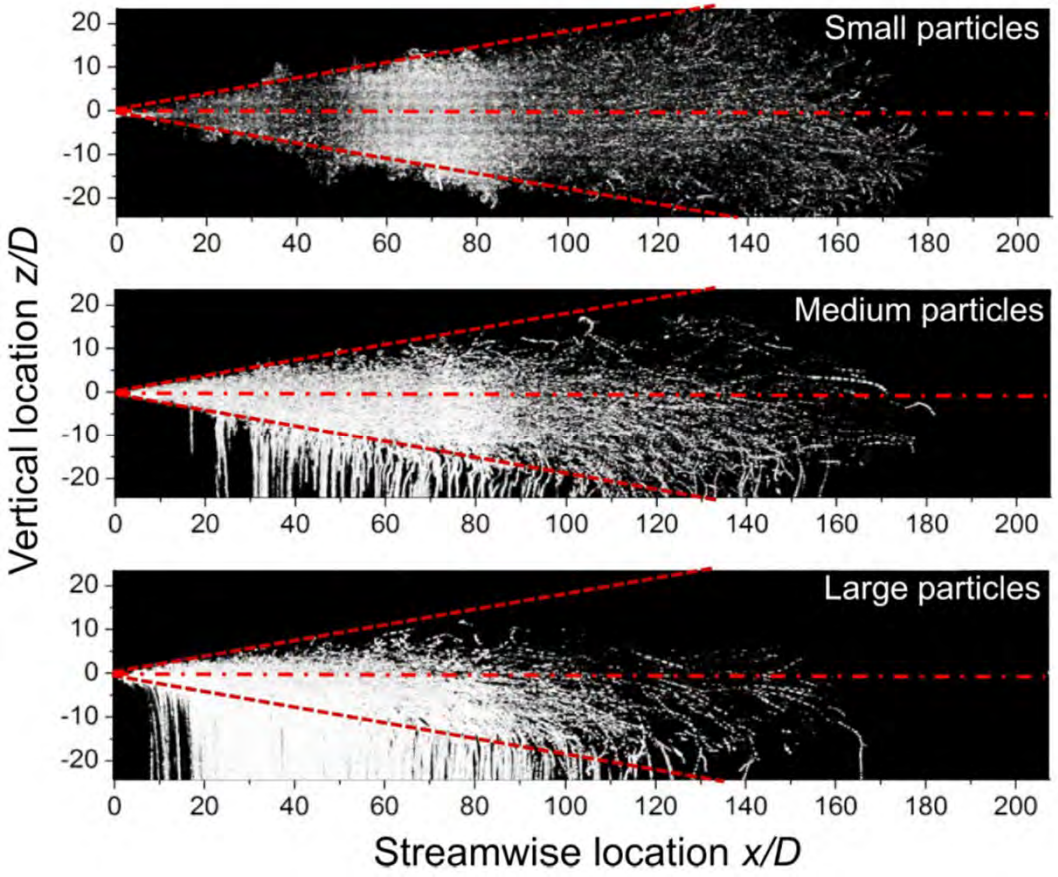
Jianjian Wei[1,2]*, Yuguo Li[1,2]

***PLoS One. 2017;3* (0169235)**

Particules 8 – 14 µm

Particules 57 – 68 µm

Particules 96 – 114 µm



Etude in vitro
Simulation toux (10 m/s)
Vidéo haute définition

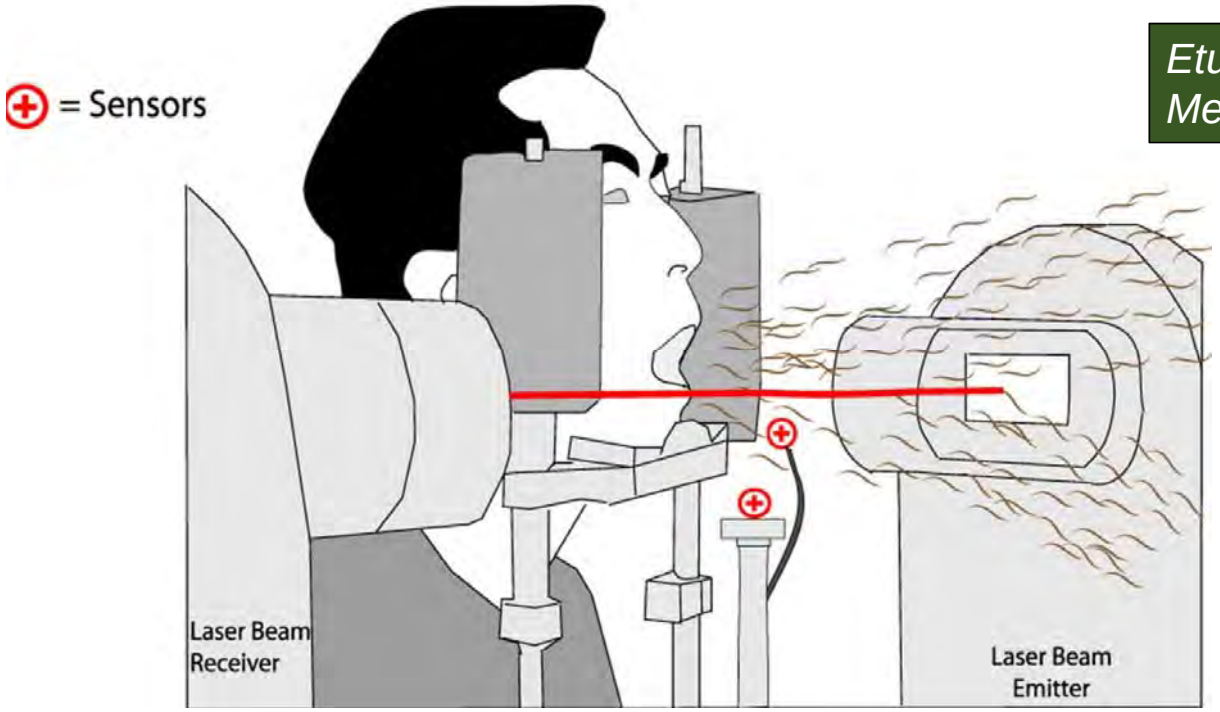
Angle de dispersion verticale = effet de la taille des particules

Taille des particules

Cough aerosol in healthy participants: fundamental knowledge to optimize droplet-spread infectious respiratory disease management

Gustavo Zayas[1*], Ming C Chiang[1], Eric Wong[2], Fred MacDonald[3], Carlos F Lange[4], Ambikaipakan Senthilselvan[5] and Malcolm King[1]

BMC Pulm Med. 2012, 12:11



Etude in vivo (volontaires sains non fumeurs, n= 45)
Mesure par diffraction laser à 17 cm (3 toux forcées)

Cough aerosol in healthy participants: fundamental knowledge to optimize droplet-spread infectious respiratory disease management

Gustavo Zayas[1*], Ming C Chiang[1], Eric Wong[2], Fred MacDonald[3], Carlos F Lange[4], Ambikaipakan Senthilselvan[5] and Malcolm King[1]

BMC Pulm Med. 2012, 12:11

- Dose des particules : 2.2 mg par toux
- Tailles des particules :
  - 97% des particules < 1 µm
  - 2.7% des particules entre 1 et 10 µm

  => 99% de particules respirables
- Pas d'influence de l'âge, sexe, poids, taille et BMI

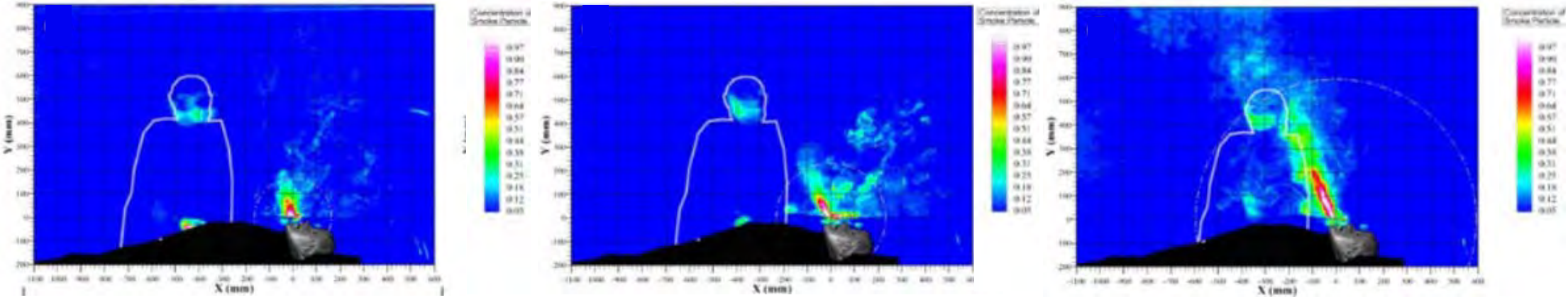
Distance de dispersion

Exhaled air dispersion during bag-mask ventilation and sputum suctioning - Implications for infection control

Matthew T. V. Chan[1,4], Benny K. Chow[2], Thomas Lo[1], Fanny W. Ko[3], Susanna S. Ng[3], Tony Gin[1] & David S. Hui[2,3]

Scientific Reports (2018) 8:198

Etude in vitro (mannequin)
Analyse de la toux (fumée)
Vidéo (balayage laser)



Toux faible (220 litres/min) **Toux moyenne (320 litres/min)** **Toux forte (650 litres/min)**

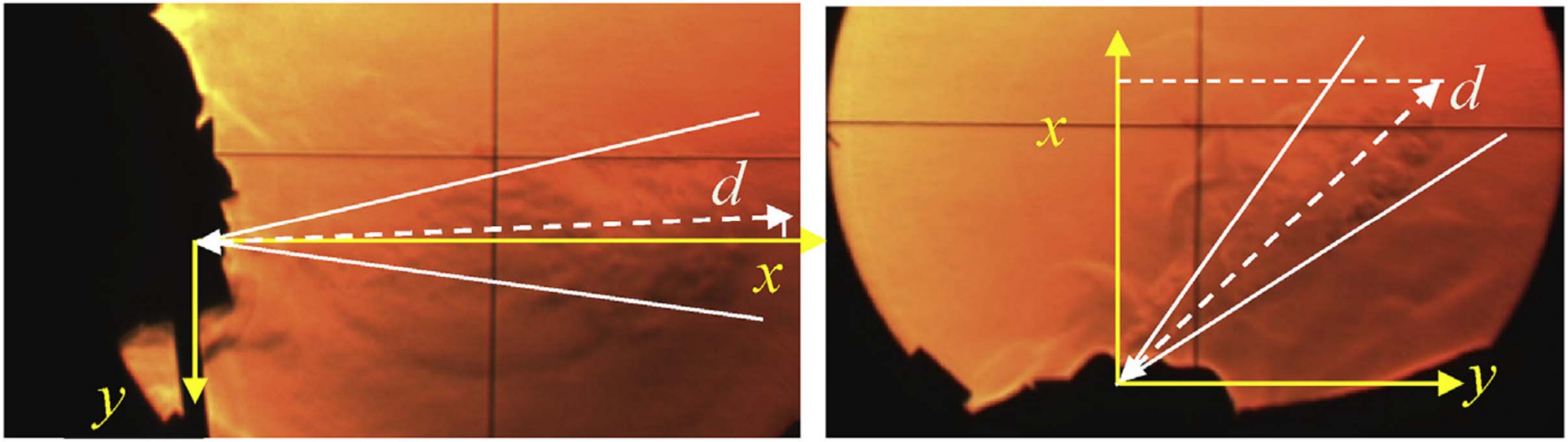
Effet de la vélocité des particules

Human exhalation characterization with the aid of schlieren imaging technique

Chunwen Xu [a, b, *], Peter V. Nielsen [b], Li Liu [b], Rasmus L. Jensen [b], Guangcai Gong [c]

Building and Environment 112 (2017) 190-199

Etude in vivo
Analyse expiration calme
Image par système optique Schlieren



Effet de la position

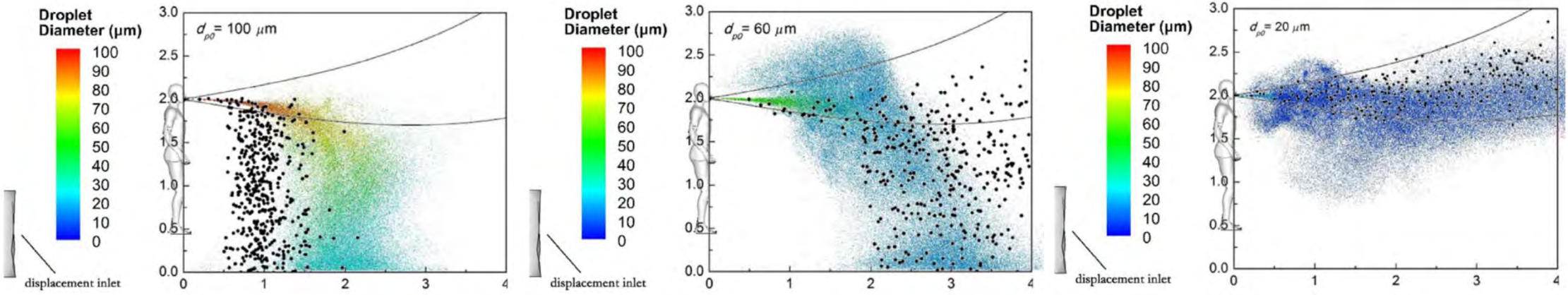
The impact of ambient humidity on the evaporation and dispersion of exhaled breathing droplets: A numerical investigation

Yichen Ji, Hua Qian*, Jin Ye, Xiaohong Zheng

School of Energy and Environment, Southeast University, Nanjing 210096, China

J Aeros Sci 2018, 115; 164-172

Etude in vitro, simulation expiration calme.
Mesure par simulation / modèles mathématiques.



100 μm **60 μm** **20 μm**

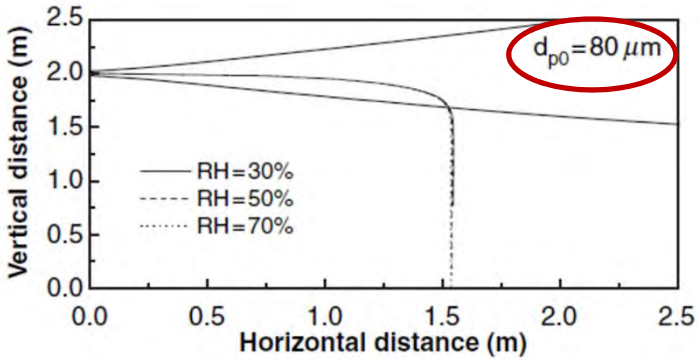
Effet de la taille des particules

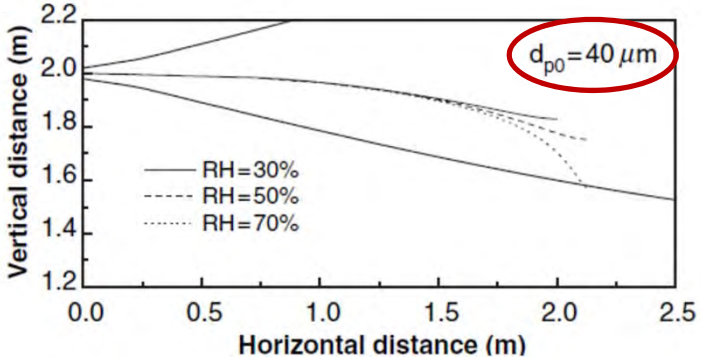
Indoor Air. **2007;17:211–225.**

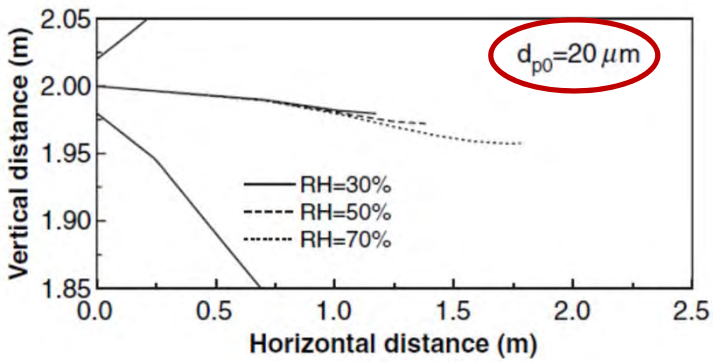
How far droplets can move in indoor environments – revisiting the Wells evaporation–falling curve

X. Xie[1], Y. Li[1], A. T. Y. Chwang[1], P. L. Ho[2], W. H. Seto[3]

Etude in vitro , analyse de la toux (10 m/s)
Mesure par modèles mathématiques

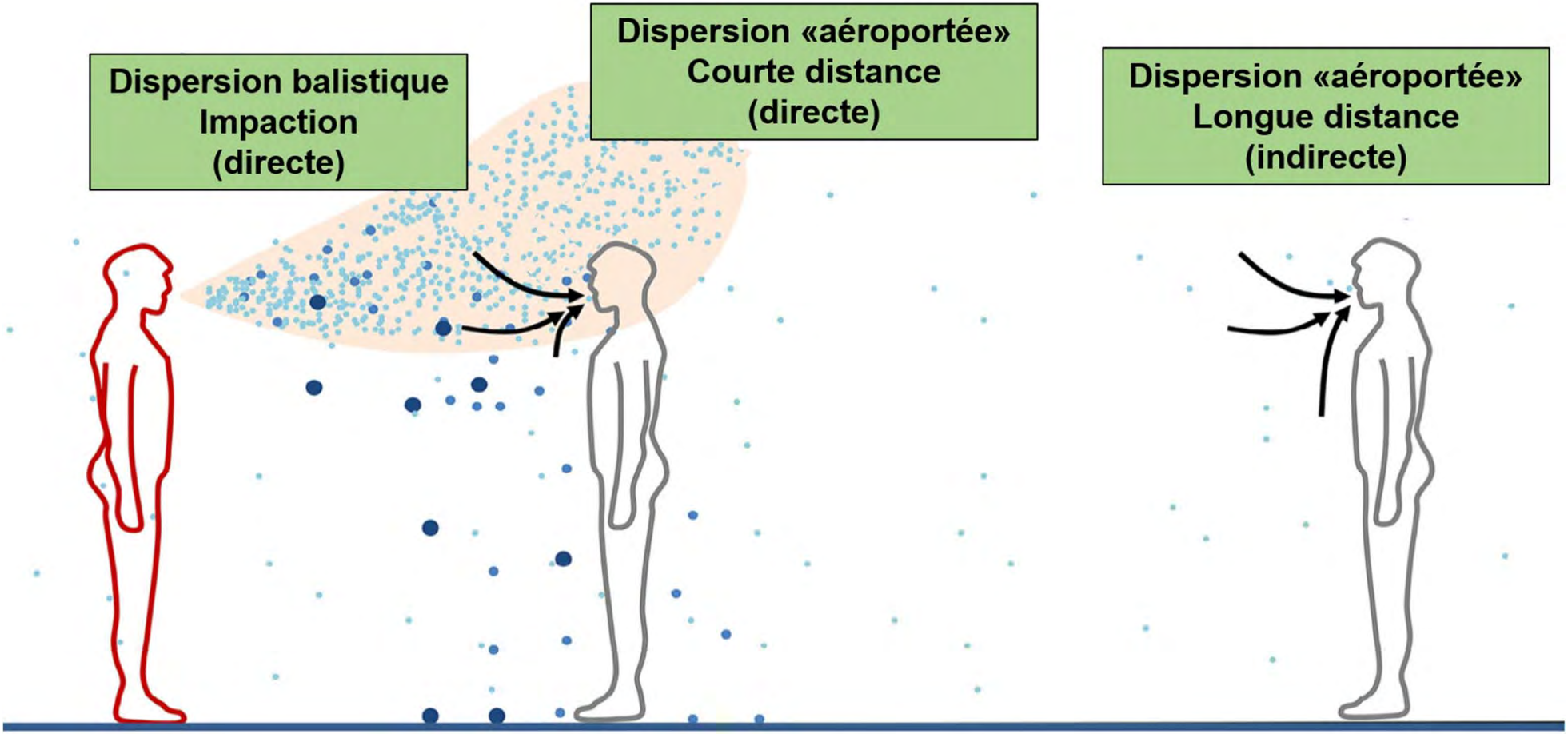






Effet de l'évaporation et de l'humidité relative

Modes de dispersion des particules



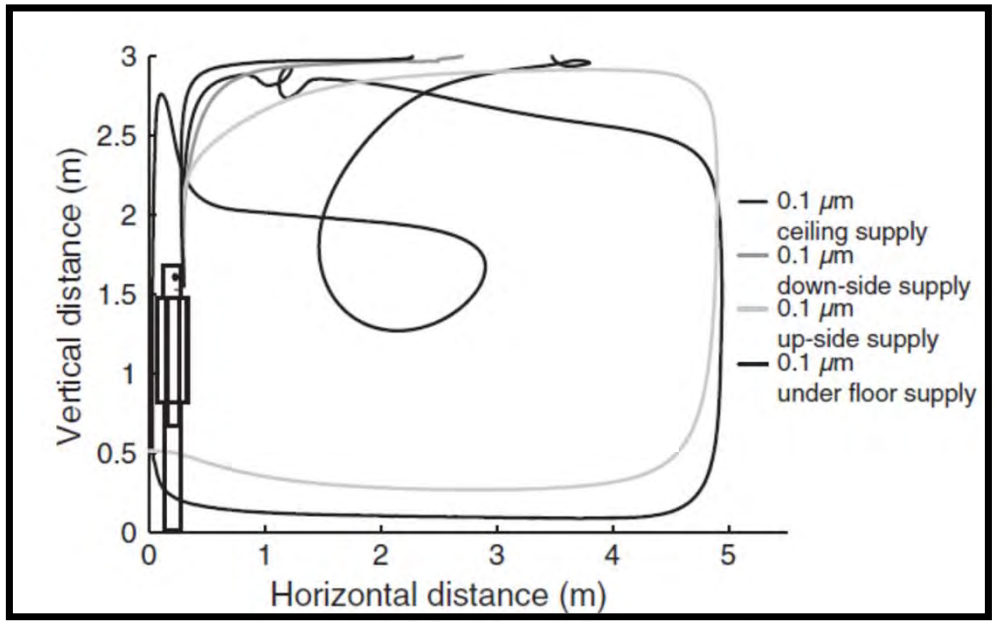
Am J Infect Control 44 (2016) S102-S108

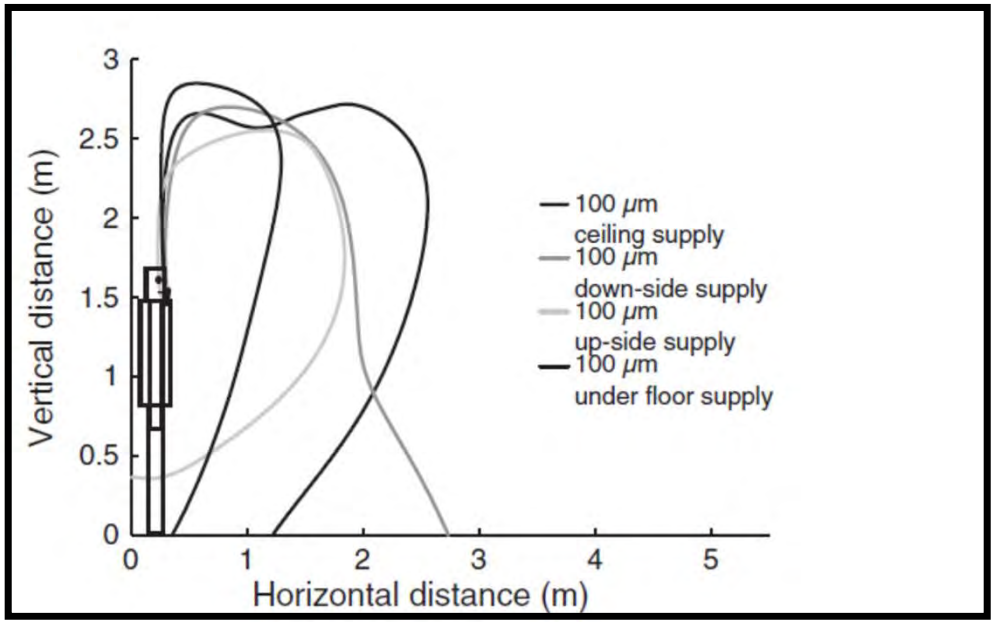
Some questions on dispersion of human exhaled droplets in ventilation room: answers from numerical investigation

C. Chen, B. Zhao

Indoor Air 2010; 20: 95–111

Etude in vitro, Toux (10 m/sec)
Mesure par simulation / modèles mathématiques





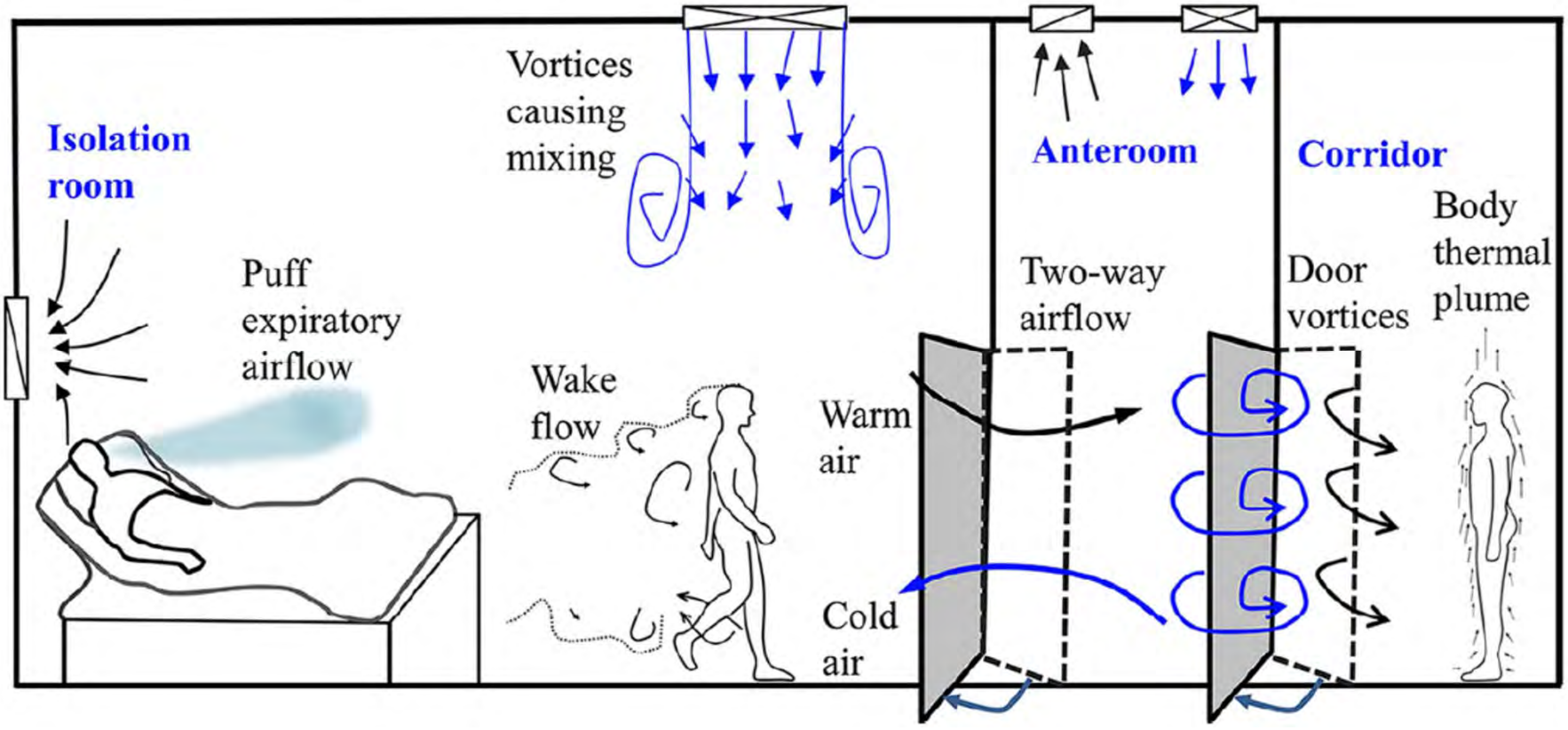
0.1 µm **100 µm**

Effet de l'environnement (température, humidité, flux mécanique…)

Airborne spread of infectious agents in the indoor environment

Jianjian Wei PhD, Yuguo Li PhD *

Am J Infect Control 44 (2016) S102-S108



Effet de l'environnement (température, humidité, flux mécanique…)

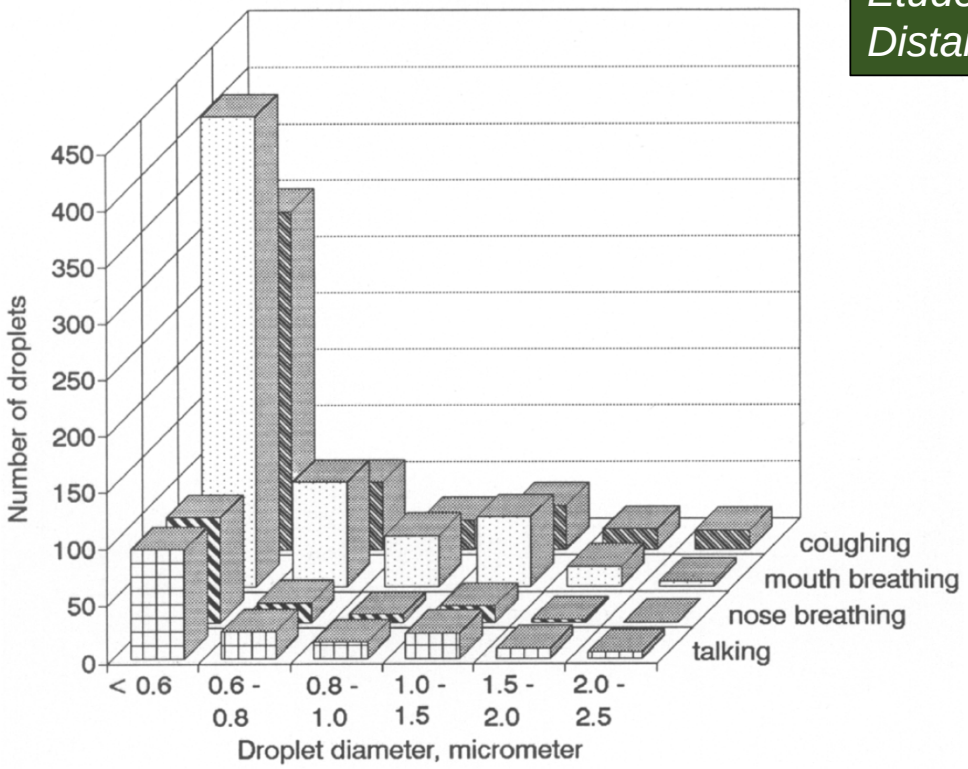
Dispersion et kinésithérapie

J Aeros Med 1997, 10(2); 105-116

The Size Distribution of Droplets in the Exhaled Breath of Healthy Human Subjects

RAO S. PAPINENI and FRANK S. ROSENTHAL

Etude in vivo, analyse de la taille des gouttelettes
Distance mesure = 5 mm



Aérosolisation = activité respiratoire

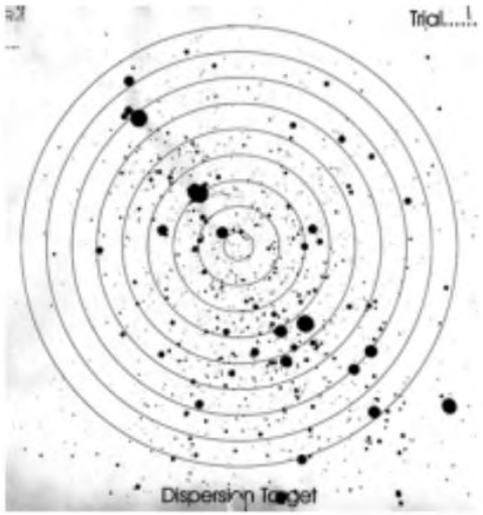
Research article

A new paradigm in respiratory hygiene: increasing the cohesivity of airway secretions to improve cough interaction and reduce aerosol dispersion

Gustavo Zayas*[1], John Dimitry[2], Ana Zayas[2], Darryl O'Brien[1] and Malcolm King[1]

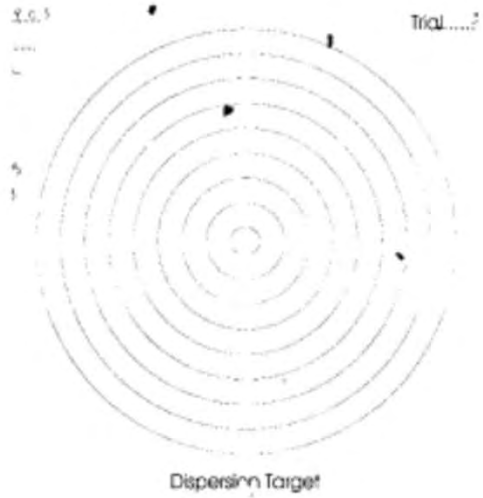
BMC Pulm Med. 2005 Sep 2;5:11

Etude in vitro, analyse de la toux
Effet de la filance, distance cible = 40 cm



1.5 µl

15 µl



150µl

Aérosolisation = rhéologie

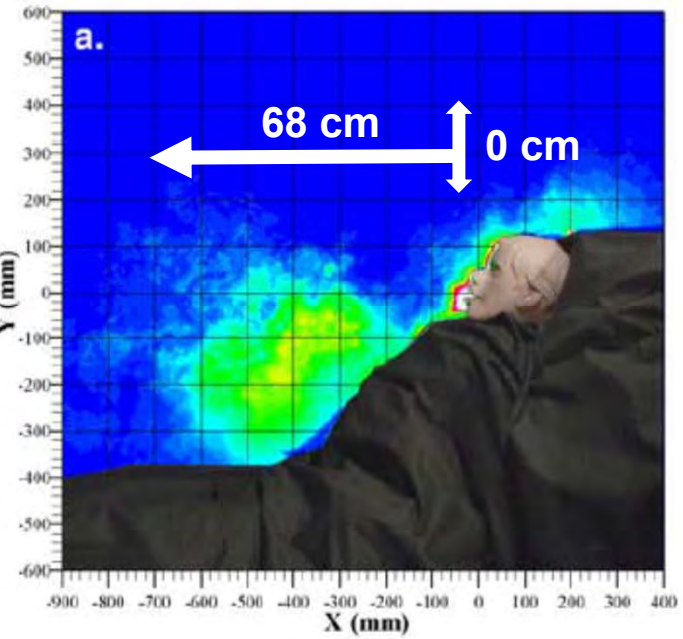
Exhaled Air Dispersion during Coughing with and without Wearing a Surgical or N95 Mask

David S. Hui[1,2*], Benny K. Chow[2,3], Leo Chu[4], Susanna S. Ng[1], Nelson Lee[1,2], Tony Gin[4], Matthew T. V. Chan[4]

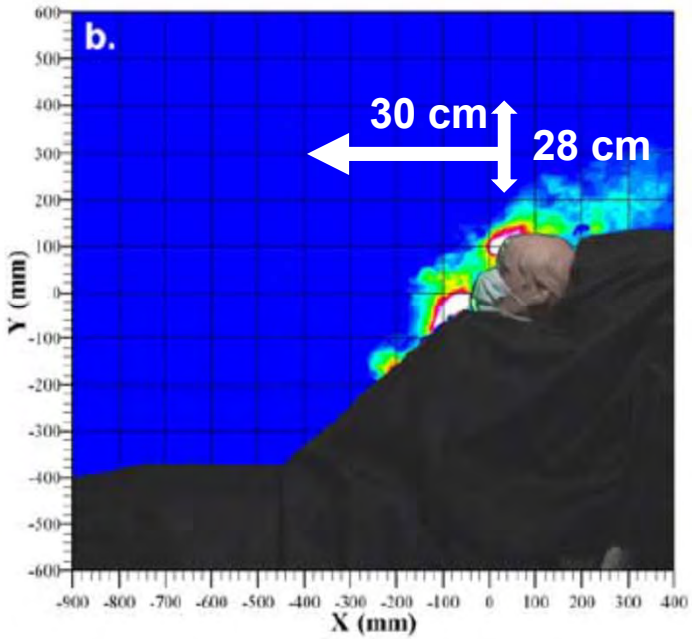
PLoS One. 2012;7(12:e50845)

Etude in vitro sur mannequin
Analyse de la toux (fumée)
Vidéo (balayage laser)

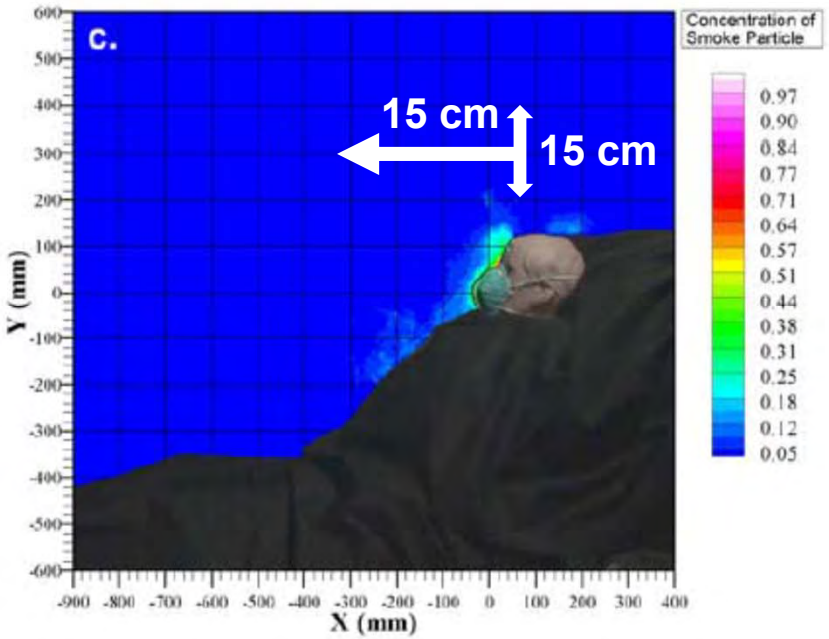
sans masque



avec masque simple



avec masque N95



Dispersion = filtre à particules

Aerosol dispersion during various respiratory therapies: a risk assessment model of nosocomial infection to health care workers

DSC Hui *, MTV Chan, B Chow

Hong Kong Med J 2014;20(Suppl 4):S9-13

Respironics Image 3 mask plus whisper swivel exhalation valve (inspiratory/expiratory positive airway pressure, cmH_2O)*	**Distance de dispersion (m)**
10/4	0.95
14/4	0.95
18/4	>0.95
Simple oxygen mask (oxygen flow, L/min)*	
4	0.20
6	0.22
8	0.30
10	0.40, >0.4 during coughing
Jet nebuliser (driven by air at 6 L/min)	
Normal lung	0.45
Mild lung injury	0.54
Severe lung injury	>0.80

Etude in vitro sur mannequin
Analyse de la toux (fumée)
Vidéo haute définition (balayage laser)

Effet du débit expiratoire patient

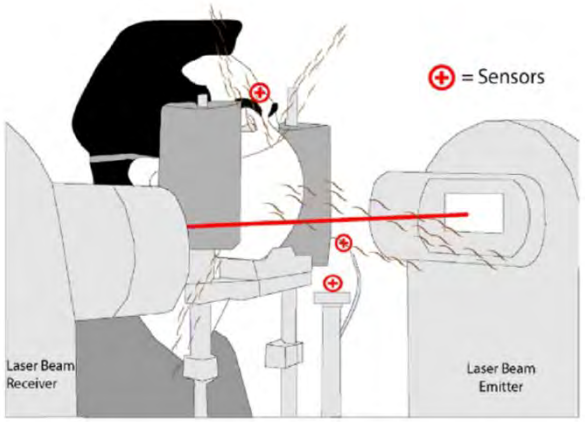
Dispersion = techniques de thérapie respiratoire

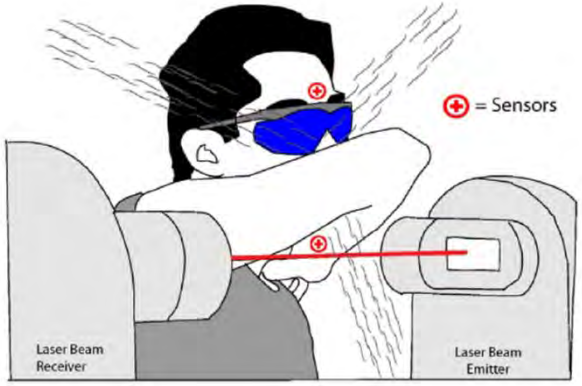
Effectiveness of cough etiquette maneuvers in disrupting the chain of transmission of infectious respiratory diseases

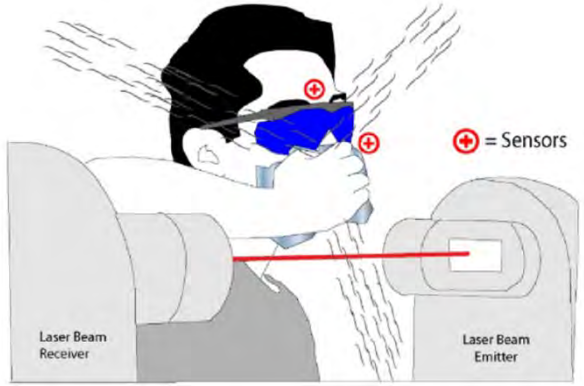
Gustavo Zayas[1*], Ming C Chiang[1], Eric Wong[2], Fred MacDonald[3], Carlos F Lange[4], Ambikaipakan Senthilselvan[5] and Malcolm King[1*]

BMC Public Health 2013, 13:811

Etude in vivo (volontaires sains non fumeurs, n= 31)
Mesure par diffraction laser à 17 cm (3 répétitions)







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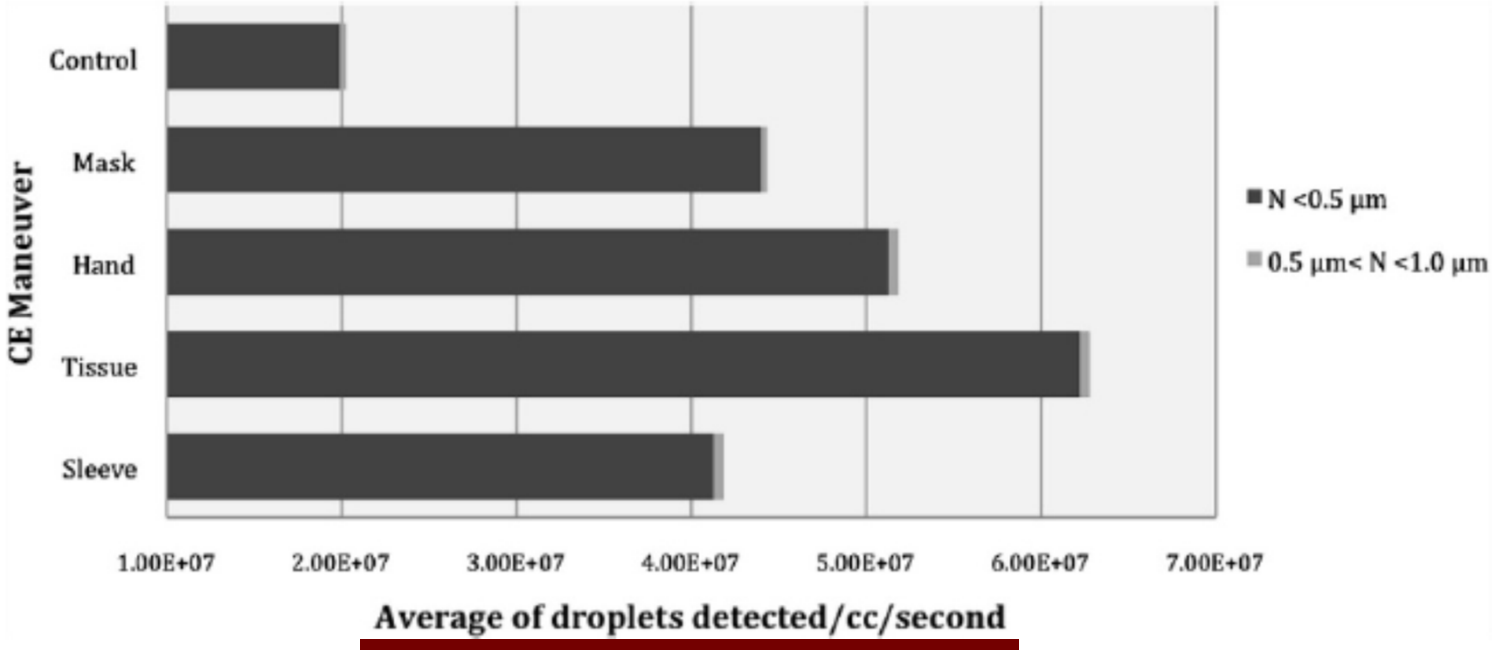

Dispersion = techniques de «limitation» de la dispersion

Conclusions

- Respecter une distance de sécurité (> 1.5 à 2 mètres)
- Protection du thérapeute
- Humidification = Augmentation de la taille des gouttelettes
- Mythes et croyances !!!
- Eviter les courants d'air !!!!
- Limiter l'aérosolisation *(ex : rhéologie, nébulisation de NaCl…)*