JNI 20es Journées Nationales d'Infectiologie
Lyon
et la région Auvergne-Rhône-Alpes
du mercredi 5 juin 2019
au vendredi 7 juin 2019

Infections virales des voies respiratoires basses

Indications raisonnées de la tomodensitométrie thoracique

Pr Xavier Duval

Déclaration de liens d'intérêt avec les industries de santé en rapport avec le thème de la présentation (loi du 04/03/2002) :

Intervenant : Duval Xavier

Titre : Infections virales des voies respiratoires basses
Indication raisonnée de la tomodensitométrie thoracique

☐ L'orateur ne souhaite pas répondre

Consultant ou membre d'un conseil scientifique	☑ OUI	☐ NON
Conférencier ou auteur/rédacteur rémunéré d'articles ou documents	☐ OUI	☑ NON
Prise en charge de frais de voyage, d'hébergement ou d'inscription à des congrès ou autres manifestations	☐ OUI	☑ NON
Investigateur principal d'une recherche ou d'une étude clinique	☑ OUI	☐ NON

Pneumonies aigues communautaires

- **Fréquentes** :
  - 10% de l'ensemble des Infections Respiratoires Basses
  - 500 000 cas/an en France
  - 1.7 millions de consultation au Service d'Accueil des Urgences

- **Graves** :
  - 2 à 5% de mortalité (40% si admission en réanimation)
  - 1ère cause infectieuse de mortalité dans les pays occidentaux (55 000 décès/an USA)

Diagnostic des PAC

Association

- **Signes fonctionnels respiratoires :**

  toux, expectorations, dyspnée, douleur thoracique, hémoptysie

- **Signes généraux**

  fièvre, …

- **Radiographie thoracique : atteinte parenchymateuse**

Stratégies diagnostique et thérapeutique

- **Suspicion diagnostique**
- **Traitement antibiotique probabiliste pour traiter une PAC bactérienne**

Stratégies diagnostique et thérapeutique

- **Suspicion diagnostique**
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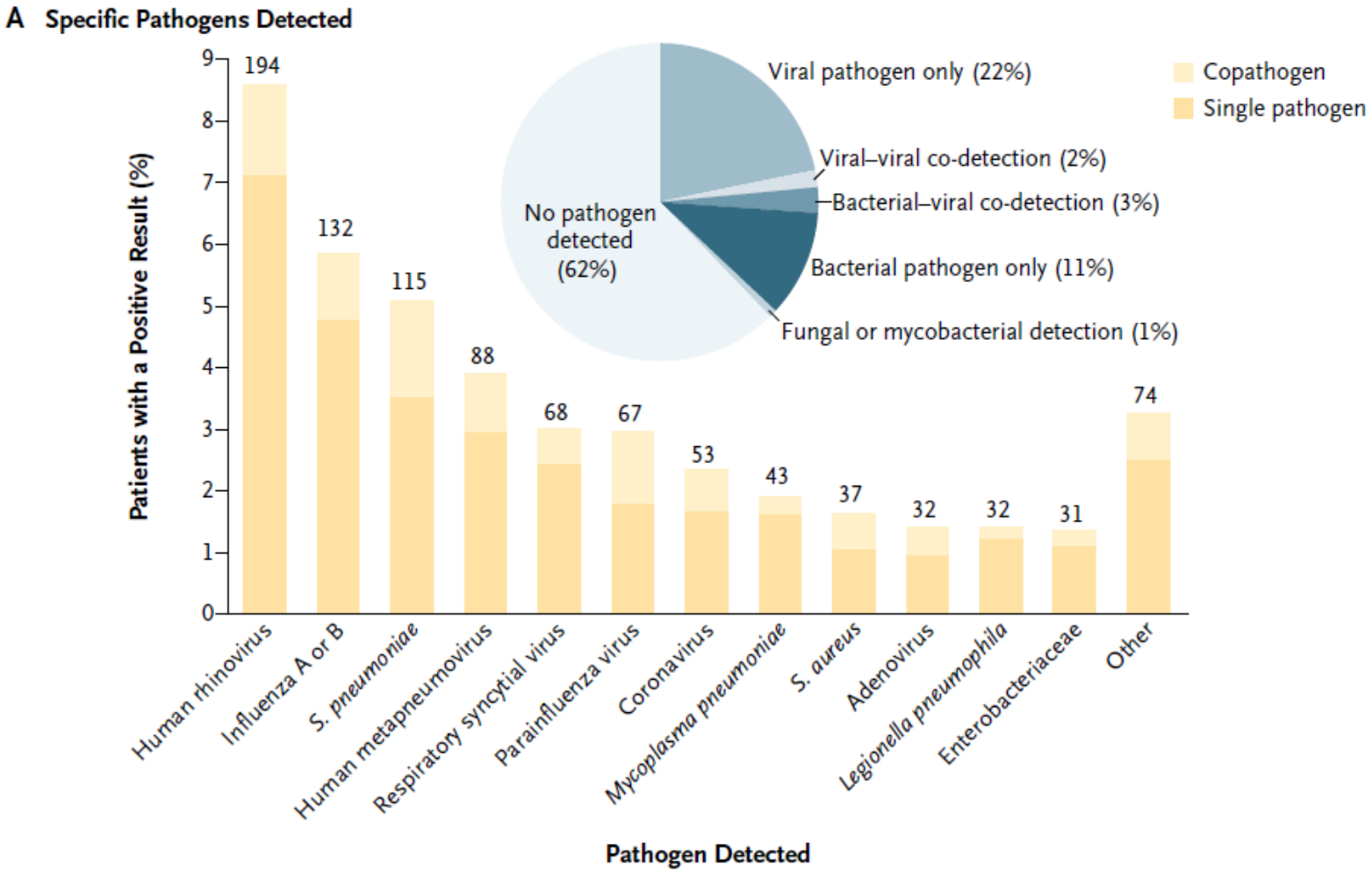
MAIS Remise en question de nos certitudes….

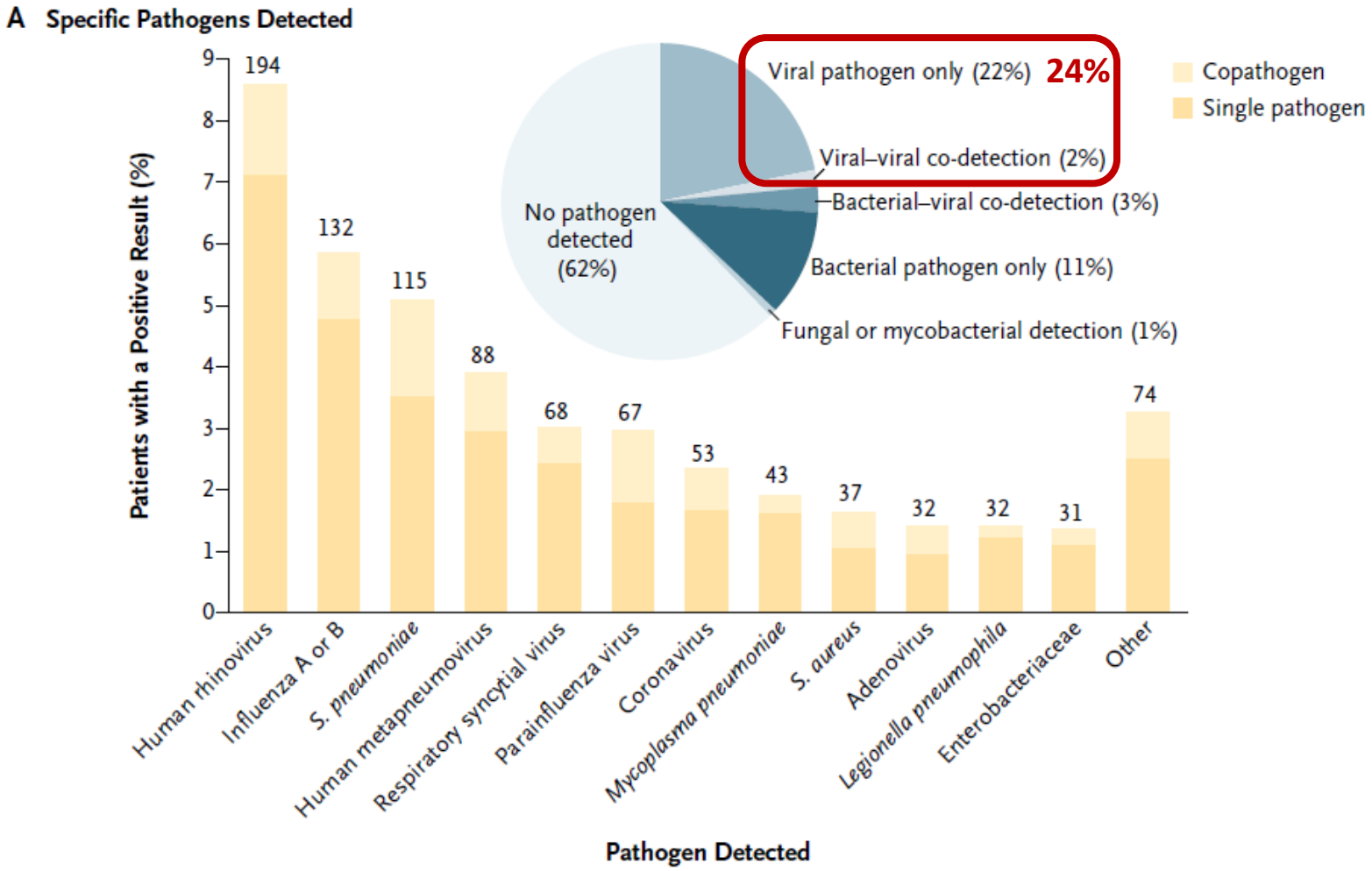
- **Microorganismes**

Microorganismes responsables



S. Jain N Engl J Med 2015;373:415-27.

Microorganismes responsables



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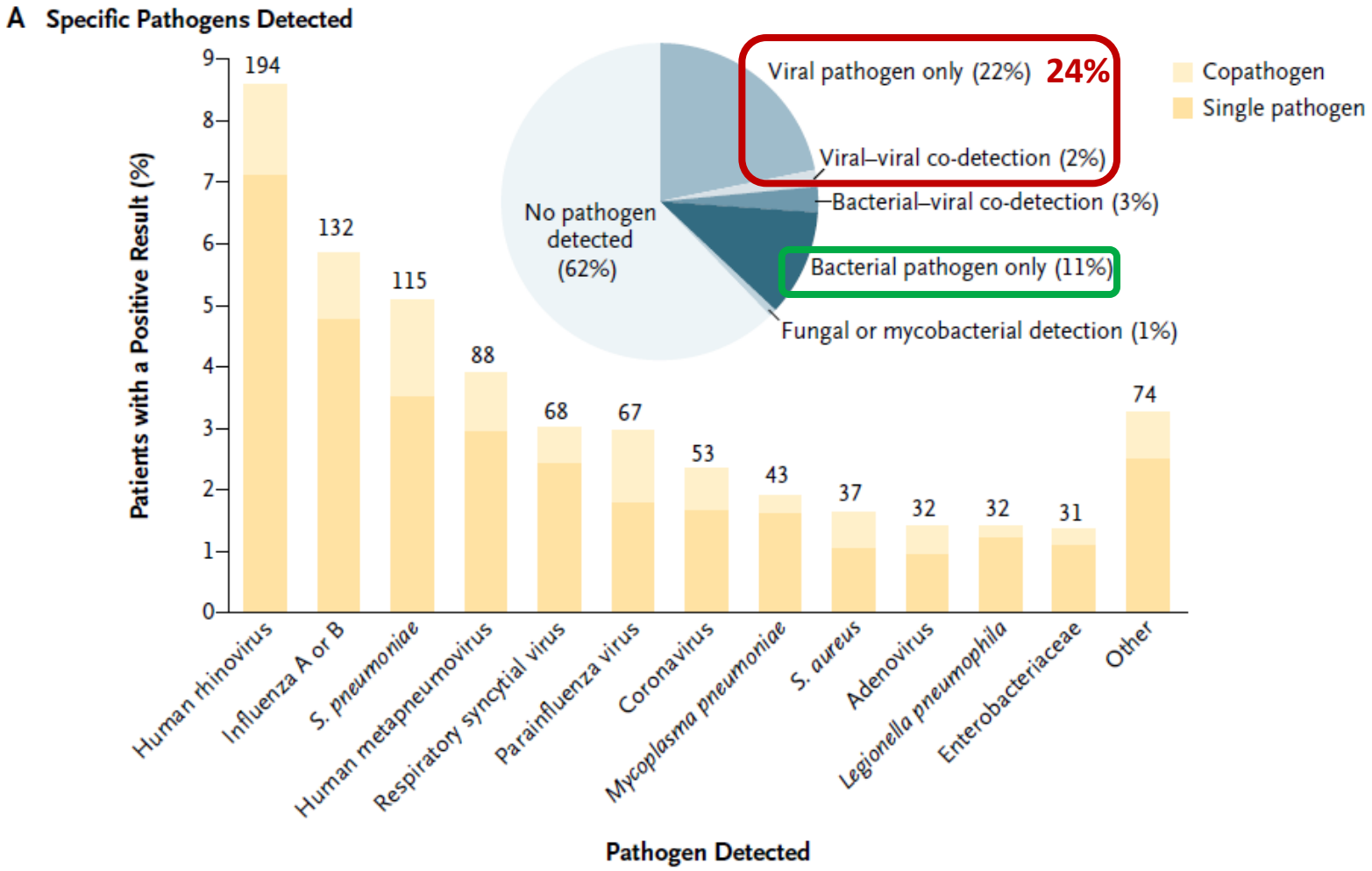

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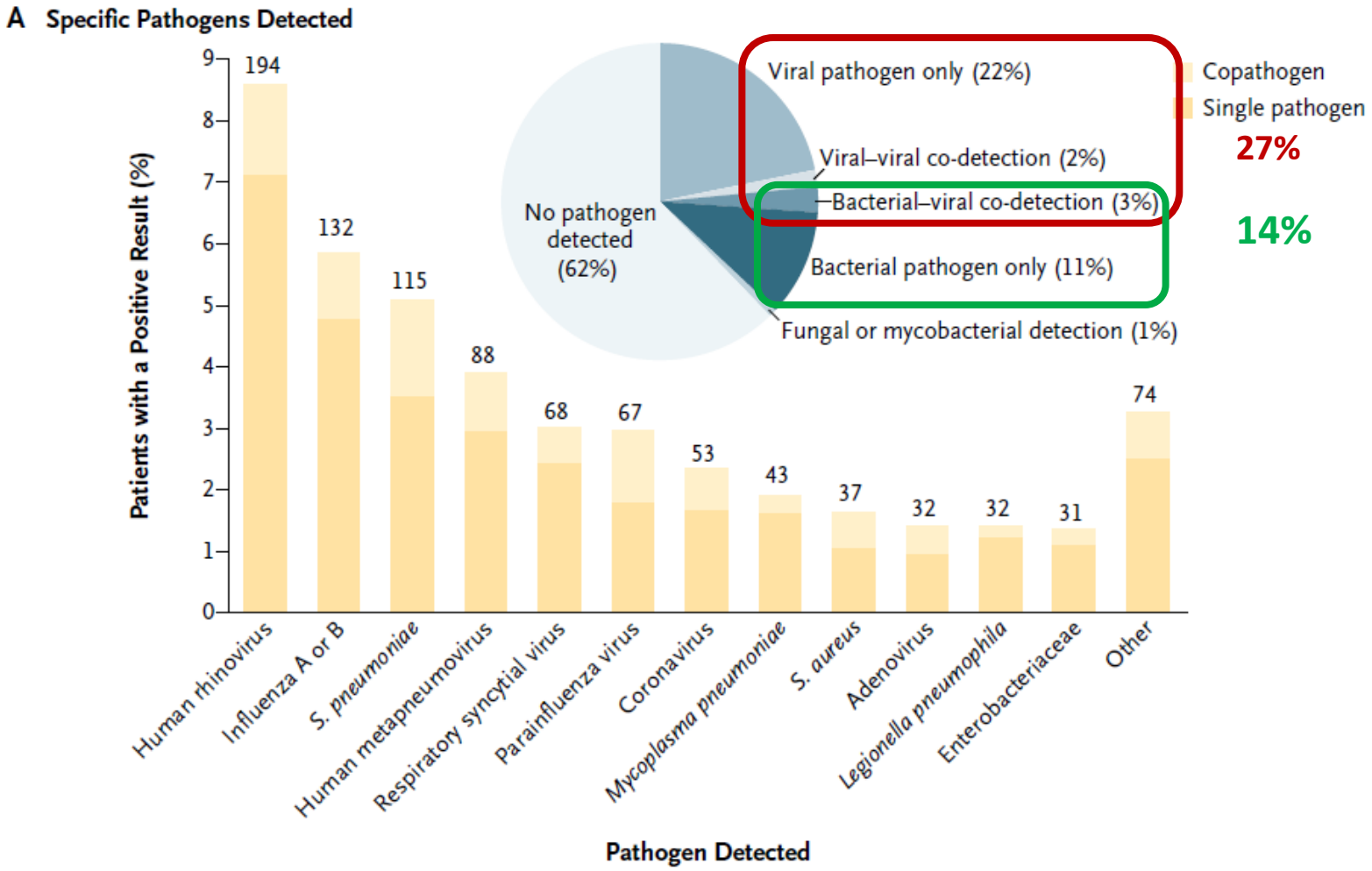

S. Jain N Engl J Med 2015;373:415-27.

Microorganismes responsables: virus (Adultes)

Immunocompétent
- Influenza
- HPIV
- Adenovirus
- RSV
- HMPV

Immunodéprimés
- Influenza
- RSV
- Adenovirus
- Rhinovirus
- HPIV
- HMPV
- Coronavirus
- CMV
- HSV
- Varicella-zoster virus
- Human bocavirus

Méthodes diagnostiques:
- PCR nasopharyngée
- PCR sur prélèvements profonds

Ribavirin, Cidofovir, Acyclovir

IVIG

Stratégies diagnostique et thérapeutique

- **Suspicion diagnostique**
- **Traitement antibiotique probabiliste pour traiter une PAC bactérienne**

MAIS Remise en question de nos certitudes….

- **Microorganismes**
- **Diagnostic radiologique**

Radiographie et Pneumonie aigue communautaire

- **Faible concordance dans l'interprétation des radiographies de thorax (Kappa 0,01 à 0,51)**
  - Diagnostic de PAC
    - Faux positifs : 20-30%
    - Faux négatifs: 20-30%
  - Complications
  - Lésion sous jacente

Syrjala CID 1998, Claessens AJRCCM 2015, Upchurch Chest 2018, Prendki Eur Respir J 2018

Early Chest Computed Tomography Scan to Assist Diagnosis and Guide Treatment Decision for Suspected Community-acquired Pneumonia

Yann-Erick Claessens[1], Marie-Pierre Debray[2], Florence Tubach[3], Anne-Laure Brun[4], Blandine Rammaert[5], Pierre Hausfater[6], Jean-Marc Naccache[7], Patrick Ray[8], Christophe Choquet[9], Marie-France Carette[10], Charles Mayaud[7], Catherine Leport[11], and Xavier Duval[12]

American Journal of Respiratory and Critical Care Medicine Volume 192 Number 8 | October 15 2015

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Low-dose computed tomography for the diagnosis of pneumonia in elderly patients: a prospective, interventional cohort study

Virginie Prendki[1], Max Scheffler[2], Benedikt Huttner[3], Nicolas Garin[4,5], François Herrmann[6], Jean-Paul Janssens[7], Christophe Marti[4], Sebastian Carballo[4], Xavier Roux[1], Christine Serratrice[1], Jacques Serratrice[4], Thomas Agoritsas[4], Christoph D. Becker[2], Laurent Kaiser[3], Sarah Rosset-Zufferey[4], Valérie Soulier[4], Arnaud Perrier[4], Jean-Luc Reny[1], Xavier Montet[2] and Jérôme Stirnemann[4]

Eur Respir J 2018; 51: 1702375

Community-Acquired Pneumonia Visualized on CT Scans but Not Chest Radiographs

Pathogens, Severity, and Clinical Outcomes

CHEST

Cameron P. Upchurch, MD; Carlos G. Grijalva, MD, MPH; Richard G. Wunderink, MD; Derek J. Williams, MD, MPH; Grant W. Waterer, MBBS, PhD; Evan J. Anderson, MD; Yuwei Zhu, MD; Eric M. Hart, MD; Frank Carroll, MD; Anna M. Bramley, MPH; Seema Jain, MD; Kathryn M. Edwards, MD; and Wesley H. Self, MD, MPH

CONCLUSIONS: Adults hospitalized with CAP who had radiological evidence of pneumonia on CT scan but not on concurrent chest radiograph had pathogens, disease severity, and outcomes similar to patients who had signs of pneumonia on chest radiography. These findings

Syrjala CID 1998, Claessens AJRCCM 2015, Upchurch Chest 2018, Prendki Eur Respir J 2018

Community-Acquired Pneumonia

Visualized

Radiograp

Pathogens, Sev

Cameron P. Upchurch

Grant W. Waterer, ME

Anna M. Bramley, MP

CONCLUSIONS: Ac

CT scan but not

comes similar to

CHEST

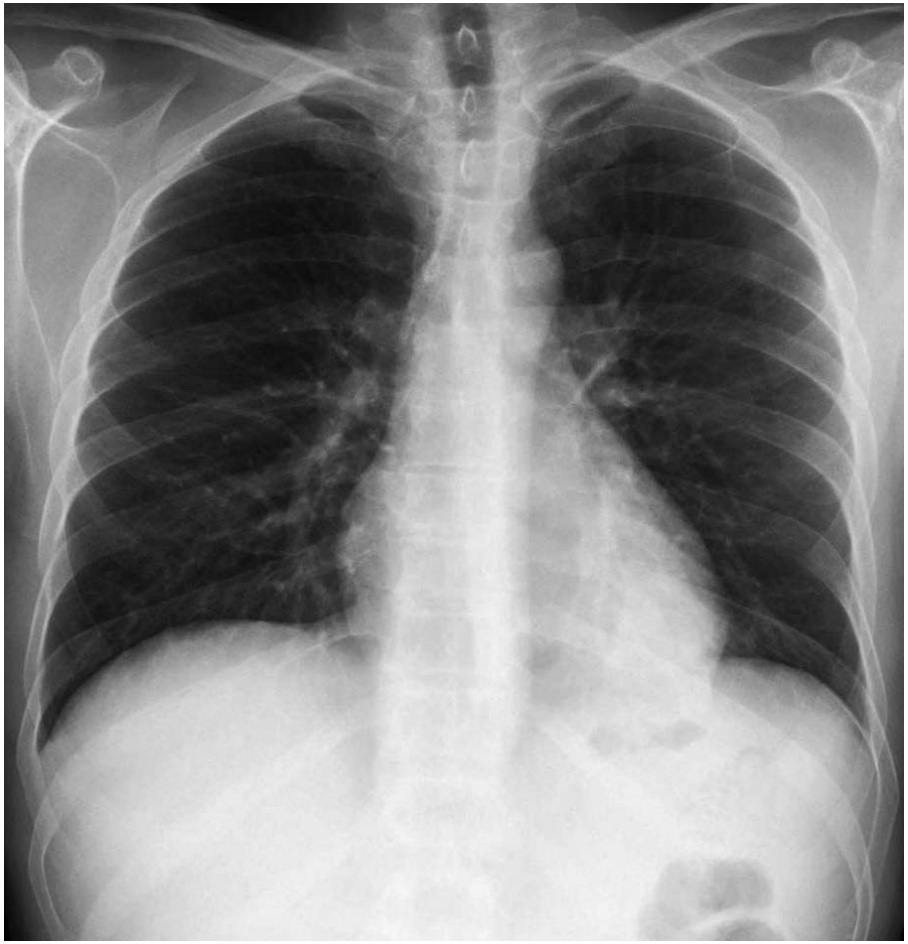
EDITORIALS

The Diagnosis of Community-acquired Pneumonia

Do We Need to Take a Big Step Backward?

If confirmed by further studies, this shifts the assessment of the diagnosis of CAP from "we might occasionally get it wrong" to "Houston, we have a problem." The implications for everything from empiric therapy to reimbursement and quality of care measures are enormous.

Grant W. Waterer, M.B.B.S., Ph.D.

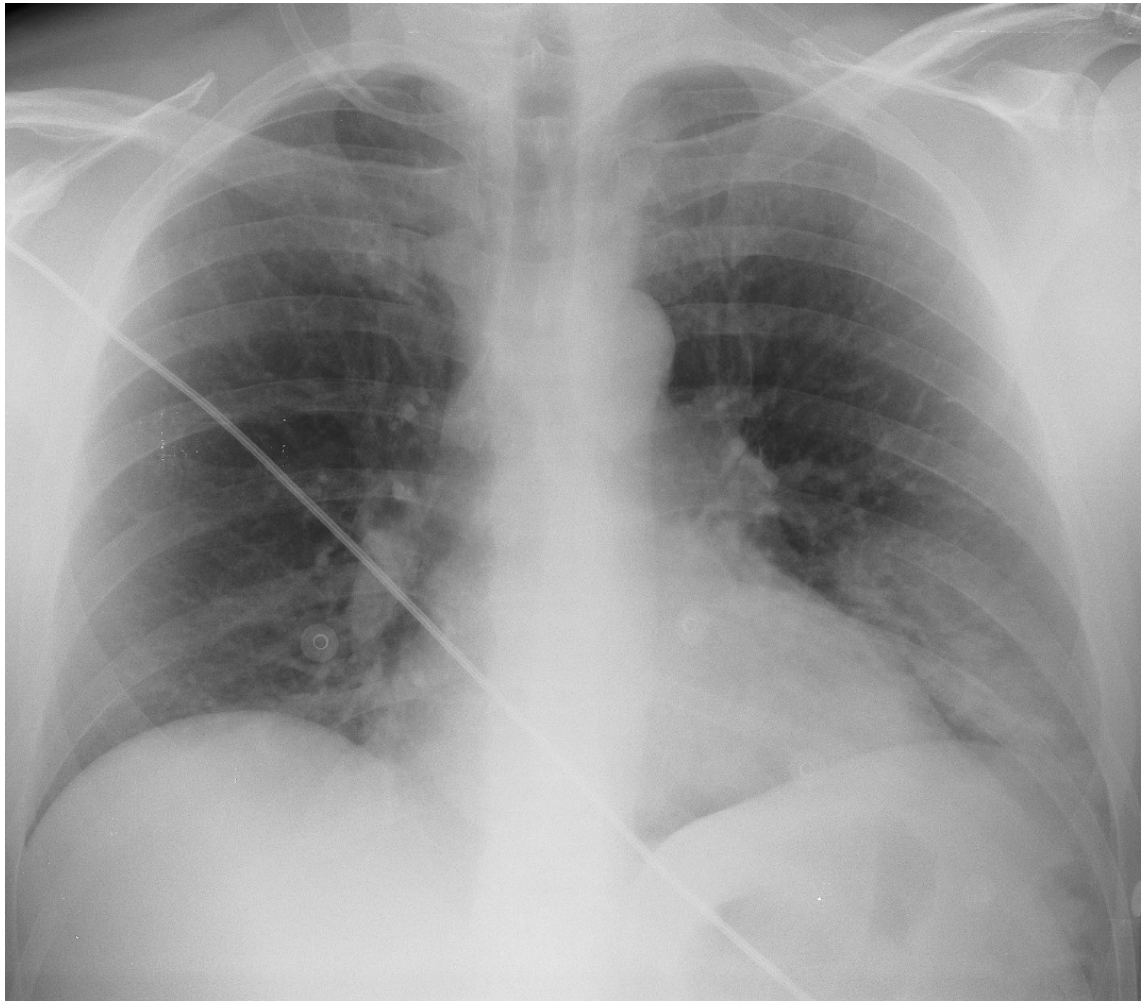


Radiographie thoracique : atteinte parenchymateuse

Confiance diagnostique

Aspect	Dénomination
Opacité alvéolaire focale ± systématisée ± bronchogramme aérique	*Pneumonie lobaire*
Opacités multifocales disséminées mal limitées, sans bronchogramme aérique (“mottes péribronchiques”)	*Pneumonie lobulaire*
Opacités interstitielles localisées ou diffuses	*Pneumonie interstitielle*
Nodules multiples	*Emboles septiques*
Opacité ronde	*Pneumonie ronde*
Normale	

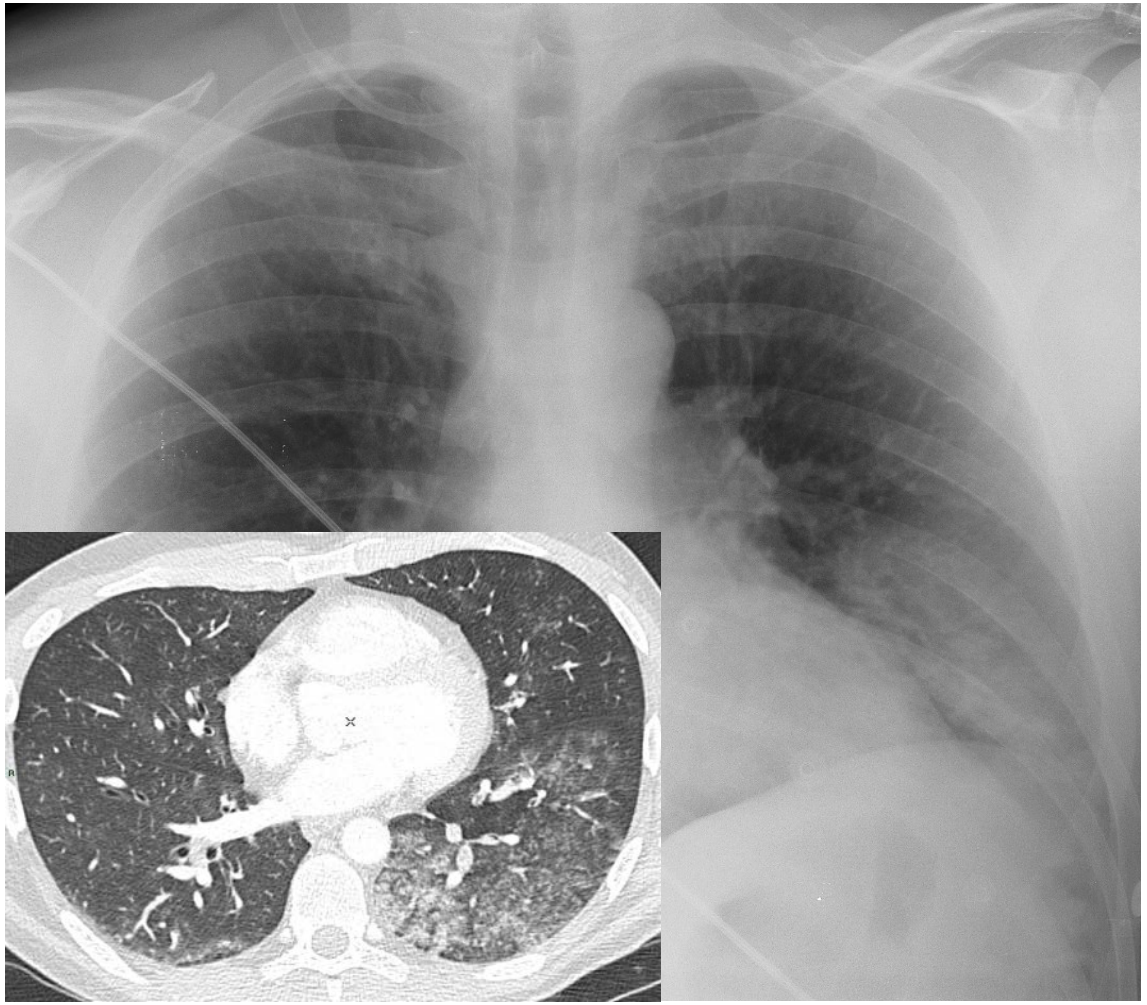
Tout « infiltrat » fébrile n'est nécessairement de cause infectieuse



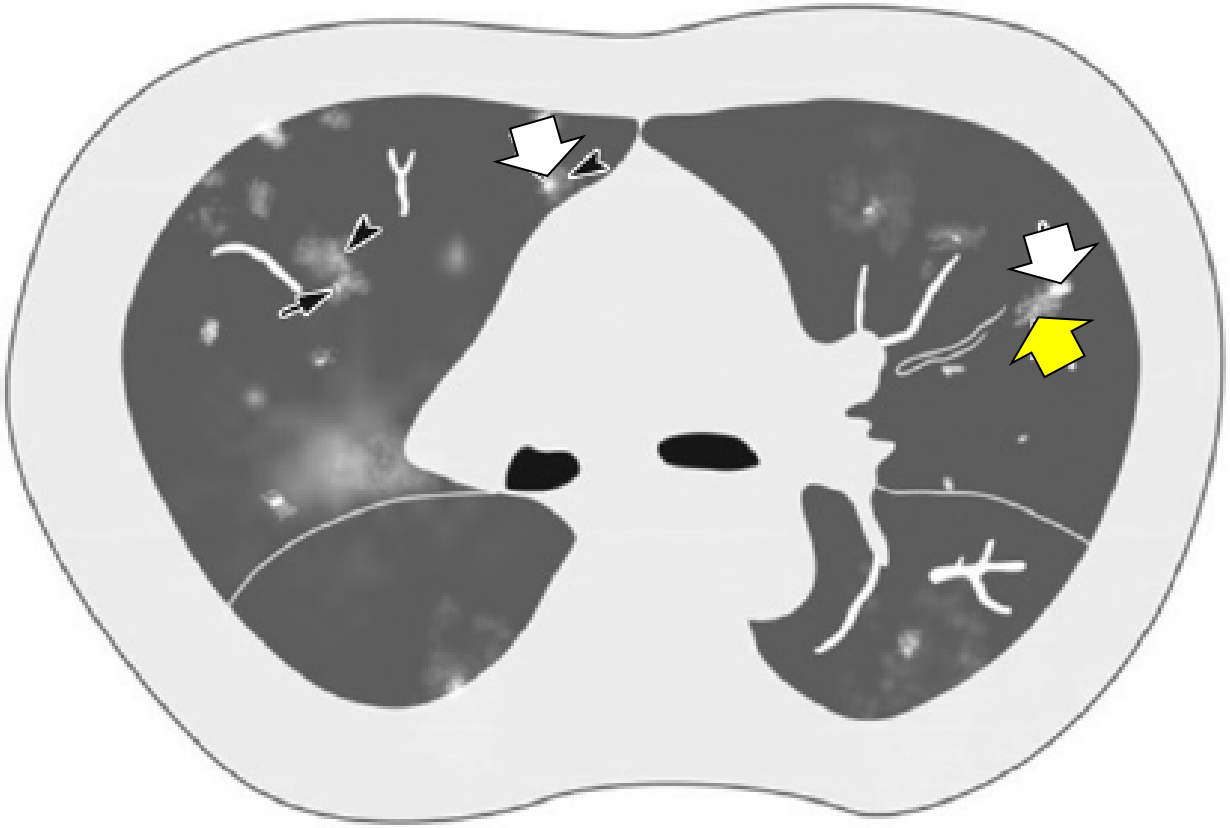
Tout « infiltrat » fébrile n'est nécessairement de cause infectieuse

Pneumopathie organisée

- Pneumopathie à éosinophile
- Pneumopathie médicamenteuse
- Œdème pulmonaire
- Infarctus pulmonaire
- Hémorragie pulmonaire
- …



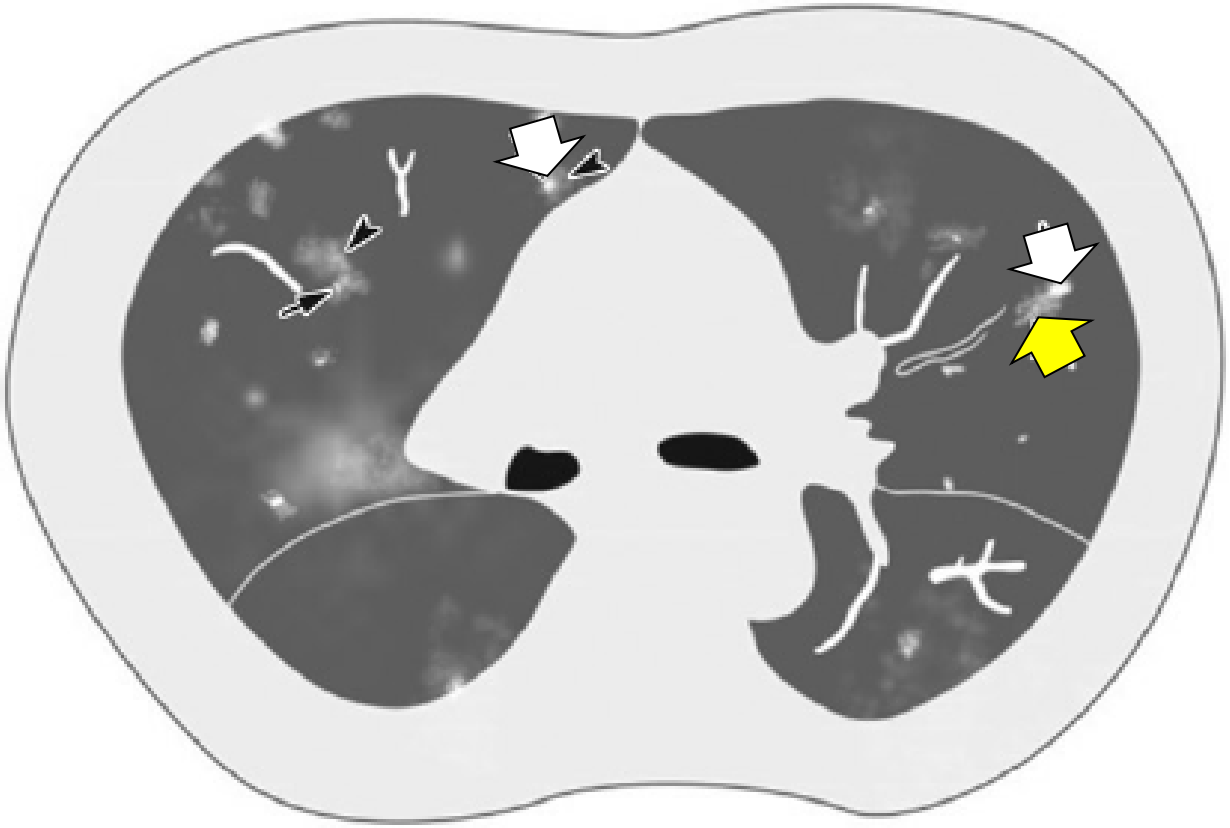
Différents aspects scannographiques



Opacités nodulaires multifocales 1–10-mm plus ou moins visibles (flèches blances) entourées d'un **halo ou d'opacités en verre dépoli en motte** (flèche jaune) dans les 2 poumons

RadioGraphics 2018; 38:719–739

Différents aspects scannographiques



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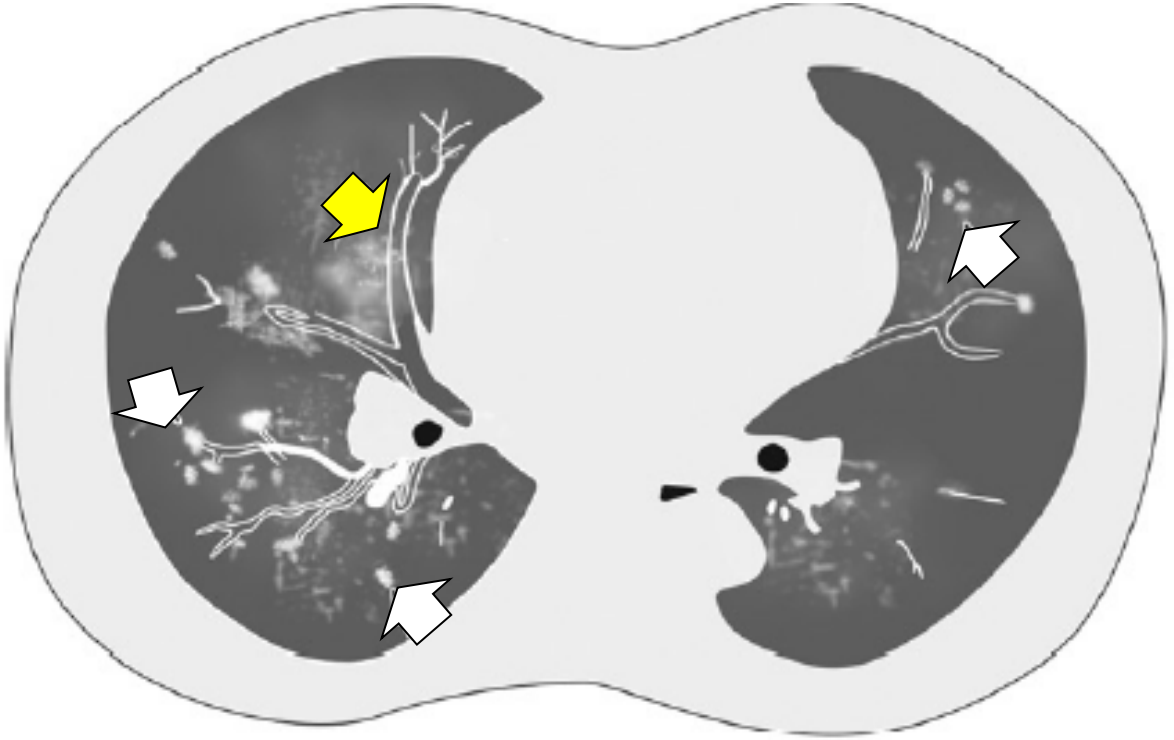
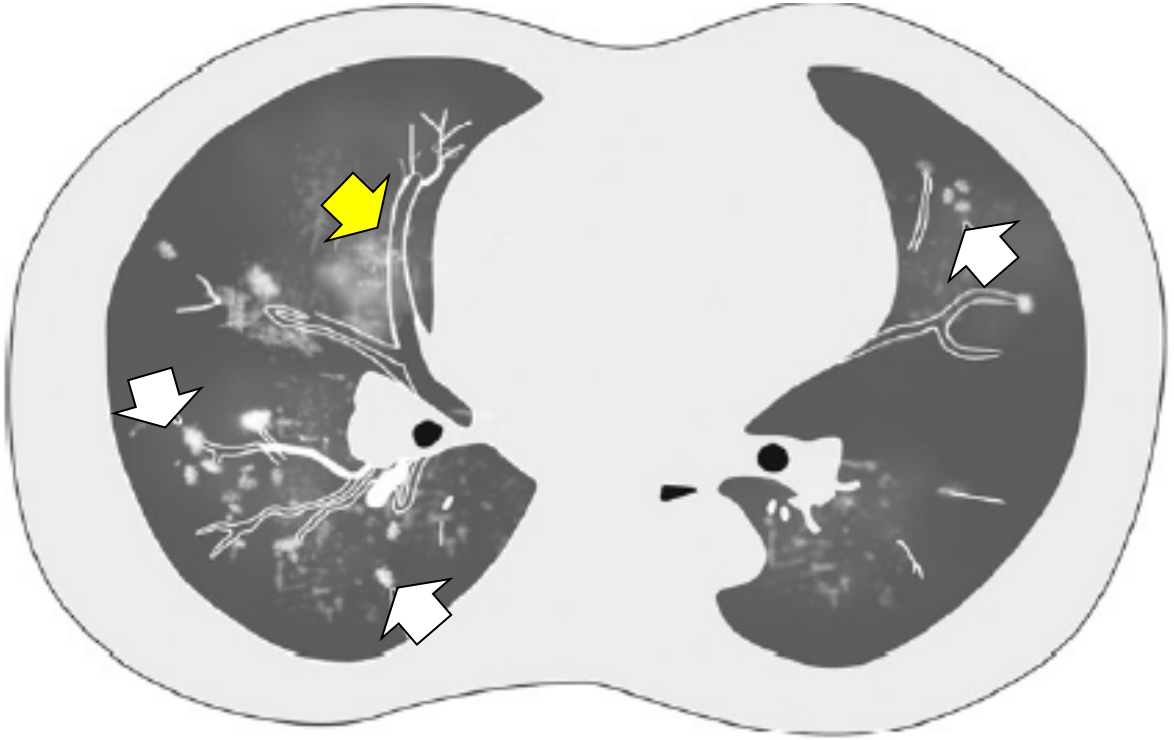


Multiples nodules (fleches blanche) ou **verre dépoli** (flèche jaune) **le long des axes bronchovasculaires**

RadioGraphics 2018; 38:719–739

Différents aspects scannographiques

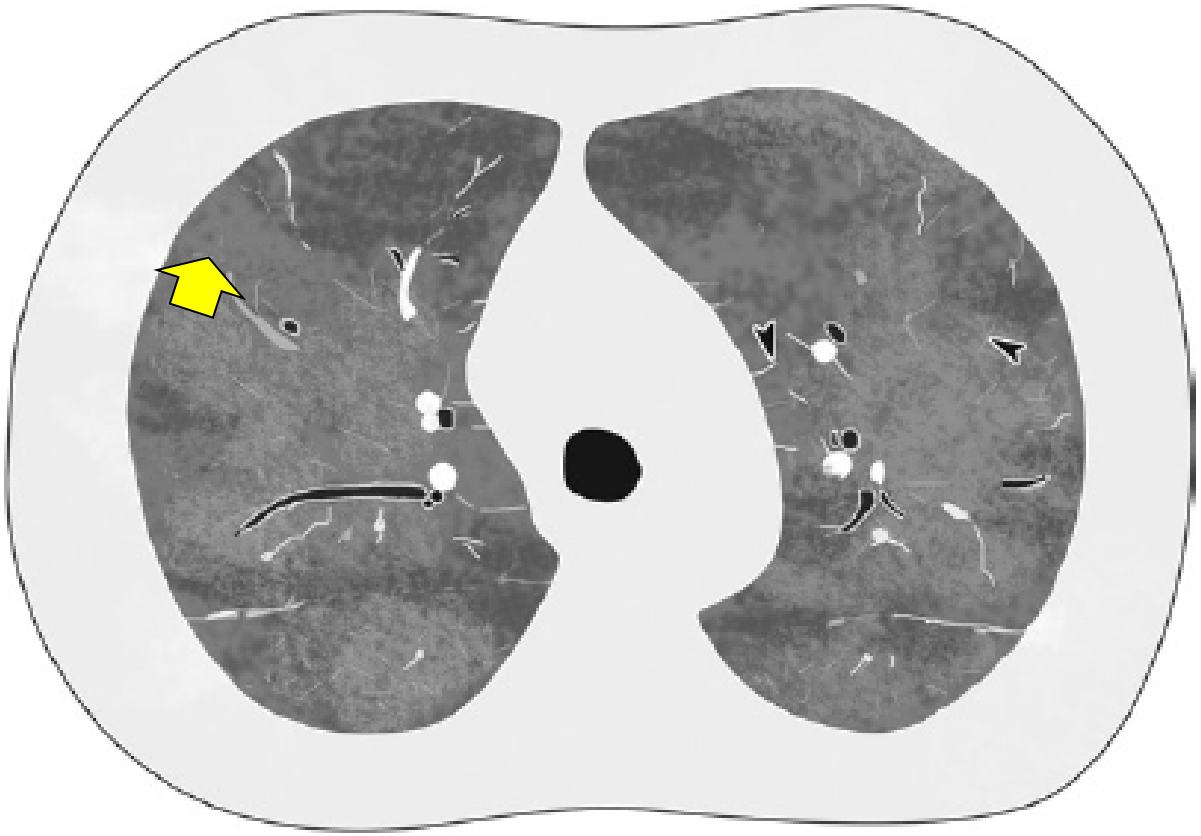


Multiples nodules (fleches blanche) ou **verre dépoli** (flèche jaune) **le long des axes bronchovasculaires**

Human metapneumovirus

RadioGraphics 2018; 38:719–739

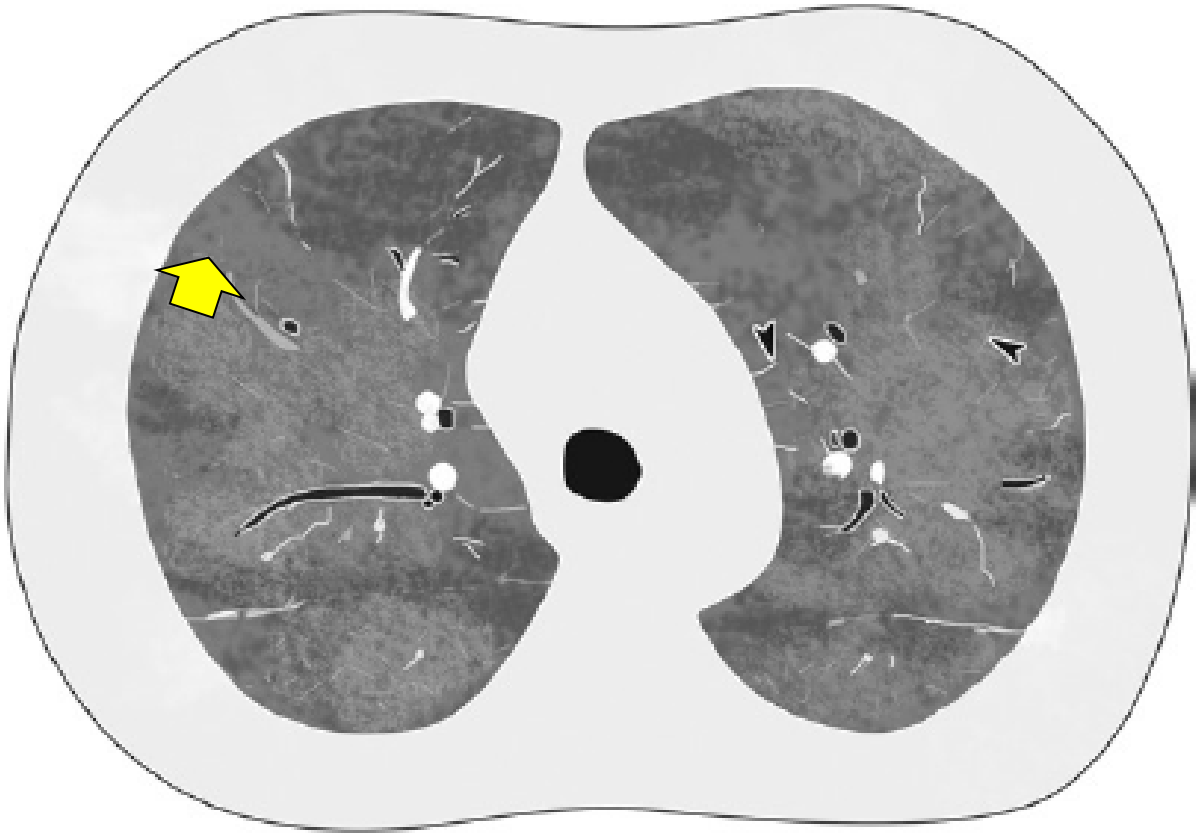
Différents aspects scannographiques



Aspect en verre dépoli diffus associé à un épaississement des septa interlobulaires des 2 poumons

RadioGraphics 2018; 38:719–739

Différents aspects scannographiques

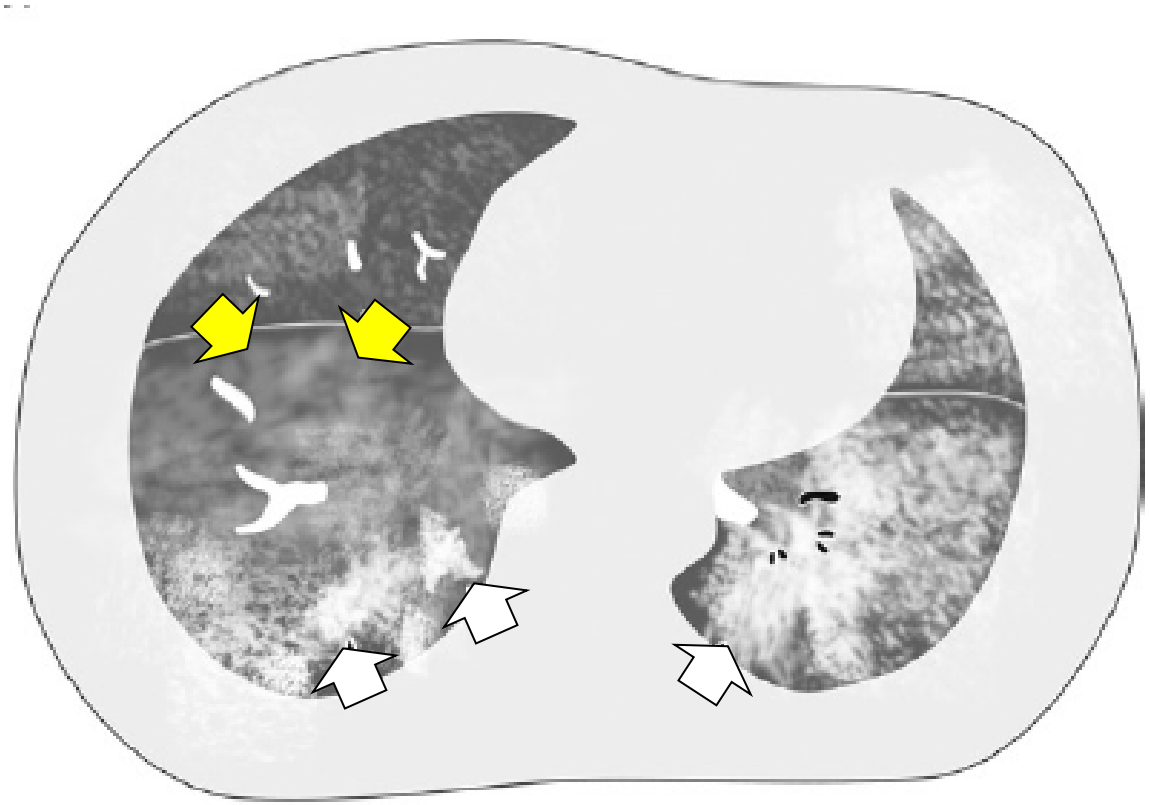


Aspect en verre dépoli diffus associé à un épaississement des septa interlobulaires des 2 poumons

CMV

RadioGraphics 2018; 38:719–739

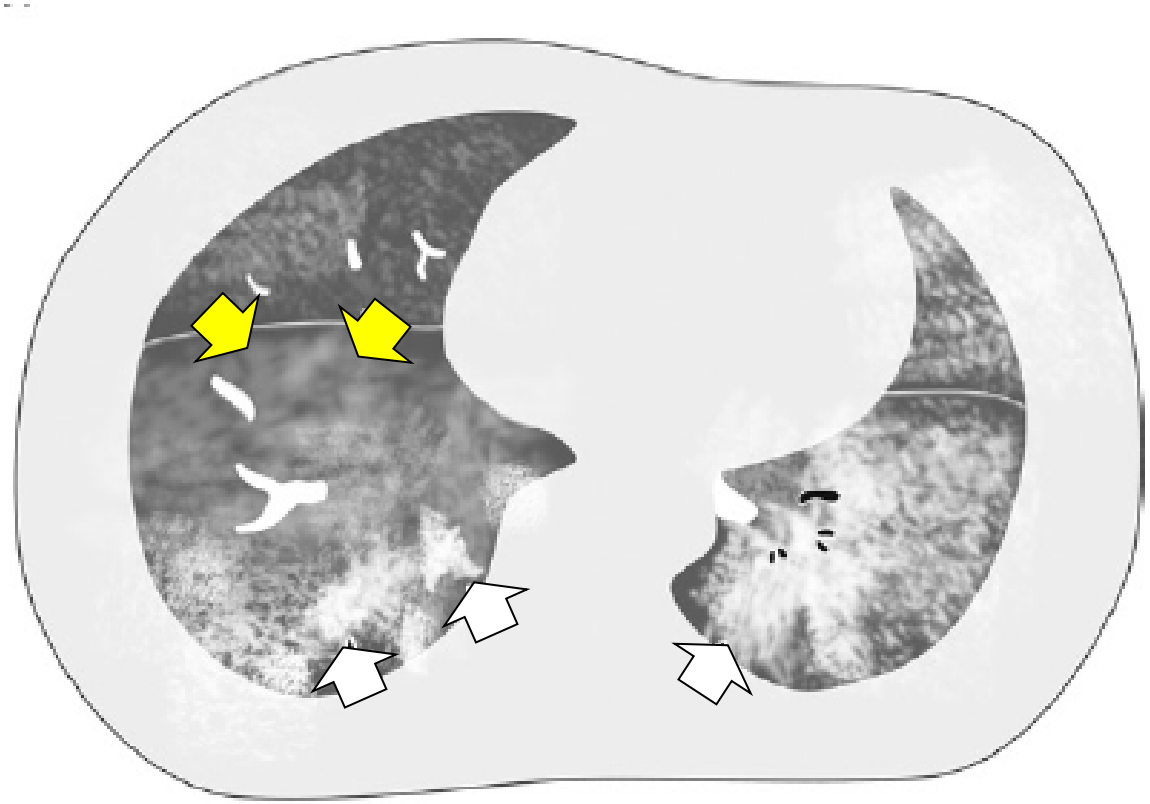
Différents aspects scannographiques



Multiples **zones de consolidation irrégulières** (flèches blanches) le long des axes bronchovasculaires et **aspects en verre dépoli diffus** (flèches jaunes) avec épaississement septaux bilatéraux

RadioGraphics 2018; 38:719–739

Différents aspects scannographiques

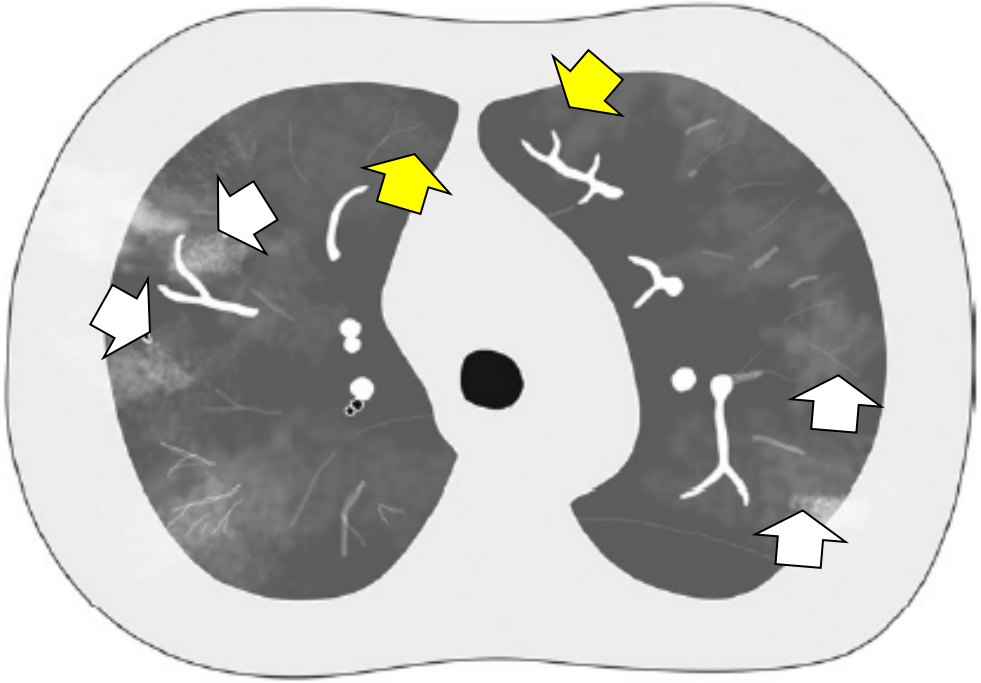


Multiples **zones de consolidation irrégulières** (flèches blanches) le long des axes bronchovasculaires et **aspects en verre dépoli diffus** (flèches jaunes) avec épaississement septaux bilatéraux

Influenza

RadioGraphics 2018; 38:719–739

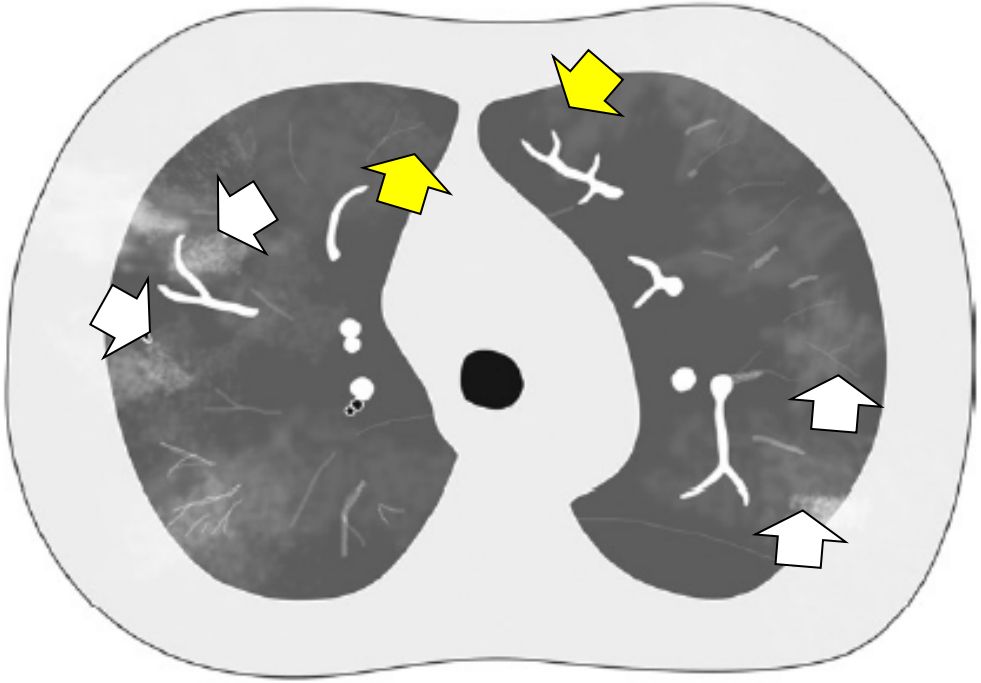
Différents aspects scannographiques



Multiples aspects en verre dépoli en mottes (flèches) avec épaississements interlobulaires des 2 poumons (pointes de flèches)

RadioGraphics 2018; 38:719–739

Différents aspects scannographiques



Multiples aspects en verre dépoli en mottes (flèches) avec épaississements interlobulaires des 2 poumons (pointes de flèches)

Rhinovirus

RadioGraphics 2018; 38:719–739

A comparative study of thin-section CT findings between seasonal influenza virus pneumonia and *Streptococcus pneumoniae* pneumonia

[1]A ONO, MD, [1]F OKADA, MD, [2]S TAKATA, MD, [3]K HIRAMATSU, MD, [4]Y ANDO, MD, [2]T NAKAYAMA, MD, [5]T MAEDA, MD and [1]H MORI, MD

Br J Radiol;87:2014_0051

Table 2. Thoracic CT findings for each type of pneumonia

Findings	Influenza virus ($n = 30$)	*Streptococcus pneumoniae* ($n = 71$)	*p*-value
Ground-glass attenuation	30 (100.0)	58 (81.7)	0.012
Bronchial wall thickening	14 (46.7)	30 (42.2)	NS
Crazy-paving appearance	8 (26.7)	7 (9.9)	0.030
Centrilobular nodules	7 (23.3)	32 (45.1)	0.040
Interlobular septal thickening	3 (10.0)	3 (4.2)	NS
Consolidation	0 (0.0)	54 (76.1)	<0.001
Cavity	0 (0.0)	0 (0.0)	NS
Mucoid impaction	0 (0.0)	37 (52.1)	<0.001
Pleural effusion	0 (0.0)	17 (23.9)	0.003
Lymph node enlargement	0 (0.0)	4 (5.6)	NS

NS, not significant.
Data in parentheses are percentages.

Intérêt du scanner dans le diagnostic étiologique de PAC

	Nodules centro lobulaires	Opacités en verres dépolis de distribution lobaire	Opacités segmentaires	Epaississement septum interlobulaire	Opacités en verres dépolis diffuses
Influenza	+++	+++	+		+
Rougeole	++	+	+		+
Hantavirus			++	+	+++
Adénovirus	++	+	+++		
Herpes simplex	+	+++	+++		+
HMPV	++	++			
Rhinovirus				++	++

Original Article | Thoracic Imaging

https://doi.org/10.3348/kjr.2016.17.6.940
pISSN 1229-6929 · eISSN 2005-8330
Korean J Radiol 2016;17(6):940-949

Korean Journal of Radiology
KJR

Clinical Features and Radiological Findings of Adenovirus Pneumonia Associated with Progression to Acute Respiratory Distress Syndrome: A Single Center Study in 19 Adult Patients

Min Jae Cha, MD[1], Myung Jin Chung, MD[2], Kyung Soo Lee, MD[2], Tae Jung Kim, MD[2], Tae Sung Kim, MD[2], Semin Chong, MD[1], Jungho Han, MD[3]

Table 3. Comparison of ARDS and Non-ARDS Groups according to Clinical and Radiological Factors

Characteristics	All (n = 19)	ARDS Group (n = 12)	Non-ARDS Group (n = 7)	*P*
Age (yr)	41.6 ± 19.1	43.3 ± 22.3	38.9 ± 15.1	0.651
Premorbid conditions (%)	8 (42)	5 (42)	4 (57)	0.650
Initial radiographic findings (%)				0.813
Normal	2 (11)	1 (8)	1 (14)	
Focal opacity	9 (47)	5 (42)	4 (57)	
Multifocal/diffuse opacity	8 (42)	6 (50)	2 (29)	
Radiographic disease course (%)				0.048
Type 1	2 (11)	0 (0)	2 (29)	
Type 2	9 (47)	5 (42)	4 (57)	
Type 3	2 (11)	1 (8)	1 (14)	
Type 4	6 (31)	6 (50)	0 (0)	
CT findings				
Unilateral/bilateral (%)	2 (11)/17 (89)	1 (8)/11 (92)	1 (14)/6 (86)	0.998
Ground-glass opacity (%)	19 (100)	12 (100)	7 (100)	N/A
Consolidation (%)	14 (74)	10 (83)	4 (57)	0.305
Micronodules (%)	3 (16)	2 (17)	1 (14)	0.997
Inter/intralobular septal thickening (%)	12 (63)	7 (58)	5 (71)	0.656
Pleural effusion (%)	13 (68)	11 (92)	2 (29)	0.010
Number of the involved lobes	4.2 ± 1.4	4.2 ± 1.6	4.1 ± 1.2	0.973
Total CT score	9.2 ± 4.8	12.8 ± 4.5	6.4 ± 4.1	0.007

ARDS = acute respiratory distress syndrome, CT = computed tomography, N/A = not applicable

Radiographie versus scanner thorax

	Radiographie de thorax		Scanner thorax	
	Face	Face + Profil	Low dose	Full dose
Couts (euros)	21,28			123,8 à 79,8 euros
Irradiation	0,02 mSv	0,05mSv	0,5 mSV	1 à 3 mSv
Durée examen	< 5 min	< 5 min	10-15 min	10-15 min
Durée interprétation	< 5 min	< 5 min	10-15 min	10-15 min
Disponibilité	70 appareils de radiographie / 10^6 habitants		17 scanners / 10^6 habitants	

Early Chest Computed Tomography Scan to Assist Diagnosis and Guide Treatment Decision for Suspected Community-acquired Pneumonia

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Low-dose computed tomography for the diagnosis of pneumonia in elderly patients: a prospective, interventional cohort study

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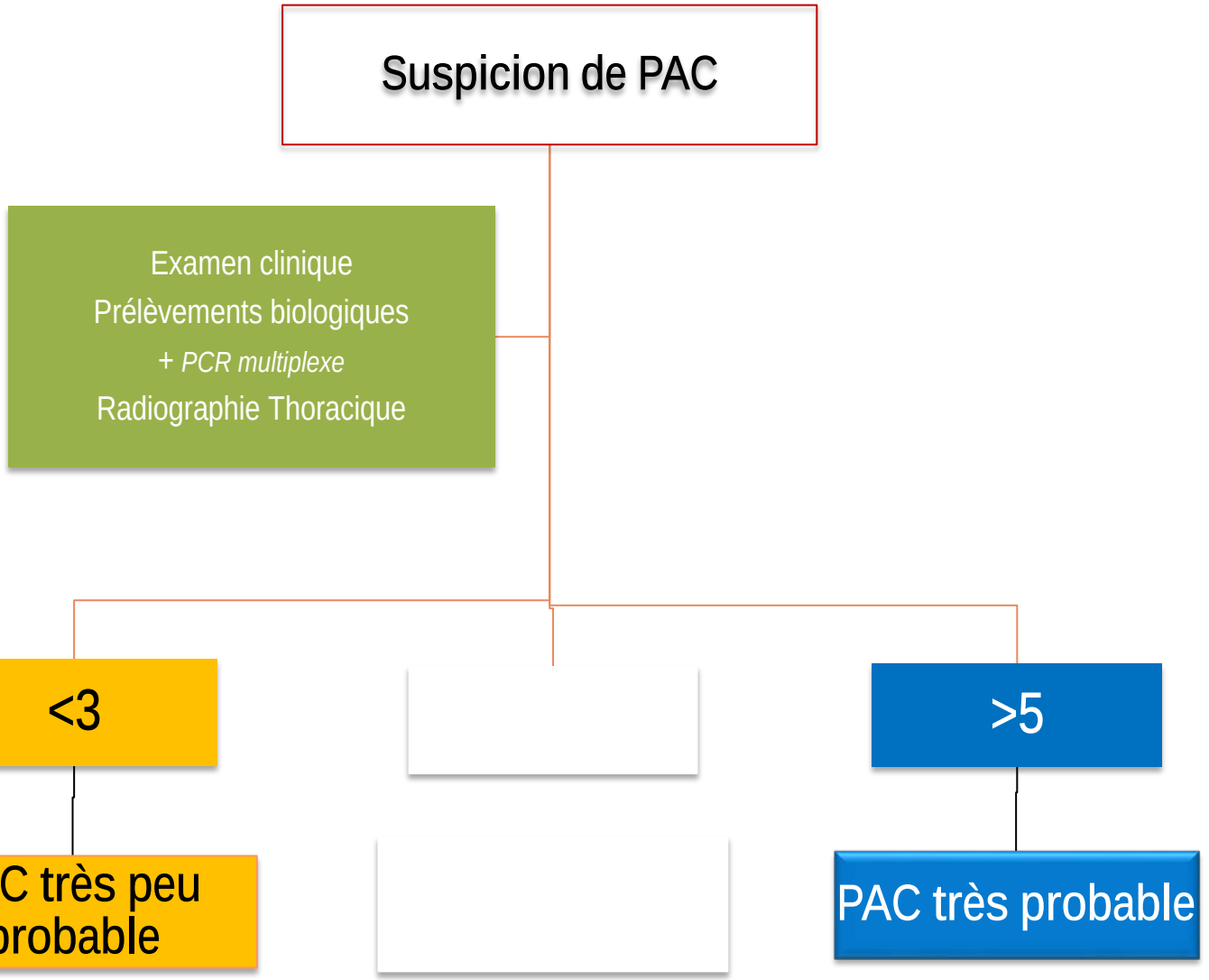
ESCAPED score

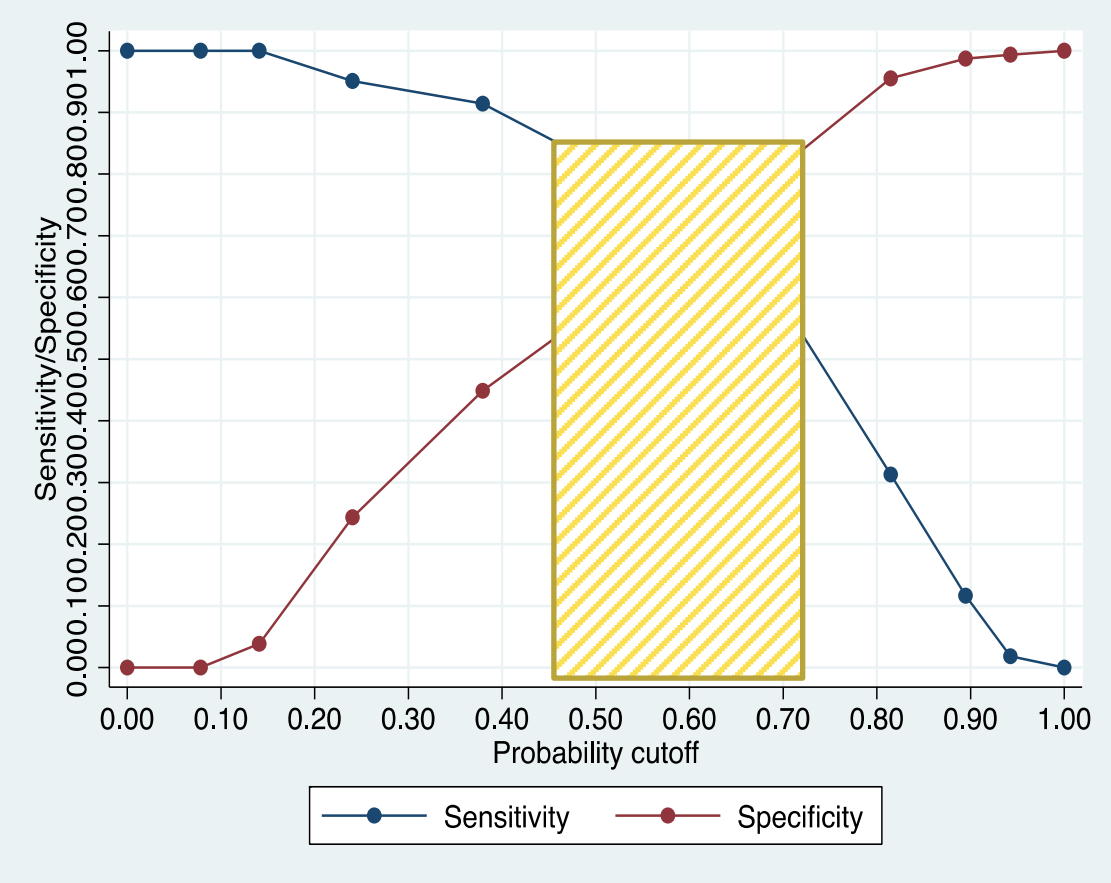
	Bootstrap procedure			
	Incidence Risk Ratio [95%CI]	p-value	Beta coefficient	weight
Cough	1.4 [1.0-1.9]	0.046	0.32	1
Chest pain	1.3 [1.0-1.6]	0.02	0.27	1
Fever (≥ 38° C)	1.3 [1.0-1.6]	0.031	0.24	1
Positive multiplex PCR* except rhinovirus in nasopharyngeal swab	1.4 [1.1-1.7]	0.006	0.30	1
C reactive protein **≥ 50 mg/L**	1.7 [1.3-2.2]	<0.001	0.51	2
Chest X-ray Parenchymal infiltrate	1.7 [1.3-2.3]	<0.001	0.55	2

PCR: multiplex respifinder et PCR pneumocoque

Algorithme ESCAPED



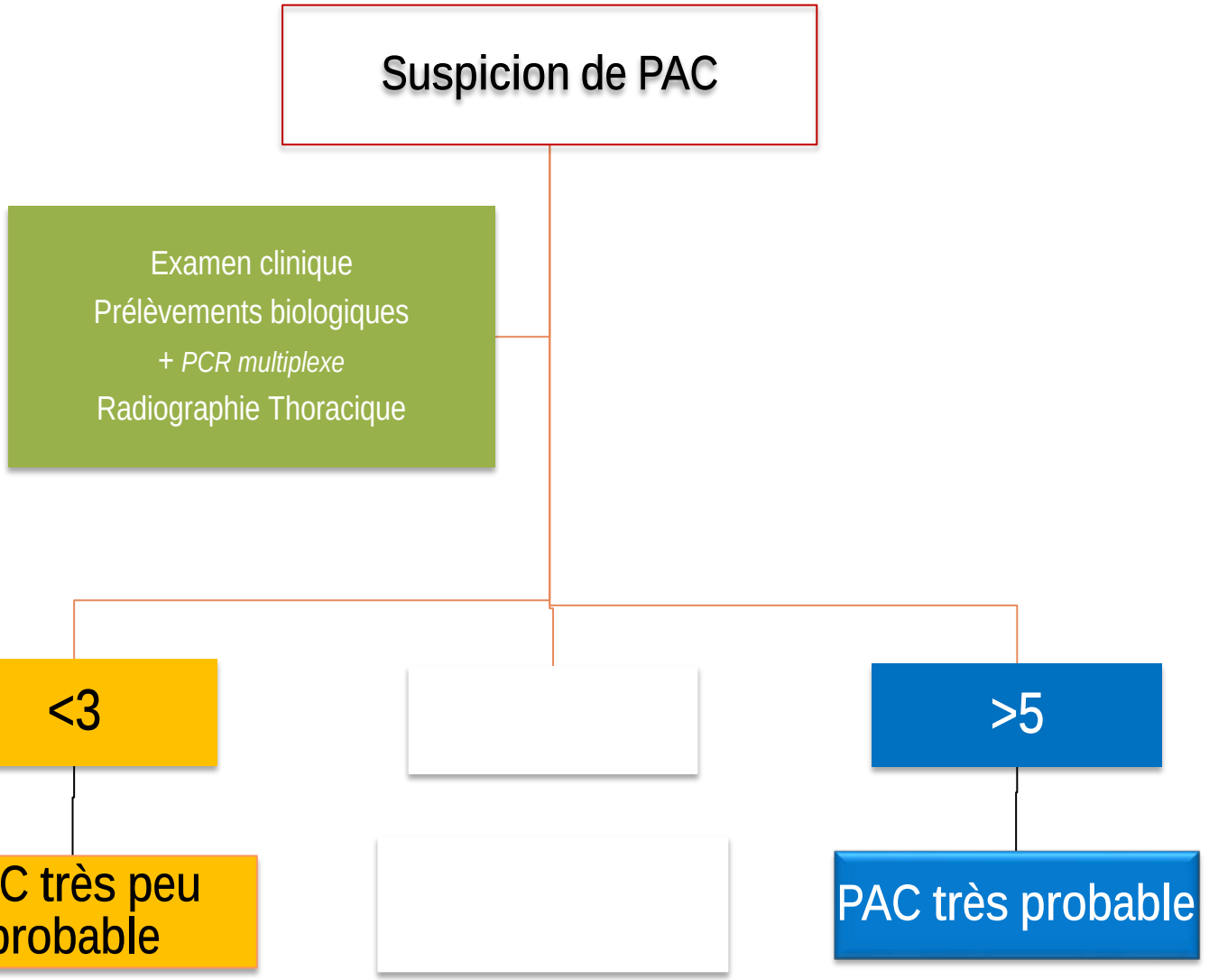
ESCAPED SCORE : Zone grise



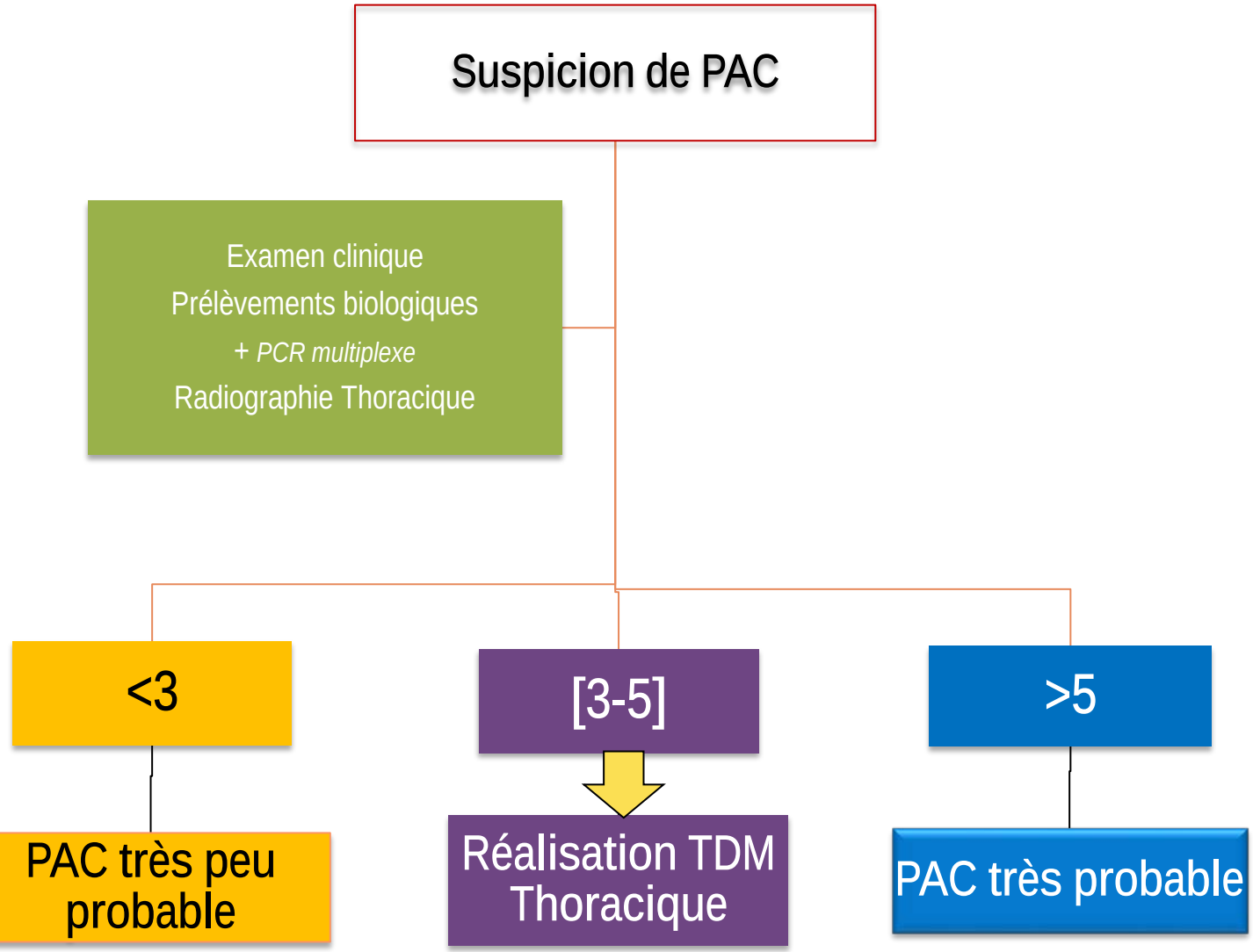
Zone Grise
[3-5]

55% des patients

Algorithme ESCAPED



Algorithme ESCAPED



Algorithme ESCAPED

Suspicion de PAC

	ED physician (N = 319)	P-ESCAPED Algorithm derivation cohort (N=319)
AUC	0.60 (0.56-0.64)	0.81 (0.77-0.85)
Sensitivity	91%	73%
Specificity	28%	89%
Positive predictive value	57%	88%
Negative predictive value	76%	76%

PAC très peu probable

Réalisation TDM Thoracique

PAC très probable

Algorithme ESCAPED

Suspicion de PAC

	ED physician (N = 319)	P-ESCAPED Algorithm derivation cohort (N=319)	P-ESCAPED Algorithm validation cohort (N=200)
AUC	0.60 (0.56-0.64)	0.81 (0.77-0.85)	0.80 (0.73-0.87)
Sensitivity	91%	73%	88%
Specificity	28%	89%	72%
Positive predictive value	57%	88%	86%
Negative predictive value	76%	76%	75%

PAC très peu probable

Réalisation TDM Thoracique

PAC très probable

Conclusion: Indications raisonnées de la tomodensitométrie thoracique

- Virus isolés deux fois plus fréquemment que bactéries
- Mauvaise performance de la radiographie thoracique
- Démarche diagnostique:
  - **Affirmer la PAC**: PCR nasopharyngée algorithme ESCAPED
    Scanner chez environ 1 patient / 2
  - **Retenir la responsabilité virale:** analyse du pattern radiologique
- Démarche thérapeutique / pronostique:
  - Antibiothérapie: initiation / interruption
  - Initiation d'antiviraux si possible
  - Détection de séquelles / causes favorisantes

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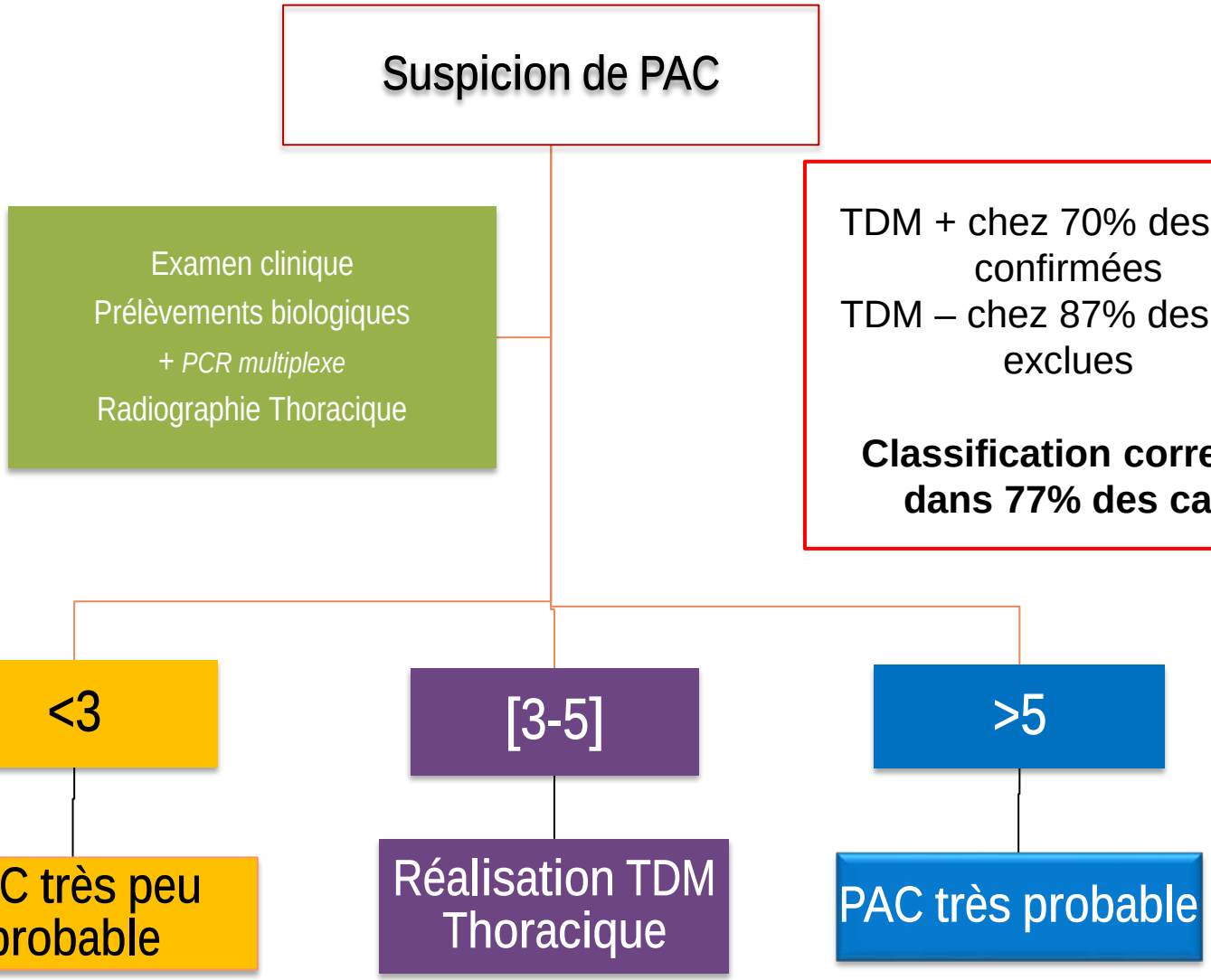

Table 2: Pathogenesis and CT Findings of Viral Pneumonia

Family [subfamily]	Common Name	Transmission*	Pathogenesis	Typical CT Findings						Systemic Involvement
				Distribution	Consolidation	GGO	Nodule	Bronchial Wall Thickening	Pleural Effusion	
Adeno-	Adenovirus	Respiratory, fecal-oral, conjunctival	Bronchiolar and alveolar damage	Multifocal	+++	+++	Centrilobular+	UC	C	Not definite
Herpes- [Alphaherpes-]	HSV	Contact (oral or genital secretion)	Cytopathic effect with diffuse alveolar damage	Multifocal random, or segmental	++	+++	+	UC	F	Gingivostomatitis, pharyngitis and herpes labialis (HSV1)
	Varicella-zoster virus	Contact, airborne (aerosol, droplets)	Hematogenous spread to alveolus, cytopathic effect with mononuclear cell infiltration	Multifocal	Rare	Surrounding halo	1–10 mm (in late phase, calcification)	UC	Rare	Skin rash
Herpes- [Betaherpes-]	CMV	Contact, transplacental, blood transfusion	Cytopathic effect with diffuse alveolar damage	Diffuse	++	++++	++	UC	Rare	Not definite
Herpes- [Gammaherpes-]	Epstein-Barr virus	Oral, blood transfusion, organ transplantation	Mononuclear inflammatory cell infiltration along bronchovascular bundles and interlobular septa	Diffuse (pneumonia is rare)	Rare	++	Rare	UC	V	Infectious mononucleosis, mediastinal LAP, splenomegaly
Parvo-[Parvo-]	Bocavirus†	Aerosol and contact	Induced cytokine expression	Diffuse	++	++	Rare	UC	C	Not definite
Paramyxo-	HPIV	Contact, droplet	Bronchiolar and alveolar damage with mucus plugging	Airway, multifocal	+	+	Centrilobular++	C	UC	Not definite
	Measles	Airborne (aerosol, droplets), contact with secretion or skin rash	Bronchiolar and alveolar epithelial damage with multinucleated giant cell formation	Multifocal	Rare	+	+	UC	C	Hilar LAP, gastroenteritis, encephalins
	Mumps†	Droplets or aerosol, transplacental	Mononuclear cell infiltration of bronchiole and alveolar septa	Multifocal	Rare	++	Rare	UC	Rare	Parotid gland (95% of patients)

Pneumo-	RSV	Contact, aerosol	Destruction of bronchial and alveolar epithelium with small airway obstruction	Airway, multifocal	+	+	Centrilobular+++	C	C	Not definite
	HMPV	Direct or close contact, droplet, aerosol	Upregulation of cytokines leads to perivascular and peribronchiolar infiltration	Airway, multifocal	+	+	Centrilobular+++	C	UC	Not definite
Hanta-	HCPS, HFRS	Aerosol	Direct involvement of vascular endothelium resulting in increased endothelial permeability	Pulmonary edema	Rare	Rare	Rare	UC	F	ARF (HFRS), thrombocytopenia, hypotension, shock (HCPS)
Phenui-	SFTS	Tick-borne	Upregulation of cytokines resulting in increased endothelial permeability	Pulmonary edema	Rare	Rare	Rare	UC	F	Shock, multiorgan failure, thrombocytopenia
Orthomyxo-	Influenza	Droplet, airborne	Destruction of airway epithelial barrier, resulting in necrotizing bronchitis and diffuse alveolar damage	Airway, multifocal	+	+	++	C	UC	Not definite
Corona- [Corona-]	Human coronavirus	Droplet, airborne, contact	SARS: diffuse alveolar damage by involving angiotensin-converting enzyme; MERS: dysregulation of the host cellular transcriptome resulting in apoptosis	Peripheral, multifocal	+++	+	Rare	UC	Rare	Not definite
Picorna-	Rhinovirus	Droplet, aerosol, or contact	Disruption of epithelial barrier function causing increase vascular leakage and mucus secretion; no cytopathic effect	Multifocal	+	++	Rare	UC	Rare	Not definite
	Enterovirus	Fecal-oral, contact, droplet	Attachment to decay-accelerating factor of the lower respiratory tract	Multifocal	+	++	Rare	UC	Rare	Not definite

Note.—ARF = acute renal failure, C = common, F = frequent, HCPS = hantavirus cardiopulmonary syndromes, HFRS = hemorrhagic fever with renal syndrome, LAP = lymphadenopathy, SFTS = severe fever with thrombocytopenia syndrome, UC = uncommon, V = variable. Percentage of the area of lung involvement: + = 10%–25%, ++ = 25%–50%, +++ = 50%–75, ++++ = greater than 75%.

*The main routes of transmission are listed first.

†CT findings of Bocavirus pneumonia or pulmonary involvement of mumps are not well established; there are few case reports in the literature.

Table 3: Taxonomy of Viral Pneumonia Pathogens, Diagnostic Tests, and Treatment

Order (-virales)	Family (-viridae) and Subfamily [-virinae]	Genus (-virus)	Species (-virus)	Common Name	Diagnostic Test*	Treatment Option†
Adeno-	Adeno-	Mastadeno-	Human mastadeno-	Adenovirus	NAT, antigen detection, culture	Cidofovir, IVIG
Herpes-	Herpes-[Alphaherpes-]	Simplex-	Human alphaherpes- 1 and 2	HSV	NAT, antigen detection, Tzanck smear, serology	Acyclovir
		Varicello-	Human alphaherpes- 3	Varicella zoster virus	NAT, serology, culture	Acyclovir
	Herpes- [Betaherpes-]	Cytomegalo-	Human betaherpes- 5	CMV	NAT, CMV antigenemia (blood), culture, serology	Ganciclovir, foscarnet, IVIG, CMV IG
	Herpes- [Gammaherpes-]	Lymphocrypto-	Human gammaherpes- 4	Epstein-Barr virus	NAT, serology	Acyclovir
Unassigned	Parvo-[Parvo-]	Bocaparvo-	Primate bocaparvo- 1 and 2	Bocavirus	NAT	No specific treatment
Mononega-	Paramyxo-	Respiro-	Human respiro- 1 and 3	HPIV	NAT, culture, antigen detection	Ribavirin, IVIG
		Morbilli-	Measles morbilli-	Measles	NAT, serology, culture, antigen detection	Ribavirin
		Rubula-	Mumps rubula-	Mumps	NAT, serology, culture	No specific treatment
	Pneumo-	Orthopneumo-	Human orthopneumo-	RSV	NAT, antigen detection, culture	Ribavirin, IVIG
		Metapneumo-	Human metapneumo-	HMPV	NAT, culture, antigen detection	Ribavirin
Bunya-	Hanta-	Orthohanta-	Hantaan orthohanta-	Hantavirus cardiopulmonary syndromes, hemorrhagic fever with renal syndrome	NAT (blood), serology	No specific treatment
	Phenui-	Phlebo-	Severe fever with thrombocytopenia syndrome phlebo-	Severe fever with thrombocytopenia syndrome	NAT (blood), serology	No specific treatment
			Rift Valley fever phlebo-	Rift Valley fever	NAT (blood), serology	No specific treatment
Unassigned	Orthomyxo-	Influenza-	Influenza-	Influenza	NAT, antigen detection, culture	Neuraminidase inhibitor (oseltamivir, zanamivir, peramivir), M2 protein inhibitor (amantadine, rimantadine)
Nido-	Corona-[Corona-]	Alphacorona-	Human corona-	Coronavirus	NAT, serology	No specific treatment
		Betacorona-	SARS-related	SARS	NAT, serology	No specific treatment
			MERS-related	MERS	NAT, serology	Ribavirin, interferon α-2a
Picorna-	Picorna-	Entero-	Rhino-	Rhinovirus	NAT, culture	No specific treatment
			Entero-	Enterovirus	NAT, culture	

Note.—Viral order names end with "virales," family names end with "viridae," subfamily names end with "virinae," genus names end with "virus," and species names include the name of the disease with "virus." IG = immunoglobulin, IVIG = intravenous immunoglobulin, NAT = nucleic acid amplification test.

*Specimens for diagnostic test were respiratory samples (nasopharyngeal swab or aspirate, sputum, tracheal aspirate, or bronchoalveolar lavage fluid), unless otherwise stated.

†In immunocompromised patients, the reduction of immunosuppressive drugs generally is recommended.