



THOMAS LANGER



PERSONAL INFORMATION

Name **THOMAS LANGER**

Address

Telephone

Fax

E-mail **Thomas.Langer@unimib.it**

Nationality Italian

Date of birth 5TH June 1983

EDUCATION AND TRAINING

- Dates (from – to) **2002:** Baccalaureate degree at the DSM, Deutsche Schule Mailand
- 2002-2008:** Medical school at the university of Milan.
- 2008:** Degree in medicine (110/110 cum laude). Title of the thesis: Sodium Bicarbonate test: a new method for the evaluation of volemia in the critically ill patient.
- 2008 -2014:** Residency in Anesthesiology and Intensive Care Medicine of the Hospital Policlinico IRCCS Ca' Granda Milan, Italy.
- 2011-2012:** National Academics/ National Research Council Fellow at the US Army Institute for Surgical Research, Fort Sam Houston, San Antonio, TX, USA.
- 2014:** Board certification in Anesthesia and Intensive Care Medicine (70/70 cum laude). Title of the thesis: Extracorporeal gas exchange and spontaneous breathing: an alternative to mechanical ventilation.
- 2016-17:** Postdoc Fellowship at the Department of Pathophysiology and Transplantation (Director: Prof. A. Pesenti)
- 2017- 2019:** Researcher (RTD-A) at the Department of Pathophysiology and Transplantation (Director: Prof. A. Pesenti)
- 2017:** Habilitation as Associate Professor (Abilitazione Scientifica Nazionale, Bando D.D. 1532/2016, Settore concorsuale 06/L1)
- 2019 - :** Assistant Professor (RTD-B) at the Department of Medicine and Surgery of the University of Milano-Bicocca.

Certifications:

- 2010:** Winfocus, Echocardiography for intensivists certification
- 2011:** Advanced Trauma Life Support certification
- 2013:** European Pediatric Life Support certification
- 2014:** Advanced Life Support certification
- 2012:** Cardiohelp training certification, San Antonio, Texas
- 2015:** Refresher ATLS

Societies:

- 2009 - :** Regular member of the SIAARTI , Società Italiana Anestesia Analgesia Rianimazione e Terapia Intensiva
- 2011- 2013 :** Regular member of the APS, American Physiological Society
- 2011- 2013 :** Regular member American Thoracic Society

2013- : Regular member of the European Society of Intensive Care Medicine
2014- : Associate member of the European Society of Anesthesiology

RESEARCH ACTIVITY

• Dates (from – to)

FIELDS OF INTEREST: Pediatric critical care, acid-base equilibrium, fluid therapy, renal physiology, respiratory physiology, pathophysiology of respiratory failure, extracorporeal respiratory support, control of breathing.

2006-2008: clinical research in post-operative intensive care unit. Title: Sodium-bicarbonate test: a new method for the assessment of volemia in the critically ill patient.

2006 – 2008: development and validation of the urinary analyzer K.IN.G® (Kidney Instant monitorinG, collaboration of Kardia and Orvim, <http://www.kardia.it/king/downloads.asp>).

2008 – 2011: Experimental research: large animal model of ventilator-induced lung injury (VILI). Search for a safe threshold for mechanical ventilation and investigation on the protective effects of positive end expiratory pressure (PEEP).

2010 – 2011: Principal investigator of an animal study on acid-base and renal effects of acute dilutions with different crystalloid solutions. **Title:** Dilution with three different solutions: plasmatic effects and quantity and quality of urinary output.

2010-2011: Principal investigator of a study analyzing the shift of electrolytes due to acute changes in partial pressure of carbon dioxide during extracorporeal respiratory support. **Title:** Contribution of red blood cells to the compensation for hypocapnic alkalosis through plasmatic SID variations.

2011-2013 : Principal Investigator of the study : « *Pathophysiology of spontaneous breathing during extracorporeal respiratory support in healthy sheep and in sheep with ARDS* » conducted at the US Army Institute for Surgical Research, Fort Sam Houston, San Antonio, TX, USA.

2014- 2017: Co-PI and coordinator of the study: « *Influence of intraoperative arterial blood pressure target on the development of post-operative cognitive dysfunction after non-cardiac surgery in patients aged 75 and older: a randomized controlled trial.* »

Clinical Activity:

2014- 2016: Staff Anesthesiologist and Intensive Care Physician at the Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan Italy. Anesthesia for Liver, Lung, Kidney Transplantation, Anesthesia for Thoracic, General, Urologic, Ear-Nose- Throat, Maxillofacial and Eye Surgery, Surgical Intensive Care Unit.

2016-2017 : Consultant at the Intensive Care Unit of the San Marco Hospital of Osio Sotto, Bergamo.

2017- : Staff Intensivist in the Pediatric Intensive Care Unit, Clinica De Marchi, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan Italy

2019 - : Staff intensivist in the General Intensive Care and Burn Unit of the Hospital Niguarda Ca' Granda, Milan, Italy.

2020 : Coordinator of the COVID-ICU « Corona 2 » (8 Bed) during the first wave of the pandemic

PERSONAL SKILLS AND COMPETENCES

MOTHER TONGUE

ITALIAN, GERMAN

OTHER LANGUAGES

ENGLISH

• Reading skills EXCELLENT
• Writing skills VERY GOOD
• Verbal skills VERY GOOD

FRENCH

• Reading skills GOOD
• Writing skills SUFFICIENT
• Verbal skills GOOD

TECHNICAL SKILLS
AND COMPETENCES

Mechanical Ventilators, Cardiohelp, ECMO –ECCO₂R. Adequate knowledge of statistical programs (SigmaPlot, SigmaStat

Peer reviewed publications:

1. Caironi P, Langer T, Gattinoni L. Acute lung injury/acute respiratory distress syndrome pathophysiology: what we have learned from computed tomography scanning. *Curr Opin Crit Care*. 2008 Feb;14(1):64-9.
2. Caironi P, Langer T, Taccone P, Bruzzone P, De Chiara S, Vagginelli F, Caspani L, Marengi C, Gattinoni L. Kidney instant monitoring (K.IN.G): a new analyzer to monitor kidney function. *Minerva Anesthesiol*. 2010 May;76(5):316-24. Epub 2010 Mar 24.
3. Protti A, Cressoni M, Santini A, Langer T, Mietto C, Febres D, Chierichetti M, Coppola S, Conte G, Gatti S, Leopardi O, Masson S, Lombardi L, Lazzerini M, Rampoldi E, Cadringer P, Gattinoni L. Lung Stress and Strain During Mechanical Ventilation: Any Safe Threshold? *Am J Respir Crit Care Med*. 2011 Feb; 183 (10):1354-62.
4. Caironi P, Langer T, Carlesso E, Protti A, Gattinoni L. Time to generate ventilator-induced lung injury among mammals with healthy lungs: a unifying hypothesis. *Intensive Care Med*. 2011 Dec;37(12):1913-20. Epub 2011 Nov 4.
5. Gattinoni L, Carlesso E, Langer T. Clinical Review: Extracorporeal Membrane Oxygenation. *Crit Care*. 2011;15(6):243. Epub 2011 Dec 8.
6. Gattinoni L, Carlesso E, Langer T. Towards ultraprotective mechanical ventilation. *Curr Opin Anaesthesiol*. 2012 Apr;25(2):141-7.
7. Langer T, Carlesso E, Protti A, Monti M, Comini B, Zani L, Andreis DT, Iapichino GE, Dondossola D, Caironi P, Gatti S, Gattinoni L. In vivo conditioning of acid-base equilibrium by crystalloid solutions: an experimental study on pigs. *Intensive Care Med*. 2012 Apr;38(4):686-93. Epub 2012 Jan 25
8. Langer T, Vecchi V, Belenkiy SM, Cancio LC, Gattinoni L, Batchinsky A. Pressure-guided positioning of bicaval dual-lumen catheters for venovenous extracorporeal gas exchange. *Intensive Care Med*. 2013 Jan;39(1):151-4.
9. Belenkiy S, Ivey KM, Batchinsky AI, Langer T, Necsoiu C, Baker W, Salinas J, Cancio LC. Noninvasive carbon dioxide monitoring in a porcine model of acute lung injury due to smoke inhalation and burns. *Shock*. 2013 Jun;39(6):495-500.
10. Protti A, Andreis DT, Monti M, Santini A, Sparacino CC, Langer T, Votta E, Gatti S, Lombardi L, Leopardi O, Masson S, Cressoni M, Gattinoni L. Lung stress and strain during mechanical ventilation: any difference between statics and dynamics? *Crit Care Med*. 2013 Apr;41(4):1046-55.
11. Vecchi V, Langer T, Bellomi M, Rampinelli C, Chung KK, Cancio LC, Gattinoni L, Batchinsky A. Low-dose CT for quantitative analysis in acute respiratory distress syndrome. *Crit Care*. 2013 Aug 31;17(4):R183.
12. Langer T, Vecchi V, Belenkiy S, Cannon JW, Chung KK, Cancio LC, Gattinoni L, Batchinsky A. Extracorporeal gas exchange and spontaneous breathing for the treatment of Acute Respiratory Distress Syndrome: an alternative to mechanical ventilation? *Crit Care Med*. 2014 Mar;42(3):e211-20.
13. Chiumello D, Langer T, Vecchi V, Luoni S, Colombo A, Brioni M, Froio S, Cigada I, Coppola S, Protti A, Lazzerini M, Gattinoni L. Low-dose chest computed tomography for quantitative and visual anatomical analysis in patients with acute respiratory distress syndrome. *Intensive Care Med*. 2014 May;40(5):691-9

14. Langer T, Scotti E, Carlesso E, Protti A, Zani L, Chierichetti M, Caironi P, Gattinoni L. Electrolyte shifts across the artificial lung in patients on extracorporeal membrane oxygenation: interdependence between partial pressure of carbon dioxide and strong ion difference. *J Crit Care*. 2015 Feb;30(1):2-6. doi: 10.1016/j.jcrc.2014.09.013. Epub 2014 Sep 22
15. Langer T, Ferrari M, Zazzeron L, Gattinoni L, Caironi P. Effects of intravenous solutions on acid-base equilibrium: from crystalloids to colloids and blood components. *Anaesthesiol Intensive Ther*. 2014 Nov-Dec;46(5):350-60. doi: 10.5603/AIT.2014.0059.
16. Caironi P, Langer T, Gattinoni L. Albumin in critically ill patients: the ideal colloid? *Curr Opin Crit Care*. 2015 Aug;21(4):302-8. doi: 10.1097/MCC.0000000000000223.
17. Prat NJ, Meyer AD, Langer T, Montgomery RK, Parida BK, Batchinsky AI, Cap AP. Low-Dose Heparin Anticoagulation During Extracorporeal Life Support for Acute Respiratory Distress Syndrome in Conscious Sheep. *Shock*. 2015 Dec; 44(6):560-8. doi: 10.1097/SHK.0000000000000459.
18. Santini A, Protti A, Langer T, Comini B, Monti M, Sparacino CC, Dondossola D, Gattinoni L. Prone position ameliorates lung elastance and increases functional residual capacity independently from lung recruitment. *Intensive Care Med Exp*. 2015 Dec;3(1):55. doi: 10.1186/s40635-015-0055-0. Epub 2015 Jun 11.
19. Langer T, Zanella A, Caironi P. Understanding the role of the cerebrospinal fluid in acid-base disorders. *Intensive Care Med*. 2015 Sep 23. [Epub ahead of print] No abstract available.
20. Langer T, Santini A, Scotti E, Van Regenmortel N, Malbrain ML, Caironi P. Intravenous balanced solutions: from physiology to clinical evidence. *Anaesthesiol Intensive Ther*. 2015;47 Spec No:78-88. doi: 10.5603/AIT.a2015.0079. Epub 2015 Nov 20.
21. Langer T, Santini A, Bottino N, Crotti S, Batchinsky AI, Pesenti A, Gattinoni L. "Awake" extracorporeal membrane oxygenation (ECMO): pathophysiology, technical considerations and clinical pioneering. *Critical Care*. 2016. *In press*.
22. Protti A, Properzi P, Magnoni S, Santini A, Langer T, Guenzani S, Ferrero S, Bassani G, Stocchetti N, Gattinoni L. Skeletal muscle lactate overproduction during metformin intoxication: An animal study with reverse microdialysis. *Toxicol Lett*. 2016 Jul 25;255:43-6. doi: 10.1016/j.toxlet.2016.05.010. Epub 2016 May 10.
23. Beely BM, Campbell JE, Meyer A, Langer T, Negaard K, Chung KK, Cap AP, Cancio LC, Batchinsky AI. Electron microscopy as a tool for assessment of anticoagulation strategies during extracorporeal life support: the proof is on the membrane. *ASAIO J*. 2016 Jun 1. [Epub ahead of print]
24. Mauri T, Langer T, Zanella A, Grasselli G, Pesenti A. Extremely high transpulmonary pressure in a spontaneously breathing patient with early severe ARDS on ECMO. *Intensive Care Med*. 2016 Aug 11. [Epub ahead of print] No abstract available.
25. Taccone P, Langer T, Grasselli G. Do we really need postop ICU after elective surgery? No... not anymore! *Intensive Care Med*. 2017 Jul;43(7):1037-1038.
26. Mauri T, Cambiagli B, Spinelli E, Langer T, Grasselli G. Spontaneous breathing: a double-edged sword to handle with care. *Ann Transl Med*. 2017

Jul;5(14):292. doi: 10.21037/atm.2017.06.55. Review.

27. Langer T, Limuti RM, Concezione T, van Regenmortel N, Duval ELIM, Caironi P, Malbrain M, Pesenti A. Intravenous fluid therapy for hospitalized and critically ill children: rationale, available drugs and possible side effects. *Anesthesiology Inten Therapy* 2017 [in press]
28. Doronzio A, Langer T, Balicco B. Trattamento del paziente adulto con polmonite associata al ventilatore Le principali differenze tra linee guida IDSA/ATS 2005 e 2016. *Gimpios* 2017;7(3):120-124
29. Pesenti A, Carlesso E, Langer T, Mauri T Ventilation during extracorporeal support : Why and how. *Med Klin Intensivmed Notfmed*. 2017 Nov 28. doi: 10.1007/s00063-017-0384-8. [Epub ahead of print] Review.
30. Santini A, Spinelli E, Langer T, Spadaro S, Grasselli G, Mauri T. Thoracic electrical impedance tomography: an adaptive monitor for dynamic organs. *J Emerg Crit Care Med* 2018;2:71
31. Langer T, Santini A, Zadek F, Chiodi M, Pagni P, Cordolcini V, Bonanomi B, Rosini F, Marcucci M, Valenza F, Marengi C, Inglese S, Pesenti A, Gattinoni L. Intraoperative hypotension is not associated with postoperative cognitive dysfunction in elderly patients undergoing general anesthesia for surgery: results of a randomized controlled pilot trial. *J Clin Anesth*. 2018 Sep 19;52:111-118. doi: 10.1016/j.jclinane.2018.09.021. [Epub ahead of print]
32. Langer T, Castagna V, Brusatori S, Santini A, Mauri T, Zanella A, Pesenti A. Short-term physiologic effects of regional pulmonary occlusion. *Anesthesiology*. 2019 Aug;131(2):336-343.
33. Langer T, Baio S, Chidini G, Marchesi T, Grasselli G, Pesenti A, Calderini E. Severe diaphragmatic dysfunction with preserved activity of accessory respiratory muscles in a critically ill child: a case report of failure of neurally adjusted ventilatory assist (NAVA) and successful support with pressure support ventilation (PSV). *BMC Pediatr*. 2019 May 17;19(1):155
34. Zanella A, Caironi P, Castagna L, Rezoagli E, Salerno D, Scotti E, Scaravilli V, Deab SA, Langer T, Mauri T, Ferrari M, Dondossola D, Chiodi M, Zadek F, Magni F, Gatti S, Gattinoni L, Pesenti AM. Extracorporeal Chloride Removal by Electrodialysis (CRe-ED): A Novel Approach to Correct Acidemia. *Am J Respir Crit Care Med*. 2019 Sep 25.
35. Langer T, Santini A, Zanella A, Pesenti A. Physiologic effects of pulmonary artery occlusion : Reply. *Anesthesiology* 2020 pp. 935-936
36. Grasselli G, Greco M, Zanella A, Albano G., Antonelli M, Bellani G, Bonanomi E, Cabrini L, Carlesso E, Castelli G, Cattaneo S, Cereda D, Colombo S, Coluccello A, Crescini G, Forasteiri Molinari A, Foti G, Fumagalli R, Iotti GA, Langer T, Latronico N, Lorini FL, Mojoli F, Natalini G, Pessina CM, Ranieri VM, Rech R, Scudeller L, Rosano A, Storti E, Thompson BT, Tirani M, Villani PG, Pesenti A, Cecconi M. Risk factors Associated with mortality among patients with COVID-19 in Intensive Care Units in Lombardy, Italy. *JAMA Internal Medicine JAMA Intern Med*. 2020 Oct 1;180(10):1345-1355. doi: 10.1001/jamainternmed.2020.3539.
37. Zanella A, Langer T, Caironi P, Gattinoni L, Pesenti A. Reply by Zanella *et al.* to Swenson. *Am J Respir Crit Care Med* 2020 Sep 15;202(6):908-909. doi: 10.1164/rccm.202005-1842LE.
38. Spinelli E, Mauri T, Lissoni A, Crotti S, Langer T, Albanese M, Volta CA, Fornari C, Tagliabue P, Grasselli G, Pesenti A. Spontaneous Breathing Patterns During Maximum Extracorporeal CO2 Removal in Subjects With Early Severe ARDS. *Respir Care*. 2020 Jul;65(7):911-919. doi: 10.4187/respcare.07391. Epub 2020 Feb 11

39. Grasselli G, Tonetti T, Protti A, Langer T, Girardis M, Bellani G, Laffey J, Carrafiello G, Carsana L, Rizzuto C, Zanella A, Scaravilli V, Pizzilli G, Grieco DL, Di Meglio L, de Pascale G, Lanza E, Monteduro F, Zompatori M, Filippini C, Locatelli F, Cecconi M, Fumagalli R, Nava S, Vincent JL, Antonelli M, Slutsky AS, Pesenti A, Ranieri VM; collaborators. Pathophysiology of COVID-19-associated acute respiratory distress syndrome: a multicentre prospective observational study. *Lancet Respir Med*. 2020 Dec;8(12):1201-1208.
40. Langer T, D'Oria V, Spolidoro GCI, Chidini G, Scalia Catenacci S, Marchesi T, Guerrini M, Cislighi A, Agostoni C, Pesenti A, Calderini E. Fluid therapy in mechanically ventilated critically ill children : the sodium, chloride and water burden of fluid creep. *BMC Pediatr*. 2020 Sep 5;20(1):424. doi: 10.1186/s12887-020-02322-3.
41. Magliocca A, Rezoagli E, Zani D, Manfredi M, De Giorgio D, Olivari D, Fumagalli F, Langer T, Avalli L, Grasselli G, Latini R, Pesenti A, Bellani G, Ristagno G. Cardiopulmonary Resuscitation-Associated Lung Edema (CRALE)- A Translational Study. *Am J Respir Crit Care Med*. 2020 Sep 8. doi: 10.1164/rccm.201912-2454OC. Online ahead of print.
42. Cipriani E, Langer T, Bottino N, Brusatori S, Carlesso E, Colombo SM, Zanella A, Pesenti A, Grasselli G. Key Role of Respiratory Quotient to Reduce the Occurrence of Hypoxemia During Extracorporeal Gas Exchange: A Theoretical Analysis. *Crit Care Med*. 2020 Dec;48(12):e1327-e1331. doi: 10.1097/CCM.0000000000004619.
43. Foti G, Giannini A, Bottino N, Castelli GP, Cecconi M, Grasselli G, Guatteri L, Latronico N, Langer T, Monti G, Muttini S, Pesenti A, Radrizzani D, Ranucci M, Rusotto V, Fumagalli R; COVID-19 Lombardy ICU Network. Management of critically ill patients with COVID-19: suggestions and instructions from the coordination of intensive care units of Lombardy. *Minerva Anesthesiol* 2020 Nov;86(11):1234-1245.
44. Protti A, Greco M, Filippini M, Vilardo AM, Langer T, Villa M, Frutos-Vivar F, Santini A, Caruso PF, Spano S, Anzueto A, Citerio G, Bellani G, Foti G, Fumagalli R, Pesenti A, Grasselli G, Cecconi M. Barotrauma in mechanically-ventilated patients with coronavirus disease 2019: a survey of 38 hospitals in Lombardy, Italy. *Minerva Anesthesiol*. 2020 Dec 16. doi: 10.23736/S0375-9393.20.15002-8. Online ahead of print.
45. Langer T, L Malbrain M, Van Regenmortel N. Hypotonic or isotonic maintenance solutions for paediatric patients: the never-ending story. *Anaesthesiol Intensive Ther*. 2020;52(5):357-358. doi: 10.5114/ait.2020.101362.
46. Borges FK, Sheth T, Patel A, Marcucci M, Yung T, Langer T, Alboim C, Polanczyk CA, Germini F, Azeredo-da-Silva AF, Sloan E, Kaila K, Ree R, Bertolotti A, Vedovati MC, Galzerano A, Spence J, Devereaux PJ. Accuracy of Physicians in Differentiating Type 1 and Type 2 Myocardial Infarction Based on Clinical Information. *CJC Open* 2020 Jul 17;2(6):577-584. doi: 10.1016/j.cjco.2020.07.009. eCollection 2020 Nov
47. Langer T, Favarato M, Giudici R, Bassi G, Garberi R, Villa F, Gay H, Zeduri A, Bragagnolo S, Molteni A, Beretta A, Corradin M, Moreno M, Vismara C, Perno CF, Buscema M, Grossi E, Fumagalli R. Development of machine learning models to predict RT-PCR results for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in patients with influenza-like symptoms using only basic clinical data. *Scand J Trauma Resusc Emerg Med*. 2020 Dec 1;28(1):113. doi: 10.1186/s13049-020-00808-8.
48. Chanques G, Constantin JM, Devlin JW, Ely EW, Fraser GL, Gélinas C, Girard TD, Guérin C, Jabaudon M, Jaber S, Mehta S, Langer T, Murray MJ,

- Pandharipande P, Patel B, Payen JF, Puntillo K, Rochweg B, Shehabi Y, Strøm T, Olsen HT, Kress JP. Analgesia and Sedation in patients with ARDS. *Intensive Care Med.* 2020 Dec;46(12):2342-2356. doi: 10.1007/s00134-020-06307-9. Epub 2020 Nov 10.
49. Marrazzo F, Spina S, Pepe PE, D'Ambrosio A, Bernasconi F, Manzoni P, Graci C, Frigerio C, Sacchi M, Stucchi R, Teruzzi M, Baraldi S, Lovisari F, Langer T, Sforza A, Migliari M, Sechi G, Sangalli F, Fumagalli R; AREU 118 EMS Network. Rapid reorganization of the Milan metropolitan public safety answering point operations during the initial phase of the COVID-19 outbreak in Italy. *J Am Coll Emerg Physicians Open* 2020 Sep 27;1(6):1240-1249.
 50. Malbrain MLNG, Langer T, Annane D, Gattinoni L, Elbers P, Hahn RG, De Laet I, Minini A, Wong A, Ince C, Muckart D, Mythen M, Caironi P, Van Regenmortel N. Intravenous fluid therapy in the perioperative and critical care setting: Executive summary of the International Fluid Academy (IFA). *Ann Intensive Care.* 2020 May 24;10(1):64.
 51. Vivona L, Battistin M, Carlesso E, Langer T, Valsecchi C, Colombo SM, Todaro S, Gatti S, Florio G, Pesenti A, Grasselli G, Zanella A. Alkaline Liquid Ventilation of the Membrane Lung for Extracorporeal Carbon Dioxide Removal (ECCo2R) : In Vitro Study. *Membranes (Basel).* 2021 Jun 22;11(7):464. doi: 10.3390/membranes11070464.
 52. Langer T, Brusatori S, Carlesso E, Zadek F, Brambilla P, Ferraris Fusarini C, Duska F, Caironi P, Gattinoni L, Fasano M, Lualdi M, Alberio T, Zanella A, Pesenti A, Grasselli G. Low noncarbonic buffer power amplifies acute respiratory acid-base disorders in patients with sepsis: an in vitro study. *J Appl Physiol (1985).* 2021 Aug 1;131(2):464-473. doi: 10.1152/jappphysiol.00787.2020. Epub 2021 Jun 17.
 53. Rezoagli E, Bastia L, Grassi A, Chierigato A, Langer T, Grasselli G, Caironi P, Pradella A, Santini A, Protti A, Fumagalli R, Foti G, Bellani G. Paradoxical Effect of Chest Wall Compression on Respiratory System Compliance: A Multicenter Case Series of Patients With ARDS, With Multimodal Assessment. *Chest.* 2021 Jun 9;S0012-3692(21)01088-6. doi: 10.1016/j.chest.2021.05.057.
 54. Van Regenmortel N, Moers L, Langer T, Roelant E, De Weerd T, Caironi P, Malbrain MLNG, Elbers P, Van den Wyngaert T, Jorens PG. Fluid-induced harm in the hospital: look beyond volume and start considering sodium. From physiology towards recommendations for daily practice in hospitalized adults. *Ann Intensive Care.* 2021 May 17;11(1):79. doi: 10.1186/s13613-021-00851-3.
 55. Langer T, Brioni M, Guzzardella A, Carlesso E, Cabrini L, Castelli G, Dalla Corte F, De Robertis E, Favaro M, Forastieri A, Forlini C, Girardis M, Grieco DL, Mirabella L, Nosedà V, Previtali P, Protti A, Rona R, Tardini F, Tonetti T, Zannoni F, Antonelli M, Foti G, Ranieri M, Pesenti A, Fumagalli R, Grasselli G; PRONA-COVID Group. Prone position in intubated, mechanically ventilated patients with COVID-19: a multi-centric study of more than 1000 patients. *Crit Care.* 2021 Apr 6;25(1):128. doi: 10.1186/s13054-021-03552-2.
 56. Berta L, De Mattia C, Rizzetto F, Carrazza S, Colombo PE, Fumagalli R, Langer T, Lizio D, Vanzulli A, Torresin A. A patient-specific approach for quantitative and automatic analysis of computed tomography images in lung disease: Application to COVID-19 patients. *Phys Med.* 2021 Feb;82:28-39. doi: 10.1016/j.ejmp.2021.01.004. Epub 2021 Jan 28.

Book chapters:

1. Langer T, Valenza F, Caironi P. Urine electrolytes and acid base In: Encyclopedia of intensive care medicine / edited by JL Vincent, JB Hall. - New York : Springer, 2012. - ISBN 9783642004179. - pp. 2368-2370.
2. Langer T, Caironi P. Respiratory Alkalosis. In: Oxford Textbook of Critical Care, second edition. Edited by Andrew Webb, Derek Angus, Simon Finfer, Luciano Gattinoni, and Mervyn Singer
3. Langer T, Carlesso E, Gattinoni L. Extracorporeal Membrane Oxygenation. In Oxford Textbook of Cardiathoracic Anesthesia. Chapter 12, page 131-36
4. Caironi P, Langer T, Ferrari M. Urinary Electrolyte Monitoring in the critically ill: Revisiting Renal Physiology. Annual Update in Intensive Care and Emergency Medicine. 2015; 351-363.
5. Langer T, Pelosi P, Caironi P. Respiratory acid-base disorders. In Critical Care Nephrology

Honors and Awards:

1. Langer T, Altavilla P, Caironi P, Gattinoni L. Infusion of sodium-bicarbonate and continuous urinary pH analysis: a novel tool for the assessment of volemia in the critically ill patient. **Best abstract** in the section : Physiology and Medicine. 2008; Young European Scientist Meeting, Porto, Portugal.
2. Caironi P, Langer T, Taccone P, Carlesso E, Gattinoni L. Urinary analysis as a novel approach for the assessment of volemia and acid-base disturbances in the critically ill. Project winner of the ESICM-ECCRN Research Awards: Clinical Research. 2008.
3. A. Santini, T. Langer, F. Zadek, M. Chiodi, V. Cordolcini, P. Pagni, S. Inglese, M. Mari, A. Pesenti, L. Gattinoni. Intraoperative blood pressure target and development of postoperative cognitive dysfunction in patients aged 75 and more undergoing general anaesthesia for elective non-cardiac surgery: a single centre randomized controlled pilot trial. **Best abstract** at the 28th Smart meeting 2017, Milan, Italy.
4. Bando Linea R&S per aggregazioni, Regione Lombardia, Programma Operativo Regionale 2014-2020, cofinanziato con il FESR (Fondo Europeo per lo Sviluppo Regionale), “Kidney INSTant monitorinG”; ID 147520 – Industria della Salute (PI: Kardia srl; Co-Investigator)
5. Ricerca finalizzata 2016: Regional hypo-perfusion as metabolic raiser of ventilator-induced lung injury (VILI): development of an experimental model, test of an innovative treatment involving extra-corporeal CO₂ removal and pilot clinical trial (Co-Investigator). Grant: 450000 Euro
6. Linea 2. Dotazione annuale per attività istituzionale piano di sostegno alla ricerca 2015/2017. Anno 2018. Titolo: Sodium And chloride restriction in “fluid creep” for critically ill CHILDren: a randomized controlled trial. “Salty Child trial”. PI: Thomas Langer. Grant: 12000 Euro.
7. Kick-off projects and activities within 4EU+ University Alliance in collaboration with the Charles University of Prague and the University of

Copenhagen. Title: Sources of errors in acid-base evaluation in the critically ill. Grant: 12000 Euro.

Invited Talks:

1. Crystalloid infusion: how to predict the acid-base changes. In 23° Simposio Mostra Anestesia Rianimazione e Terapia Intensiva, SMART, Milan, 2012.
2. Extracorporeal Gas Exchange: an Alternative to Mechanical Ventilation? In 24° Simposio Mostra Anestesia Rianimazione e Terapia Intensiva, SMART, Milan, 2013.
3. Extracorporeal Gas Exchange as An Alternative to Mechanical Ventilation for the treatment of ARDS. In International Conference on Complex Acute Illness, ICCAI, Budapest, 2013.
4. Acid-base effects of intravenous fluids. In 25° Simposio Mostra Anestesia Rianimazione e Terapia Intensiva, SMART, Milan, 2014.
5. Effect of intravenous solutions on acid-base equilibrium according to Stewart's approach. In 26° Simposio Mostra Anestesia Rianimazione e Terapia Intensiva, SMART, Milan, 2015.
6. Acid-base equilibrium of the cerebrospinal fluid. In 26° Simposio Mostra Anestesia Rianimazione e Terapia Intensiva, SMART, Milan, 2015.
7. Stewart's approach to acid-base equilibrium and the effects of intravenous fluids on pH. In Aggiornamento sull'equilibrio acido-base, Ospedale Universitario di Pisa, Pisa, Novembre 2015.
8. Che sete: cosa e quanto beve il paziente chirurgico? Poco e bene. In VII CONGRESSO NAZIONALE DI DAY SURGERY, Humanitas Research Hospital, Rozzano, Italy. Rozzano 13-14 May 2016.
9. Buffer power and hypercapnia. In 27° Smart Meeting. Session: ACID BASE EQUILIBRIUM Chairpersons: M. Jacob, M. Pinsky. Milan, 25-27 May 2016.
10. "Fluidi corporei e fluidi disponibili" in Acqua per la vita, la terapia infusioneale dopo quasi 135 anni di soluzione "fisiologica", convegno accreditato presso lo Stabilimento Ospedaliero di Magenta "Aula Biasioli" Via Al Donatore di Sangue, 50 – 20013, Magenta. Magenta, 13 ottobre 2016.
11. Is it convenient to correct pH? In 28° Smart Meeting, 10-12th May 2017; Session: ACID-BASE EQUILIBRIUM. Chairpersons: P. Caironi, S. Faenza
12. How saline, ringer or balanced solutions may affect the acid base status. In 28° Smart Meeting, 10-12th May 2017; Session: ELECTROLYTES. Chairpersons: M. Quintel, G. Iapichino.
13. Cristalloidi bilanciati in fluidoterapia. In XXVII Congresso Sicurezza in Anestesia, 1-2 Dicembre 2017, Napoli.
14. I know the Strong Ion Difference: what do I do with it? In 29° Smart Meeting, 9-11th May 2018; Session: ACID-BASE EQUILIBRIUM.
15. Physiology and Pathophysiology of gas exchanges. In Basic course in blood gas interpretation. Rome 18th April 2018
16. Acid-Base equilibrium. In In Basic course in blood gas interpretation. Rome 18th April 2018
17. Interactive clinical cases. In In Basic course in blood gas interpretation. Rome

18th April 2018

18. "Awake" Extracorporeal Membrane Oxygenation. 16th International Symposium on Perfusion. Bruxelles, 5-6 October 2018
19. Effect of intravenous fluid on acid-base equilibrium: is it important? Palermo, 72° congresso nazionale SIAARTI, 10th October 2018
20. Acid-base equilibrium of the Cerebrospinal fluid. In International Fluid Academy Day, Understanding Acid-Base and Beyond. Amsterdam 24th November 2018. Course Director: Thomas Langer, Paul Elbers, Frantisek Duska.
21. Interactive clinical cases. In International Fluid Academy Day, Understanding Acid-Base and Beyond. Amsterdam 24th November 2018. Course Director: Thomas Langer, Paul Elbers, Frantisek Duska.
22. Intravenous fluid therapy for critically ill children. Congresso ANIARTI Lombardia, 11th January 2019.
23. Basic respiratory physiology to understand pediatric respiratory failure. In Milano Expert Ventilation course: From basics to lung protective strategies. Milano 2 April 2019.
24. Acid-base effects of intravenous fluids. In EAB, Idro-elettrolitico e scambi gassosi nel paziente critico. Rome, 3-5 Aprile 2019
25. CSF acid-base. In EAB, Idro-elettrolitico e scambi gassosi nel paziente critico. Rome, 3-5 Aprile 2019
26. Interactive discussion of clinical cases. In EAB, Idro-elettrolitico e scambi gassosi nel paziente critico. Rome, 3-5 Aprile 2019
27. Clinical Case to Warm you up! in the SMART acid-base Course: Equilibrio acido-base: se si capisce si ricorda! May 7th 2019. Milano, Italy.
28. The blood gas analyzer: how it works, pre-analytical errors and meaning of measured/calculated variables. in the SMART acid-base Course: Equilibrio acido-base: se si capisce si ricorda! May 7th 2019. Milano, Italy.
29. Acute and chronic respiratory acid-base disorders: how to differentiate. In the SMART acid-base Course: Equilibrio acido-base: se si capisce si ricorda! May 7th 2019. Milano, Italy.
30. Interactive clinical cases, PART 1. In the SMART acid-base Course: Equilibrio acido-base: se si capisce si ricorda! May 7th 2019. Milano, Italy.
31. Metabolic alkalosis: generation and maintenance. In the SMART acid-base Course: Equilibrio acido-base: se si capisce si ricorda! May 7th 2019. Milano, Italy.
32. Acid-base equilibrium of the cerebrospinal fluid. In the SMART acid-base Course: Equilibrio acido-base: se si capisce si ricorda! May 7th 2019. Milano, Italy.
33. Interactive clinical cases, PART 2. In the SMART acid-base Course: Equilibrio acido-base: se si capisce si ricorda! May 7th 2019. Milano, Italy.
34. I really do not understand this blood gas analysis. Meet the experts. Role: moderator. Experts: Prof. Carole Ichai, Prof. Pietro Caironi. In 30° Smart Meeting, 8th May 2019, Milano.
35. Saline infusion and hyperchloremic acidosis: Myth of Reality ? In 30° Smart Meeting, 8th May 2019, Milano. Chairmen: Prof. Manu Malbrain, Dr. Alberto Zanella.

36. Blood gas exchange and transport. 1st International Summer School of Clinical Acid-Base and Homeostasis, Prague, Czech Republic 18-21 September 2019.
37. How the blood gas analyze works: pre-analytical errors, pitfalls, meaning of measured/calculated variables. 1st International Summer School of Clinical Acid-Base and Homeostasis, Prague, Czech Republic 18-21 September 2019.
38. Acid-base equilibrium of the cerebrospinal fluid. 1st International Summer School of Clinical Acid-Base and Homeostasis, Prague, Czech Republic 18-21 September 2019.
39. Boston rules, what do they really mean ? 1st International Summer School of Clinical Acid-Base and Homeostasis, Prague, Czech Republic 18-21 September 2019.
40. The most interesting case of my life. 1st International Summer School of Clinical Acid-Base and Homeostasis, Prague, Czech Republic 18-21 September 2019.
41. Hyponatremia: a practical approach. 1st International Summer School of Clinical Acid-Base and Homeostasis, Prague, Czech Republic 18-21 September 2019.
42. Workshop: ask me what you did not get. 1st International Summer School of Clinical Acid-Base and Homeostasis, Prague, Czech Republic 18-21 September 2019.
43. My patient is hyponatremic: what now? 73^o Congresso Nazionale SIAARTI, Rome 16th October 2019.
44. How to assess volemic status. Fluid overload and underload. International Fluid Accademy Day, Valencia, Spain, 26th October 2019.
45. Cerebrospinal fluid, blood brain barrier and implications on acid-base. International Fluid Accademy Day, Valencia, Spain, 26th October 2019.

Mentoring:

2015, Doctoral Thesis of Martina Dansi Mtr. n. 745169.

Correlatore Langer T, Relatore Prof. Mari D.

Title of the Thesis: Postoperative delirium in elderly frail patients: effects of intraoperative blood pressure management.

2017, Doctoral Thesis of Valentina Castagna, Mtr. n. 797342.

Correlatore Langer T, Relatore Prof. Pesenti A

Title of the Thesis: Inflating the balloon of the pulmonary artery catheter: short term physiologic consequences.

2018, Doctoral Thesis of Serena Brusatori

Correlatore Langer T, Relatore Prof. Pesenti A

Title of Thesis : Acid-base variations of whole blood and isolated plasma induced by acute changes in PCO₂ in critically ill patients and healthy controls: an in-vitro study.

2018, Doctoral Thesis of Giorgio Giudici

Correlatore Langer T, Relatore Prof. Pesenti A

Title of the Thesis: Pregnancy-associated hypocapnic alkalosis:

role of cerebrospinal acid-base characteristics

2018, Specialization Thesis of Dr. Chiara Ferraris Fusarini

Correlatore Maiavacca R, Relatore Langer T

Title of Thesis: Cerebrospinal fluid acid-base equilibrium of spontaneously breathing patients with subarachnoid hemorrhage developing hypocapnic alkalosis

2019, Doctoral Thesis of Annalisa Mauro

Correlatore Langer T, Relatore Prof. Pesenti A

Title of the Thesis: Determinazione del potere tampone e della costante di dissociazione degli acidi deboli non carbonici in pazienti settici e volontari sani: uno studio internazionale acido base in-vitro.

2020, Doctoral Thesis of Roberta Garberi

Correlatore: Langer T. Relatore Prof. R. Fumgalli

Title of the Thesis: Predicting the Outcome of Coronavirus Disease 2019 (COVID-19) patients: a machine learning system (MLS) approach.

2020, Doctoral thesis of Sara Braganolo

Correlatore: Langer T. Relatore Prof. R. Fumgalli

Title of the Thesis: Hyponatremia in critically ill burn patients: measurements methods, incidence and clinical impact.

2020, Specialization thesis of Dr. Francesca De Palo

Correlatore: Langer T. Relatore Prof. R. Fumgalli

Title of the Thesis: Gestione della comunicazione con i familiari dei pazienti in completo isolamento durante la pandemia da COVID-19: una nuova sfida per il medico di terapia intensiva.

2021, Doctoral thesis of Silvia Landini

Correlatore: Langer T. Relatore Prof. R. Fumgalli

Title of the Thesis: Comunicazione e visite in terapia intensive durante il primo picco pandemico di SARS-COV2 e lockdown nazionale: studio osservazionale su scala nazionale.

2021, Doctoral thesis of Nicola Suardi

Correlatore: Langer T. Relatore Prof. R. Fumgalli

Title of the Thesis: Effetti su scambi e meccanica respiratoria del cambio postural da semi-seduto a supine in pazienti critici con ARDS dovuta a COVID-19

Teaching and Organization of events.

2016- 2019 : Coordinator of the Residency Program in Anesthesia and Intensive Care of the University of Milan (Director Prof. Antonio Pesenti)

2016 - : Lectures on gas exchange, acid-base equilibrium, fluid therapy interpretation of electrolyte disorders, respiratory mechanics for medical students and residents of the University of Milan.

2018 : Co-Director of the Masterclass of the International Fluid Academy Day, Understanding Acid-Base and Beyond. Amsterdam 24th November 2018. Course Director: Thomas Langer, Paul Elbers, Frantisek Duska.

2018 : Organizer of the First Inter-University (University of Milan and Milano-Bicocca) Crash Course in Intensive Care Medicine. Milano 26-28 November 2018

2019 : Co-Director of the First Summer School in Clinical Acid-Base and Homeostasis. Prague, Czech Republic 18-21 September 2019.

2019 : Organizer of the Second Inter-University (University of Milan and Milano-Bicocca) Crash Course in Intensive Care Medicine. Gargnano, BS 28-31 October 2019

2019- : Coordinator of the Residency Program in Anesthesia and Intensive Care of the University of Milan-Bicocca (Director Prof. Roberto Fumgalli)

2020- : member of the scientific advisory board of the Smart Meeting in Anesthesia Resuscitation and Intensive Care – 31° SMART – Virtual Meeting

Activity as Reviewer (Publons ID: I-8716-2018):

- 2014– : Transplantation International
- 2014– : European Journal of Radiology
- 2014 – : Minerva Anestesiologica
- 2015 – : Critical Care Medicine
- 2015 – : Journal of clinical Dermatology and Therapy
- 2015 – : Anesthesiology and Intensive Therapy
- 2015 – : Intensive Care Medicine Experimentals
- 2016 – : Intensive Care Medicine
- 2016 – : Respiratory Research
- 2016 – : Journal of Critical Care
- 2017 – : Critical Care
- 2018 – : Journal of Visual Experiments
- 2018 – : Pediatric Research
- 2019- : BMJ Open
- 2020- : Critical Care

Data: 10 agosto 2021

Thomas Langer