($n = 11$). Two networks affirmed conducting studies that were unfunded or self-funded. Collaborations in critical care have expanded from activities largely conducted within research networks to include collaborations between research networks (Figure 2).

Several key findings arise from our survey. First, research collaborations in critical care originated from a need for investigators to work together to advance the science behind caring for critically ill patients. Second, critical care collaborations largely focus on the design and implementation of randomized controlled trials. Third, most critical care research networks developed after 2005. Since this time, alliances have evolved in scope to include global collaborations between research networks. Fourth, most critical care research networks either conduct one or a few large studies or coordinate multiple research programs concurrently. Fifth, collaborative critical care research networks depend on peer-reviewed funding to cover infrastructure costs, with one-fourth of research networks being self-funded or unfunded. Sixth, financial support for studies is fragile and dependent on contributions from multiple funding partners.

Collaborative research networks have transformed how critical care research has been conducted over the past three decades. The future critical care research agenda will be increasingly accountable to patient and family priorities and societal expectations for research investments to translate into better health care and outcomes (8). As the human and financial costs of research increase, we anticipate greater emphasis on strategies that will simplify the logistics and costs of conducting critical care research. Novel study designs and greater collaborations among research networks will be integral to advancing future research in critical care. ■

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Lung and Diaphragm Protection during Noninvasive Respiratory Support

To the Editor:

We read with interest the article by Grieco and colleagues (1) on the physiological comparison between high-flow nasal cannula (HFNC) and noninvasive ventilation (NIV) delivered through the helmet in patients with acute hypoxic respiratory failure (AHRF). The optimal noninvasive respiratory support for patients with AHRF is, indeed, a matter of debate, as we are still far from understanding all the mechanisms leading to worsening respiratory failure and

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intubation (2). Schematically, treatment should aim at minimizing the risk of muscular exhaustion leading to rapid shallow breathing and hypercarbia, while avoiding the risk of additional lung injury, self-inflicted by high transpulmonary pressure and V_T. Noninvasive respiratory support that grants lung- and diaphragm-protective ventilation should then be considered as ideal (3, 4).

The authors should be commended for providing a complete set of physiological data that could enhance our understanding of the effects of different noninvasive support in patients with AHRF. Overall, helmet NIV dramatically decreased the inspiratory effort compared with HFNC. Thus, helmet NIV could be highly efficient in decreasing the diaphragm workload to a desired physiological level, able to protect it from myotrauma and failure (3). On the lung protection side, the authors measured transpulmonary pressure swings (ΔP_L) as a surrogate of dynamic lung stress during both study phases, reporting nonsignificant differences between HFNC and helmet NIV (Figure 2 of Reference 1, right upper panel; $P = 0.11$) (1). The reduction in inspiratory effort during helmet NIV might have been due to two different mechanisms: the improvement in respiratory mechanics because of higher positive end-expiratory pressure effect and/or the muscles unloading owing to pressure support. For a given V_T, with the first mechanism, the decrease in inspiratory effort (ΔP_{ES}) would be associated with a decrease in ΔP_L (5); on the opposite side, pressure support could decrease ΔP_{ES} with unchanged (if mechanics remain stable) or even increased ΔP_L (in the presence of overdistension). Thus, identifying which mechanism is predominant in each patient might help individualize the type of support and NIV settings more than looking at average global values. As an example, it could be interesting to investigate whether the changes in ΔP_{ES} and ΔP_L between HFNC and helmet NIV were correlated with end-expiratory transpulmonary pressure during HFNC (6), with subjects with highly negative values experiencing unchanged or even decreased ΔP_L. If this correlation does exist, helmet NIV would be preferred to HFNC in patients with very low end-expiratory transpulmonary pressure. The finding that patients with lower ΔP_{ES} during HFNC increased ΔP_L more during helmet NIV could further corroborate this hypothesis: indeed, there was no correlation between ΔP_{ES} and oxygenation during HFNC, suggesting that the major determinant of respiratory effort is not altered gas exchange, but rather worse respiratory mechanics and inflammation (4).

The authors also describe that higher ΔP_L during helmet NIV was associated with the need for intubation and with mortality. The latter is undoubtedly an exploratory analysis, but it is interesting to note that seven out of eight patients who ultimately required intubation were clinically supported by helmet NIV for a certain number of hours. It would be interesting to explore whether this might have led to higher lung stress and additional lung injury. Additional explorative analyses could include comparing gas exchange during the study protocol and the last one measured before intubation to check whether lung edema worsened or if derangements of pH and Pa_{CO_2} were the main determinants of intubation.

Already, looking at the results, it seems that the ability to limit lung stress by helmet NIV might be lower than during HFNC. Helmet NIV could be considered as step-up support before intubation only in selected patients or if monitoring confirms lung-protective conditions. ■

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Reply to Spinelli and Mauri

From the Authors:

We read with great interest the letter by Drs. Spinelli and Mauri discussing our recently published manuscript (1). We are grateful to the authors for their positive comments, useful suggestions for further analyses, and brilliant insights regarding interpretation of

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