

DOES A CALCULATED SHUNT TABLE ACCURATELY PREDICT PAO₂ FOLLOWING A CHANGE IN FIO₂? *Herb Patrick MD*



Our Respiratory Care and MICU staffs designed this PI project after initiating a ventilator guideline to maintain SaO₂ above 94% by oximetry. Although use of oximetry was valuable in limiting the number of arterial blood gases, our Respiratory Practitioners were busy making frequent FiO₂ changes to comply with the guideline. If the patient's calculated shunt was known, a new FiO₂ could be selected promptly to meet the guideline. Such calculated shunt tables have been available for years, providing the calculated shunt from two baseline values: the FiO₂ set on the ventilator and the paO₂ from an arterial blood gas. For the goal of SaO₂ above 94% by oximetry, the paO₂ would need to be approximately 70 mmHg (torr). Therefore, the FiO₂ necessary to achieve the paO₂ = 70 mmHg (torr) would be directly read from the calculated shunt table.

As an example, suppose a patient's ABG on FiO₂ = 0.8 shows a paO₂ = 100 mmHg (torr). The desired paO₂ is 70 mmHg. Question: What is the new FiO₂ setting to achieve the paO₂ = 70 mmHg (torr)? Answer: Step 1 of 2: Using the baseline ABG's FiO₂ and paO₂ together in the calculated shunt table indicates this patient's calculated shunt is 27%. Step 2 of 2: In this patient with a calculated shunt of 27%, the desired paO₂ of = 70 mmHg (torr) will be achieved using a new FiO₂ = 0.55. In this example, Respiratory Practitioners have achieved prompt adjustment of FiO₂ using the calculated shunt table.

The calculated shunt table is not perfect. It is based on the average of hundreds of patients' arterial and venous blood gas values to compute the calculated shunt. These averaged values may not accurately apply to an individual patient.

This PI project was designed to measure how accurate the calculated shunt table would be when applied to MICU patients.

Before PI project data could be collected, an Institutional Review Board (IRB) application needed to be submitted and approved. If the project data were only to be discussed at our hospital's PI committee meetings, no IRB approval would be necessary. However, PI projects submitted for presentation at Respiratory Care meetings and/or planned for publication places the data into the public domain. All research data in the public domain must have IRB approval. The public domain not only includes publication of journal articles and book chapters, but also poster or slide presentations at local, national, or international conferences.

IRB approval consists of different categories such as Expedited Review or Standard Review, depending on the complexity of the project and risks to the subject. The difference between Expedited and Standard pertains to the length of time for review by the IRB with Expedited review requiring less time. A research project qualifying for Expedited review is straightforward and has minimal risks to the subject, such as a phlebotomy removing a tablespoon of blood or performing a flow volume loop. This PI project was categorized as minimal risk to the subject. The IRB also decides if the risks to the subject require a signature of informed consent. The IRB judged that no signature for informed consent would be needed for this project. The IRB committee placed the review in the Expedited category and research project approval was obtained within two weeks. A research project with waived informed consent aids patient enrollment in the MICU area as patients there commonly receive analgesia and/or sedation. Such patients would never qualify as competent for providing informed consent. Even surrogate consent, where the subject's relative may give informed written consent instead of the research subject, was not deemed necessary for conducting this project.

The Background (Introduction) explains interest and significance in the topic. For this project, high accuracy of the calculated shunt table would encourage use of the table, reduce use of ABG's, and provide prompt adjustment of FiO₂.

The Question proposed is: Does a calculated shunt table accurately predict the new paO₂ following a change in FiO₂? (Note: The Question asked in every research project always has the possible answers: "yes" or "no.")

The Hypothesis is the preconceived answer by researchers to the Question. For this project, the Hypothesis was "Yes, a calculated shunt table accurately predicts the new paO₂ following a change in FiO₂."

The Methods are the mechanism to gather, tabulate and analyze data to answer the Question. The standard MICU bedside ventilator flow sheet and nursing flow sheet, with existing designated areas to enter ventilator settings and ABG values, would be

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answer twice. Frame questions by telling Xers why you want them to respond and what you'll do with the information. For example, "I'm trying to decide, within the next six months, whether we should allow telecommuting. Heres what I want to know." You will get a response. The issue matters to Xers, and you've generated trust because you've committed to a time line.

Personalize your request for information. Xers tell me that the boss, not the organization, is most important in their career success-or lack thereof. They also tend to bond with a boss they respect. If you're being pressured to have your subordinates respond to a companywide survey, ask them to complete the survey as a favor to you-not because they should. The fact that you might be in hot water if they don't comply matters to them. What the company wants doesn't.

Always present a worst-case scenario when you need the buy-in. Don't even think about asking the troops to "win one for the Gipper." Xers neither know nor care who the Gipper was. Instead of leaving an Xer to figure out independently if you're serious about an issue or merely taking the party line, explain what will happen if something isn't discussed fully. "If everyone doesn't know all the details, we may end up overlooking something critical. Briefly, where are you on your part of the project?"

As Xers continue to enter the workplace, managers will have to rely on a variety of communications styles, unlike the one-size-fits-all they used with Boomers. In fact, I've identified a subset of Boomers I call the Wrinkled Busters, who have the same skepticism the Xers show. They are, not surprisingly, people who went through layoffs in the '80s and have taken a blood vow that they'll never make the same emotional commitment to work again. Add this group to the Xers, and ten years from now "buzz" and "grapevine" may be retro terms.

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reviewed for data. The data collection tool would be one sheet of paper per patient, with rows for: date of data collection, ventilator settings and ABG values with the actual paO₂ and space for the predicted paO₂ using the calculated shunt table. To the far right of the row, the difference between the actual paO₂ and the predicted paO₂ will be entered after being computed. Fifty adult patients in our 20 bed MICU would be studied. For data analyses, a Table was constructed by listing the actual paO₂, the predicted paO₂, and the difference between the actual paO₂ and the predicted paO₂. If the calculated shunt table was accurate, the difference between the actual paO₂ and the predicted paO₂ would be small. The statistical comparison of the actual paO₂ and the predicted paO₂ is performed using a Graph called a Bland-Altman plot. The difference between the actual paO₂ and the predicted paO₂ is plotted against the average of the actual paO₂ and the predicted paO₂. As mentioned, a small difference is desirable, regardless of the average of the values.

The Results are a final analysis of the data. For this project, fifty patients were studied with over 400 ABG's recorded. The difference between the actual paO₂ and the predicted paO₂ was low, regardless of the average of the actual paO₂ and the predicted paO₂.

The Conclusion is: a calculated shunt table accurately predicts the new paO₂ following a change in FiO₂. Therefore, in this project, the Hypothesis was supported, corresponding to a "yes" answer to the Question. (Note: When writing the Conclusion, the Hypothesis must be addressed whether it was supported or not.)

The Reflections offers an opportunity to critique the project by suggesting possible modifications that would improve research quality. For example, even though the results demonstrated the predicted paO₂ was accurate, analyses of subsets of the data might disclose strengths or weaknesses of the calculated shunt table at certain FiO₂ values.

Future Research follows Reflections as research completed should lead to new research. For example, this project led to a new PI project to examine the predicted paO₂ using the calculated shunt table when switching between ventilator modes such as AC and PSV.

The Bibliography lists references from similar research and should include the reference for statistical methods.

The Acknowledgement lists financial support and special assistance provided to the project. There was no financial support for this project.

Conflicts of Interest are listed for all Respiratory Care Practitioners and others, such as the Medical Director of Respiratory Care or the statistician for the project. Conflicts include being a member of a speaker's bureau, consultant, and owner of stock or receiver of services or gifts from any companies related to the project.

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