



Canadian Agency for  
Drugs and Technologies  
in Health

## RAPID RESPONSE REPORT: SUMMARY OF ABSTRACTS



**TITLE: Accuracy of Sidestream CO<sub>2</sub> Monitors for Spontaneously Breathing Non-Intubated Adult Patients**

**DATE: 14 December 2010**

### **RESEARCH QUESTION:**

What is the reliability and accuracy of sidestream CO<sub>2</sub> monitors for spontaneously breathing non-intubated adult patients?

### **KEY MESSAGE**

Limited evidence from non-randomized studies suggests that end-tidal CO<sub>2</sub> measured by sidestream capnography should not be used to replace arterial CO<sub>2</sub> partial pressure as measured by blood gas analysis in spontaneously breathing adult patients.

### **METHODS**

A limited literature search was conducted on key health technology assessment resources, including PubMed, the Cochrane Library (Issue 11, 2010), University of York Centre for Reviews and Dissemination (CRD) databases, ECRI (Health Devices Gold), EuroScan, international health technology agencies, and a focused Internet search. The search was limited to English language articles published between January 1, 2005 and December 1, 2010. Retrieval was limited to the human population. Filters were applied to limit the retrieval by health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, and non-randomized studies. Internet links were provided, where available.

The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.

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## RESULTS

Rapid response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials and non-randomized studies.

Six non-randomized studies were found pertaining to the reliability and accuracy of sidestream CO<sub>2</sub> monitors for spontaneously breathing patients. No relevant health technology assessment reports, systematic reviews, meta-analyses, or randomized controlled trials were identified. Additional information that may be of interest is included in the appendix.

## OVERALL SUMMARY OF FINDINGS

Limited evidence is available regarding the accuracy of sidestream CO<sub>2</sub> analyzers in spontaneously breathing adult patients. Four non-randomized studies<sup>1,2,4,6</sup>, one of which was performed on patients with COPD<sup>1</sup>, concluded that end-tidal CO<sub>2</sub> measured by sidestream capnography was not sufficiently accurate to replace arterial CO<sub>2</sub> partial pressure as measured by blood gas analysis. One non-randomized study<sup>3</sup> concluded that the accuracy of sidestream capnometers could be improved with the use of an oral guide, while another<sup>5</sup> concluded that sidestream and mainstream capnography performed equally well in non-intubated, sedated volunteers. No information regarding sidestream capnometer reliability was identified. Further detail regarding the included studies is contained in Table 1.

<b>Table 1: Details of the Included Studies</b>			
<b>Author, Year, Study type</b>	<b>Study objectives, population</b>	<b>Results</b>	<b>Conclusions</b>
Kartel et al., 2010, NRS <sup>1</sup>	To determine the value of SS-ETCO <sub>2</sub> measurement in COPD patients in the ED.	Agreement difference from PCO <sub>2</sub> : 8.4 mmHg Precision: 11.1 mmHg	Authors concluded that ETCO <sub>2</sub> measurement should not be considered as a part of the decision-making process to predict PCO <sub>2</sub> level in COPD patients.
Jabre et al., 2009, NRS <sup>2</sup>	To assess agreement between ETCO <sub>2</sub> measured by a sidestream capnometer and values measured by a blood gas analyzer PCO <sub>2</sub> in non-intubated patients with respiratory distress in an out-of-hospital setting.	Agreement difference from PCO <sub>2</sub> : 12 mmHg Precision: 8 mmHg	Authors concluded that ETCO <sub>2</sub> measurements poorly reflected PCO <sub>2</sub> values in non-intubated patients with respiratory distress of various origins.
Kasuya et al., 2009, NRS <sup>3</sup>	To evaluate the accuracy of a mainstream capnometer with an oral guide and a sidestream capnometer with or without an oral guide in spontaneously breathing non-obese and obese patients with	Differences from PCO <sub>2</sub> <u>Non-obese pts</u> Sidestream with oral guide: 4.9 +/- 2.3 mmHg Sidestream w/ standard cannula: 7.1 +/- 3.5 mmHg  <u>Obese pts w/o OSA</u>	Authors concluded that an oral guide improved the performance of sidestream capnometry. Accuracy in non-obese and obese patients, with and without OSA, was similar.

**Table 1: Details of the Included Studies**

Author, Year, Study type	Study objectives, population	Results	Conclusions
	and without OSA during recovery from general anesthesia.	Sidestream with oral guide: 6.4 +/- 3.1 mmHg Sidestream w/ standard cannula: 8.1 +/- 5.0 mmHg  <u>Obese pt w/ OSA</u> Sidestream with oral guide: 6.3 +/- 3.2 mmHg Sidestream w/ standard cannula: 8.3 +/- 4.6 mmHg	
Law et al., 2009, NRS <sup>4</sup>	To explore the correlation and concordance between ETCO <sub>2</sub> and arterial PCO <sub>2</sub> in patients deemed to require arterial blood gas determination.	Agreement difference from PCO <sub>2</sub> : 7.2 torr (95% CI:5.5-8.9)	Authors concluded that ETCO <sub>2</sub> was not significantly correlated with PCO <sub>2</sub> , especially when supplemental oxygen was used. ETCO <sub>2</sub> currently cannot replace arterial blood gas measurement as a tool for monitoring arterial PCO <sub>2</sub> .
Sakata et al., 2009 NRS <sup>5</sup>	To determine if ETCO <sub>2</sub> measured with flow-through capnometry will more closely resemble arterial PCO <sub>2</sub> than sidestream capnometry in a bench study and in healthy, non-intubated volunteers.	Bland and Altman plots comparing ETCO <sub>2</sub> to PCO <sub>2</sub> showed essentially equal performance between the two capnometers in the healthy volunteers.	Authors concluded that flow-through and sidestream capnometry performed equally well in non-intubated, sedated patients.
Stein et al., 2006 NRS <sup>6</sup>	To compare readings from a transcutaneous capnometer and an end-tidal capnometer to PCO <sub>2</sub> measurements made via arterial-blood-gas analysis.	Sidestream ETCO <sub>2</sub> agreement difference from arterial PCO <sub>2</sub> : -14.1 +/- 7.4 mmHg	Authors conclude that clinical use of these monitors cannot be proposed under actual conditions but will be advantageous after correction of the limiting errors.

ED = emergency department; ETCO<sub>2</sub> = end-tidal carbon dioxide; mmHg = millimeters mercury; NRS = non-randomized study; OSA = obstructive sleep apnea; PCO<sub>2</sub> = carbon dioxide partial pressure; pts = patients; SS-ETCO<sub>2</sub> = sidestream end-tidal carbon dioxide; 95% CI = 95% confidence interval;

## REFERENCES SUMMARIZED

### Health technology assessments

No literature identified.

### Systematic reviews and meta-analyses

No literature identified.

### Randomized controlled trials

No literature identified.

### Non-randomized studies

1. Kartal M, Goksu E, Eray O, Isik S, Sayrac AV, Yigit OE, et al. The value of ETCO<sub>2</sub> measurement for COPD patients in the emergency department. *Eur J Emerg Med.* 2010 Mar 10. [PubMed: PM20224417](#)
2. Jabre P, Jacob L, Auger H, Jaulin C, Monribot M, Aurore A, et al. Capnography monitoring in nonintubated patients with respiratory distress. *Am J Emerg Med.* 2009 Nov;27(9):1056-9. [PubMed: PM19931750](#)
3. Kasuya Y, Akca O, Sessler DI, Ozaki M, Komatsu R. Accuracy of postoperative end-tidal Pco<sub>2</sub> measurements with mainstream and sidestream capnography in non-obese patients and in obese patients with and without obstructive sleep apnea. *Anesthesiology.* 2009 Sep;111(3):609-15. [PubMed: PM19672177](#)
4. Law GT, Wong CY, Kwan CW, Wong KY, Wong FP, Tse HN. Concordance between side-stream end-tidal carbon dioxide and arterial carbon dioxide partial pressure in respiratory service setting. *Hong Kong Med J.* 2009 Dec;15(6):440-6. [PubMed: PM19966348](#)
5. Sakata DJ, Matsubara I, Gopalakrishnan NA, Westenskow DR, White JL, Yamamori S, et al. Flow-through versus sidestream capnometry for detection of end tidal carbon dioxide in the sedated patient. *J Clin Monit Comput.* 2009 Apr;23(2):115-22. [PubMed: PM19301133](#)
6. Stein N, Matz H, Schneeweiss A, Eckmann C, Roth-Isigkeit A, Huppe M, et al. An evaluation of a transcutaneous and an end-tidal capnometer for noninvasive monitoring of spontaneously breathing patients. *Respir Care.* 2006 Oct;51(10):1162-6. [PubMed: PM17005062](#)

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**APPENDIX – FURTHER INFORMATION:**

**Review articles**

7. Krauss B. Advances in the use of capnography for nonintubated patients. *Isr J Emerg Med* [Internet]. 2008 Nov [cited 2010 Dec 4];8(3):3-15. Available from: [http://isrjem.org/isrjem\\_nov08%20kraus\\_capnography\\_postprod.pdf](http://isrjem.org/isrjem_nov08%20kraus_capnography_postprod.pdf).  
*Note: see Limitation of Capnography, page 13.*

**Non-randomized studies – unclear if capnography was sidestream or mainstream**

8. Lujan M, Canturri E, Moreno A, Arranz M, Vigil L, Domingo C. Capnometry in spontaneously breathing patients: the influence of chronic obstructive pulmonary disease and expiration maneuvers. *Med Sci Monit*. 2008 Sep;14(9):CR485-CR492. [PubMed: PM18758420](#)
9. Corbo J, Bijur P, Lahn M, Gallagher EJ. Concordance between capnography and arterial blood gas measurements of carbon dioxide in acute asthma. *Ann Emerg Med*. 2005 Oct;46(4):323-7. [PubMed: PM16187465](#)