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Effect of Ambient Temperature Variations on Positivity of Manual Fecal Immunochemical Tests

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Abstract

Introduction—In the United States, many fecal occult blood tests are mailed by patients to a laboratory for analysis. Hemoglobin is not stable in feces and can be affected by the heat. Effects of season and ambient temperature on fecal immunochemical tests (FITs) have demonstrated a decrease in positivity rates during the hottest season.

Objective—To investigate the potential effect of the average of 4-day ambient maximum temperature variations on the positivity of a single sample, one-time Clinical Laboratory Improvement Amendments (CLIA)–waived FIT.

Setting—Midwestern tertiary care hospital.

Methods—Individuals scheduled for a colonoscopy were invited to complete a qualitative FIT prior to their colonoscopy in 2010 and 2011. FITs were read as positive or negative.

Results—Valid FITs were received from 1026 individuals over 25 months. The positivity rate was 10.9%. The mean 4-day average of daily maximum ambient temperatures was calculated including the day of receipt for each sample. Fahrenheit temperatures ranged from 16.0 to 96.8. Based on the odds ratio of 1.04 with a confidence interval of 0.94 to 1.14 for a 10°F increase in temperature, there was no statistically significant evidence of an effect of the preceding maximum average 4-day ambient temperature on FIT positivity.

Conclusion—No evidence was found that ambient temperature had an effect on positivity rate over a 25-month period using 4 different qualitative FIT products. Further analysis on effect of ambient temperatures is warranted for the automated FITs and CLIA-waived FITs, including liquid-vial and dry-slide FITs. Primary care providers need to be aware of potential adverse effects of FITs.

Keywords

health promotion; prevention; program evaluation; community health; health outcomes

Colorectal cancer (CRC) screening, both organized and opportunistic, has become increasingly more common, since there are many fecal occult blood screening tests (FOBT)

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available. CRC is the third leading cause of cancer death and is largely preventable or curable if detected early.[1–5] Recent screening programs in European foreign countries and Great Britain are using the fecal immunochemical test (FIT)[6,7] and this newer screening test is now being used in the United States.[4,8,9] However, there are inherent problems with the use of the FITs.

FITs are made by a number of different manufacturers and use a variety of collection devices for the stool sample and testing mechanisms. Some FITs are liquid-based with the stool sample stored in a stabilizing buffer in a vial and others are a dry-slide where the stool sample is smeared on paper in a cardboard envelope. In the United States, most liquid-based FITs are Clinical Laboratory Improvement Amendments (CLIA)-waived tests, which allow them to be tested in smaller office settings, while one is automated, not CLIA-waived, and must be performed in a Certified Accredited Pathology lab. All of the dry-slide FITs are tested manually and are CLIA-waived. Regardless of the storage container or mechanism for testing the stool sample, the hemoglobin (Hb) concentration cutoffs for a positive result vary by manufacturer[8,10,11] and Hb breaks down over time in feces, the collection buffer, and possibly on the paper used for dry-slide collection.[12]

Investigators in the Netherlands have explored the stability of Hb in feces in the stabilizing buffer vial collection device using the automated device, the OC-Sensor, Eiken Chemical Company, Tokyo, Japan.[13] In this study, researchers describe the influence of delays between fecal sampling and delivery to the laboratory on the performance of the FIT OC-Sensor, a quantitative FIT, exposed to room temperature (+ 20°C) upon receipt of sample. Researchers found that quantifiable Hb in the fecal sample solution decreased by a mean of 29 ng/ml per day (median of 11 ng/ml per day) and those false negatives can occur due to delay between fecal sampling and laboratory delivery. Van Rossum showed that the fecal samples from colorectal cancer patients will eventually become falsely negative around seven days after the initial test.[13] Another recent study in Italy examined the performance of FITs over several seasons to evaluate the impact of ambient temperature on the performance of the screening test.[6] Using 199,654 OC-Sensor FITs, asking participants to refrigerate samples prior to mailing, and using mean ambient temperatures of 5–11 days before test analysis (tests returned to local healthcare units were refrigerated and every 2 days transported to centralized laboratory, then were analyzed by laboratory every 1–2 weeks), investigators found that the mean Hb concentrations varied by season with the lowest concentration at 25.2 ng/ml in the summer and highest at 29.5 ng/ml in the winter.[6] Another study using OC-Sensor FITs with 8,318 participants assessed whether the ambient temperatures on the day of FIT screening affected the Hb concentration.[14] The mean Hb concentration was 0.25 ng/ml in summer 0.32 ng/ml in winter.[14]

Gnatta and colleagues compared 15 true positive fecal samples and synthetic hemoglobin solutions with automated FITs that used different buffer preservatives. Samples were tested at five time intervals and three different temperatures.[15] Results found that the newer preservative preserved the hemoglobin better than the older preservative at the two higher temperatures and that synthetic hemoglobin solutions behave differently than a fecal sample. [15]

For this study, CLIA-waived liquid-based vial FITs were used whereas other studies used automated non-CLIA-waived FITs. They were all qualitative tests. The purpose of this study was to investigate the potential effect of ambient temperature variations on the positivity of a single sample, one-time CLIA-waived FIT during real-world use.

Methodology

The work presented here is analysis of part of a larger study whose purpose was to test characteristics of a one-time, single-sample FIT for detecting adenocarcinoma or advanced adenomas using optical colonoscopy as the gold standard.[16] Institutional review board (IRB) approval was obtained for this research. Subjects were paid \$20 for participation in the study.

Subject Recruitment

Individuals were recruited as described in the paper assessing the test characteristics of a one-time, single-sample FIT with colonoscopy for detecting advanced adenomas or cancer. Individuals scheduled for a screening or surveillance colonoscopy were invited by mail. The mailing included a fecal immunochemical test (FIT), instructions on how to complete it, and a form asking for the date the stool sample was obtained, and a cardboard postage-paid return box for return of the stool sample. Individuals were asked to complete the FIT prior to starting the colonoscopy preparation. Participants returned a signed informed consent if interested.[16] The first recruitment package was mailed January 22, 2010 and the last recruitment package was mailed November 22, 2011. Recruitment packages were mailed to 2,336 potential subjects.

Fecal Immunochemical Test

FITs were preferred for the fecal occult blood test as the FIT detects Hb rather heme, and thus is highly specific for occult lower gastrointestinal bleeding. If upper GI bleeding is present, Hb is largely degraded by upper gastrointestinal enzymes, in contrast to heme, which is not degraded.[17] The Inverness Clearview ULTRA iFOB had been used in our previous research and was the test chosen for this study.[4,18,19] Over the course of the study, four different FIT manufacturers were used as shown in Table 1.[16]

Ambient Temperature

A clear definition of temperature in terms of the analysis is vital to the interpretation of this study's results. It was not of interest to show how experimentally varying the internal temperature of actual FITs can alter results, but rather to explore the effect of ambient, outdoor temperatures (that is, the temperature that one would see reported in the newspaper) during real-world application of FITs.

As an estimate of the temperature that the FITs were exposed to, we chose to average the daily maximum temperatures for the four days up to and including receipt of the FIT as the mean high temperature that the FIT would have been exposed to. Six hundred and twelve subjects from the parent study provided the date of completion of their FIT. With this information, the median time in the mail was determined to be 3.0 days (mean 3.35, but

influenced by a few severely outlying observations). Assuming that an individual does as instructed and uses the FIT in the morning and places it in the mailbox shortly afterwards, the FIT would be exposed to outside, ambient temperatures for about four days, including the day the FIT was received by investigators. In the parent study, FITs were typically tested the same day they were received by investigators or within two days. The FITs were not refrigerated on receipt. Manufacturer recommended storage of the stool sample at room temperature upon receipt varied by product ranging from for 5 to 18 days.

There is evidence that high temperatures have an effect on FIT performance,[6] so each FIT test was assigned the mean of the four daily maximum temperatures it may have experienced. The mean was used, as it is not known whether a FIT was truly exposed to the maximum temperature across the four days, so an average would be a more realistic measure, while still accounting for the fact that the average maximum temperature across a number of days was more accurate for assessing the effect of temperature on FIT positivity than a single temperature reading on the day of receipt or the average of the high and low temperatures across a number of days or the average minimum temperature. Temperatures were collected for Iowa City, Iowa (location of the hospital that received all FITs) from the National Oceanic and Atmospheric Administration National Weather Service Forecast Office website (<http://www.nws.noaa.gov/climate/index.php?wfo=dvn>) using the file labeled “preliminary monthly climate data” which includes daily weather statistics for the month including average temperatures. In Iowa City, the average warmest month is July and the average coolest month is January. Figure 1 displays the minimum, average, and maximum temperatures in Iowa City for the study period.

Data Analysis

Basic statistics were performed to describe the demographics of the sample used for analysis. As four different qualitative FIT products were used throughout this study, special attention needed to be paid to any differences between them. It was assumed that all FIT products react in the same manner to temperature variation. As each FIT product was not used throughout an entire year, they were not exposed to all possible temperatures. Logistic regression was used to model the relationship between FIT positivity and temperature, with FIT results (positive vs. negative) as the response and temperature as a continuous predictor. Logistic regression was also conducted with daily mean and minimum mean temperatures with the same results as maximum mean temperatures.

A dummy variable for FIT Company (Polymedco OC-Light iFOB vs. all other companies combined) was created in order to control for potential confounding by company, as the parent study determined that Polymedco is less likely to produce positive results than the other companies and was used only over the summer. This variable was also classified as three dummy variables (Polymedco OC-Light iFOB vs. Inverness Clearview ULTRA iFOB, Alere Clearview iFOB Complete, or Quidel QuickVue iFOB) in order to determine if collapsing the three other companies together was justified.

Age and gender were additionally assessed for any confounding effects that may have been created by inequality in the distribution of sex and age of subjects across temperatures. Any multicollinearity between covariates was assessed and the fit of the model and any outlying

or influential observations were assessed with standardized Pearson residuals and DFbetas. The assumption of linearity between the log odds and predictors was carefully assessed through the addition of polynomial terms for temperature and observing a loess curve of the response by the change in temperature. All tests were two-tailed and assessed at $\alpha = 0.05$. Throughout 2013 and 2014, analysis was performed in SAS 9.3 for Windows (SAS 9.3, SAS Institute, Inc., Cary, NC).

Results

Participants returned 1,026 valid FITs from January 2010 to January 2012. One hundred and twelve (10.9%) subjects had a positive FIT and 914 (89.1%) had a negative FIT. Fifty-two percent of the FITs used were Alere Clearview iFOB Complete (See Table 1). The four FITs used were all CLIA-waived manual tests with product inserts claiming sensitivity to 50 ng Hb/ml. According to the manufacturer brochures, all products could be stored at room temperature until date of expiration (See Table 1). The mean age of participants was 57 years, 57% were female, 70% were married, 94% were Caucasian, and 34% had an annual household income less than \$40,000.

Over the 25 months, the mean four day maximum Fahrenheit temperature ranged from 16.0 to 96.8 with a mean of 63.8 (standard deviation 20.4), and was marginally left skewed. The temporal distribution of FIT products demonstrates that Alere Clearview iFOB Complete and Polymedco OC-Light iFOB were distributed during the warmer months (See Table 1). Alere Clearview iFOB Complete was the only FIT that was used throughout all temperature intervals (ranging from less than 40°F to greater than 77°F). During the time of use of Polymedco OC-Light iFOB, a positivity of 0.03 for both temperature intervals was found (See Figure 2). Inverness Clearview ULTRA iFOB, Alere Clearview iFOB Complete, and Quidel QuickVue iFOB had similar positivity values (0.12 to 0.14) for the temperature interval of 40°F to 77°F (See Figure 2).

Table 2 shows the final model for predictors of FIT positivity in relation to four-day temperature maximum and FIT manufacturer. Age and sex had no effect on the relationship between temperature and the response as confounders; thus, they were removed from the final model, which contained the ambient temperature as the mean of the four-day maximum and a dummy variable for FIT Company, that is, Polymedco versus the other three companies combined. It was determined that a linear relationship best explained the association between the predictors and the log odds in the proposed model. Based on the odds ratio of 1.04 with a confidence interval of 0.94 to 1.14 for a ten degree change in mean maximum four-day temperature (F°), there was no statistically significant evidence of an effect of ambient temperature on FIT positivity with real-world use of FITs. Polymedco OC-Light iFOB was excluded from analysis and the model was run again, resulting in the same odds ratio.

Discussion

This study investigated the potential effect of ambient temperature variations on the positivity of a single sample, one-time FIT use. Other studies have indicated lower FIT

positivity with higher temperatures when measuring ng Hb/ml using automated FITs. [6,14,20] The study contributes to the literature, because the FITs used were CLIA-waived non-automated FITs, which are more commonly used in the United States.[20] Over the 25-month time period for the parent study, no significant differences were found by ambient temperature changes in the FIT positivity results.

Grazzini and colleagues examined the performance of the automated OC-Sensor FITs recording Hg concentrations over four seasons to evaluate the impact of variations of ambient temperature on the performance of the FIT.[6] They found that Hg concentrations measured during the summer are significantly lower than those measured during the winter. [6,20] Cha and colleagues[14] had similar results when measuring Hg concentrations to Grazzini.[6] However, when Cha et al.[14] analyzed their results classifying results as positive or negative, no significant differences were found by ambient temperature, similar to our findings.

Each of these studies used ambient temperature using either maximum temperature on a given day or an average ambient temperature over the course of a number of days.[6,14] In this study, we used the mean of the four-day maximum temperature including the date of receipt and testing analysis. This study was different from the other two studies, having fewer samples. To compare these ambient temperature studies in the future, it is recommended that the dates of stool collection, receipt, and analysis be recorded.

Unfortunately, during this study, four different liquid-based FIT products were used. Changes in the FIT products encouraged a review of results on an ongoing basis resulting in one product being discontinued based on extremely low positivity rates. In an evaluation of FIT from proficiency testing programs,[21] 93% of the FITs being used in the healthcare system as measured in the proficiency programs are CLIA-waived FITs. Dry-slide FITs offer a different collection device and the fecal sample is not in a buffer in a liquid-vial. Future studies should continue to assess the effect of temperature variation on the positivity of liquid-based FITs, as well as dry-slide FITs. Dry-slide FIT products include the Beckman/Coulter Hemocult ICT and Immunostics Hema-Screen Specific.

It was determined in the parent study that Polymedco OC-Light iFOBs were significantly less likely to produce positive results (3% positive for the study) than the other three FIT products, which were all approximately equally likely to provide positive results (15% positive for the study). The odds ratio for Polymedco OC-Light iFOB testing negative compared with the other three FITs was found to be 5.93 (95% CI 3.06 to 11.51). This information is important, as the FIT tests were used sequentially, and Polymedco OC-Light iFOB was used from April to October of 2011, covering all of summer; therefore, a lack of positive results during high temperature time periods could be explained by Polymedco OC-Light iFOB testing with a significantly lower positivity rate, regardless of the temperature. Usage throughout the summer of 2011 is likely not an explanation for Polymedco OC-Light iFOB's lack of positivity, assuming that warmer temperatures decrease Hb levels, as shown by Grazzini,[6] since Alere Clearview iFOB Complete was used throughout the summer of 2010 and did not have such a low positivity (See Figure 2). Polymedco OC-Light iFOB was

failing to provide positive results at the reported sensitivity levels. As described in the data analysis section, the potential confounding introduced by Polymedco was accounted for.

A limitation of the study was the ambient temperature used data from Iowa City and some participants lived outside of the Iowa City area. Thus, the ambient four-day maximum temperature for some subjects may not match what the temperatures were for Iowa City. However, this effect is probably minimal, since all individuals were from eastern Iowa and there would not be much variation between geographic locations in eastern Iowa. In addition, the four-day average of the maximum temperatures, may not reflect what the temperatures are in a mailbox sitting outside, where in the summer, it might be expected that temperatures in the mail box might be much higher than the maximum temperature recorded by the National Oceanographic Institution. There are many factors that may have resulted in some FITs being exposed to higher or lower temperatures than the overall, outside ambient temperature. For example, one individual may have an inside mailbox or have dropped off their FIT at the post office whereas another may have exposed their FIT to extreme heat by leaving it in an outside, metal mailbox for an extended period of time (e.g., on Sunday when there is no mail pick-up). However, this study explored the effect of ambient temperature during real-world use, so the above is not necessarily a limitation, as this variability is to be expected and should not bias results. Another limitation was the use of four FIT products and the assumption that each FIT product would respond to temperature variation equally.

Through this study and the parent study, the research team became acutely aware of various FIT products, their performance, and their inherent problems. Careful consideration and product review needs to be conducted when determining what product to use for CRC screening in a physician office setting or for opportunistic one time screening. It is inherent upon healthcare providers guided by their laboratory clinicians to know their products, be cognizant of the expiration dates, and use quality control checks routinely. The analysis of returned FITs from patients should be completed upon receipt in a timely manner.

Organized and opportunistic CRC screenings are becoming routine and diffuse throughout the United States. It is evident the FIT products are not the same, nor are they standardized. Colleagues from the World Endoscopy Organization have proposed recommendations for the standardization of FITs, such as the size of the collection probe, the number of grooves in the collection probe, the amount of buffer in the vial, and the same type of preservatives in the buffer.[22,23] Efforts to improve CRC screening are needed and worthwhile.

Different from other studies, ambient temperature had no effect on positivity rate over a 25-month period using four different qualitative FIT products. Further analysis on effect of ambient temperatures is warranted for all FIT products.

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References

1. Levin TR, Jamieson L, Burley DA, Reyes J, Oehrli M, Caldwell C. Organized colorectal cancer screening in integrated health care systems. *Epidemiol Rev.* 2011; 33(1):101–110. [PubMed: 21709143]
2. Potter MB, Walsh JM, Yu TM, Gildengorin G, Green LW, McPhee SJ. The effectiveness of the FLU-FOBT program in primary care a randomized trial. *Am J Prev Med.* 2011; 41(1):9–16. [PubMed: 21665058]
3. Potter MB, Phengrasamy L, Hudes ES, McPhee SJ, Walsh JM. Offering annual fecal occult blood tests at annual flu shot clinics increases colorectal cancer screening rates. *Ann Fam Med.* 2009; 7(1):17–23. [PubMed: 19139445]
4. Levy BT, Daly JM, Luxon B, et al. The "Iowa Get Screened" colon cancer screening program. *J Prim Care Community Health.* 2010; 1(1):43–49. [PubMed: 23804068]
5. American Cancer Society. [Accessed 28 September 2011] Colorectal cancer facts & figures 2011–2013. Colorectal Cancer Facts & Figures Web site. <http://www.cancer.org/acs/groups/content/@epidemiologysurveillance/documents/document/acspc-028323.pdf>. Updated 2011
6. Grazzini G, Ventura L, Zappa M, et al. Influence of seasonal variations in ambient temperatures on performance of immunochemical faecal occult blood test for colorectal cancer screening: Observational study from the Florence district. *Gut.* 2010; 59(11):1511–1515. [PubMed: 20603498]
7. Berchi C, Guittet L, Bouvier V, Launoy G. Cost-effectiveness analysis of the optimal threshold of an automated immunochemical test for colorectal cancer screening: Performances of immunochemical colorectal cancer screening. *Int J Technol Assess Health Care.* 2010; 26(1):48–53. [PubMed: 20059780]
8. Allison JE. FIT: A valuable but underutilized screening test for colorectal cancer-it's time for a change. *Am J Gastroenterol.* 2010; 105(9):2026–2028. [PubMed: 20818351]
9. Liles EG, Perrin N, Rosales AG, et al. Change to FIT increased CRC screening rates: Evaluation of a US screening outreach program. *Am J Manag Care.* 2012; 18(10):588–595. [PubMed: 23145804]
10. Allison JE, Fraser CG, Halloran SP, Young GP. Comparing fecal immunochemical tests: Improved standardization is needed. *Gastroenterology.* 2012; 142(3):422–424. [PubMed: 22281273]
11. Fraser CG, Allison JE, Halloran SP, Young GP. Expert Working Group on Fecal Immunochemical Tests for Hemoglobin, Colorectal Cancer Screening Committee, World Endoscopy Organization. (2012). A proposal to standardize reporting units for fecal immunochemical tests for hemoglobin. *J Natl Cancer Inst.* 2012; 104(11):810–814. [PubMed: 22472305]
12. Young GP, St John DJB. Faecal occult blood tests: Choice, usage and clinical applications. *Clinical Biochemist Review.* 1992; 13:161–167.
13. van Rossum LG, van Rijn AF, van Oijen MG, et al. False negative fecal occult blood tests due to delayed sample return in colorectal cancer screening. *Int J Cancer.* 2009; 125(4):746–750. [PubMed: 19408302]
14. Cha JM, Lee JI, Joo KR, et al. Performance of the fecal immunochemical test is not decreased by high ambient temperature in the rapid return system. *Dig Dis Sci.* 2012; 57(8):2178–2183. [PubMed: 22451122]
15. Gnatta E, Zaninotto M, Epifani MG, et al. A new sampling device for faecal immunochemical testing: haemoglobin stability is still an open issue. *Clin Chem Lab Med.* 2014; 52(8):1203–1209. [PubMed: 24516002]
16. Levy BT, Bay C, Xu Y, et al. Test characteristics of faecal immunochemical tests (FIT) compared with optical colonoscopy. *J Med Screen.* 2014; 21(3):133–143. [PubMed: 24958730]
17. Park DI, Ryu S, Kim YH, Lee SH, Eun CS, Han DS. Comparison of guaiac-based and quantitative immunochemical fecal occult blood testing in a population at average risk undergoing colorectal cancer screening. *Am J Gastroenterol.* 2010; 105(9):2017–2025. [PubMed: 20502450]
18. Daly JM, Levy BT, Merchant ML, Wilbur J. Mailed fecal-immunochemical test for colon cancer screening. *J Community Health.* 2010; 35(3):235–239. [PubMed: 20127156]
19. Levy BT, Xu Y, Daly JM, Ely JW. A randomized controlled trial to improve colon cancer screening in rural family medicine: An Iowa Research Network (IRENE) study. *J Am Board Fam Med.* 2013; 26(5):486–497. [PubMed: 24004700]

20. Hunter JP, Saratzis A, Froggatt P, Harmston C. Effect of season and ambient temperature on outcome of guaiac-based faecal occult blood tests performed for colorectal cancer screening. *Colorectal Dis.* 2012; 14(9):1084–1089. [PubMed: 22122559]
21. Daly JM, Bay CP, Levy BT. Evaluation of fecal immunochemical tests for colorectal cancer screening. *J Prim Care Community Health.* 2013; 4(4):245–250. [PubMed: 23799674]
22. Allison JE, Fraser CG, Halloran SP, Young GP. Population screening for colorectal cancer means getting FIT: The past, present, and future of colorectal cancer screening using the fecal immunochemical test for hemoglobin (FIT). *Gut Liver.* 2014; 8(2):117–130. [PubMed: 24672652]
23. Rapi S, Rubeca T, Fraser CG. How to improve the performances of fecal immunological tests (FIT): Need for standardization of the sampling and pre-analytical phases and revision of the procedures for comparison of methods. *Int J Biol Markers.* 2015; 30(1):127–131.

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Figure 1.
Minimum, Average, and Maximum Temperatures (°F): January 2010 – January 2012 for
Iowa City, IA

Figure 2.
Distribution of Positivity for each Product across Temperature Intervals

Table 1

Distribution and Description of FIT Products Used Throughout Parent Study.

Dates Received & Used by Investigators	FIT Product*	Storage of FIT Product	Stool Sample Storage	Number of Subjects (valid results only)	Positivity (number of positives/total tests)
January 2010 to March 2010	Inverness Clearview ULTRA iFOB	Room temperature for 18 months or until date of expiration	Store at room temperature up to 5 days or refrigerate at 2–8°C for up to 14 days	65	0.15
March 2010 to March 2011	Alere Clearview iFOB Complete	Room temperature for 18 months or until date of expiration	Store at room temperature (48, 2°F – 98, 6°F) for up to 18 days or refrigerate at 35.6°F–46.4°F for 6 months	529	0.16
April 2011 to October 2011	Polymedco OC-Light iFOB	Store at 36–86°F until date of expiration	Store at room temperature for up to 15 days or refrigerate at 2–8°C for up to 30 days	346	0.03
October 2011 to January 2012	Quidel QuickVue iFOB	Store at 59–86°F. Shelf life is 24 months from the date of manufacture	Store at room temperature for up to 8 days at temperatures below 95°F	86	0.12
Total				1026	0.11

* Sensitivity was 50 ng Hb/ml for each product

Table 2

Logistic Regression Model Predicting Positive FIT

Covariate	Odds Ratio	95% CI	p-value
Mean four-day max temperature (change of 10°F)*	1.04	0.94 to 1.14	0.50
Polymedco	0.16	0.08 to 0.32	< 0.0001
Inverness, Alere, Quidel	Reference		

The odds ratio for a one-unit change is 1.00 (95% CI 0.99 to 1.01)