TABLE 1. Effect of Low Flow Rate on Anesthetic Costs

	Dollars Spent on Volatile Anesthetics
January–June 1984	
Isoflurane use moderate	
Low flow rare	$15,042
July–December 1984	
Isoflurane use high	
Low flow rare	$22,345
January–June 1985	
Isoflurane use high	
Low flow common	$13,914

prove understanding of the kinetics of uptake and distribution and the physiologic monitoring facilitated by the closed system technique.

In June of 1984, two (1½ h) seminars were held to teach, discuss, and demonstrate (computer assisted and bedside) the principles of closed system anesthesia. In November, 1984, a visiting professor presented two 1-h lectures and bedside teaching in the operating room. Members of the department were gently and frequently reminded of the patient, educational, cost, and environmental benefits derived from adopting a low-flow or a closed-system policy. Hand-held computers with closed sytem software were used during resident teaching in the operating room. Faculty acceptance was initialy divided; however, resident and faculty enthusiasm, acceptance, and implementation was eventually the norm, and occurred over a 1-yr period.

With essentially no net change in anesthesiology minutes, the observations shown in table 1 have been made.

Currently, isoflurance accounts for more than 95% of the volatile agents used in 10,000 general anesthetics. Control of expenditures for volatile anesthetics is possible in a busy urban teaching hospital.

JANE MATJASKO, M.D.
Associate Professor of Anesthesiology
Department of Anesthesiology
University of Maryland
22 South Greene Street
Baltimore, Maryland 21201

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Ambient Light Affects Pulse Oximeters

To the Editor:—While preparing to anesthetize an 18-month-old child, we noted an unusual response of the Nellcor Oximeter to light in the operating room. There was an audible and visible signal on the Nellcor model N100C Pulse Oximeter prior to the application of the model D-25 probe to the patient. The device signaled a heart rate of 189 beats per minute and an oxygen saturation of 98%. We assumed this to be an artifact resulting from the overhead fluorescent light. Subsequently, while setting up the device in the recovery room, we noted the same phenomenon. The room also was lit with fluorescent lights. In this instance, the recovery nurse was called to view the monitor without being informed that the probe had not yet been connected to the patient. The nurse's response was as follows, "The saturation is ok, but the heart rate is awfully fast. Why is that?" The heart rate read 199 and saturation 98%.

To our knowledge, this potentially misleading feature of the Nellcor Oximeter has not been described. The photodiode light receiver in the Model D-25 oxygen transducer must in some way receive a signal from the room light source that is sufficient to trigger the device to display erroneous data. Our mass spectrometer-Nellcor interface (fiberoptic bundle) displayed the following data (fig. 1), when the probe was *not* connected to a patient. This could produce considerable confusion if the device were disconnected from a patient and the individual observing the patient were to act on erroneous data. Brooks *et al.*[1] stated that the

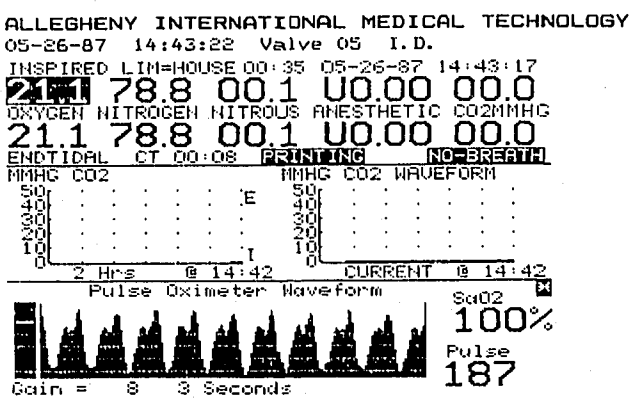

FIG. 1. Pulse oximeter data displayed along with mass spectrometer data. The oximeter probe was not attached to the patient, yet indicated a pulse rate of 187 and saturation of 100%.

Nellcor is designed to reject ambient light. The finding we report indicates that ambient light may be sensed and displayed under certain conditions. The manufacturer's technical bulletin addresses the effect of excessive ambient light on probes properly applied to patients. The problem we describe is not specifically addressed.*

* Nellcor Incorporated. Controlling external optical interference in pulse oximetry. Pulse Oximetry Note No. 5, 1986

LELAND HANOWELL, M.D.
Assistant Clinical Professor

JOHN H. EISELE, JR., M.D.
Professor and Chairman

DAVID DOWNS, M.D.
Anesthesiology Resident

Department of Anesthesiology
University of California, Davis Medical Center
Sacramento, California 95817

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In Reply:—Bright external light sources are known to affect pulse oximeters[1] and, to our knowledge, all pulse oximeters share this sensitivity. This occurs because these instruments use optical means to make their measurements. Consequently, to obtain accurate measurements, potential sources of optical interference must be controlled. Because pulse oximeters' optical components are in the sensor, proper sensor application and use are key factors in reducing optical interference. Optical interference occurs when bright light from an external source reaches the detector, or when light reaches the detector without passing through a pulsatile arteriolar bed. If not controlled, such interference can prevent the oximeter from tracking the pulse, or it can result in erratic or inaccurate but apparently normal measurements. External light sources that can interfere with pulse oximeter performance, if they are bright enough, include surgical lamps, bilirubin lamps, fluorescent lights (as used in this case), infrared heating lamps, and direct sunlight. In the presence of such lights, sensors *must* be covered with opaque material. Another type of optical interference may occur when some of the light from the sensor's light sources reaches the detector without passing *through* an arteriolar bed. Such an optical shunt results in either erratic or stable but inaccurate measurements. Optical shunts typically occur when an inappropriate sensor is selected and when a sensor is used incorrectly. The clinician should select a sensor that is suitable for the patient and the clinical setting based on the patient's size, the available sensor sites, the amount of patient activity, the intended duration of monitoring, considerations of sterility, and the adequacy of the patient's perfusion. An especially important consideration in the use of high performance sensors is that the sensor adhere snugly to the skin, so that it remains properly positioned and aligned on the patient and that no light leaks from the light source or ambient light are permitted to reach the detector.

When anomalous measurements are reported in clinical settings, we commonly find that the sensor being used was not appropriate for the patient site or application site, the sensor was repeatedly reapplied, or additional tape or a finger cot[2] was used to secure the sensor after its own adhesive was exhausted. Such practices tend to result in sensors that do not fit the patient, that do not snugly adhere to the skin, or that fall off the patient easily. In such situations, bright environmental light and shunted light from the sensor's light emitting diodes could be expected to reach the detectors without passing through a pulsating arteriolar bed. In addition, applying additional tape or finger cots can produce venous congestion and result in venous pulsations that may interfere with accurate arteriolar saturation reading.

DAVID B. SWEDLOW M.D.
Vice President, Medical Affairs

VICKI RUNNING
Manager, Technical Services and Education

SANDARA J. FEASTER, R. N., M. S., C.C.R.N.
Manager, Clinical Education

Nellcor, Inc.
25495 Whitesell Street
Hayward, California 94545

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