

# Extremely Low Frequency-Magnetic Fields (ELF-MFs)

## Measured Within and Surrounding Standard Neonatal Intensive Care Incubators

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### Background & Significance

ELF-MFs are emitted by alternating current-powered electrical equipment such as standard neonatal incubators with heating motors positioned directly under mattresses in several models.

Li et al. found that during pregnancy, daily ELF-MF exposure in the range of 0.3 - 2.0 milliGauss (mG) raised the risk of developing childhood asthma in offspring by 74% compared to low ELM-MF (<0.3 mG) exposure. In a dose-response relationship, levels >2.0 mG in pregnancy produced a 3.5-fold increased risk of childhood asthma in offspring compared to low exposure group<sup>1</sup>.

Quantifying ELM-MFs produced by standard incubators and essential electrical equipment is an important first step in identifying potential risks of exposure for preterm infants.

### Objective

To measure regional distribution of ELF-MFs from neonatal incubators, and to determine additive field effects generated by NICU electrical equipment.

### Methods

ELF-MFs of both standard and transport incubators were measured using EMDEX II Magnetic Field Meter and EMCALC 2007 software package (Enertech Consultants USA). ELF-MFs were recorded at mattress height in 3 inch increments across the surface of the mattress, as well as around the perimeter of the incubator at incremental horizontal distances ranging from 0 to 36 inches from the edge of the mattress, at vertical heights of 24, 36, and 42 inches from the floor.

Similarly, ELF-MFs emissions were measured at mattress height around the perimeter of electrical equipment adjacent to the incubator, including a ventilator/humidifier, phototherapy lights, and syringe pumps.

### Results

#### ELF-MF Magnetic Flux Density (mG) in Incubator Models

Figure A: Standard Incubator

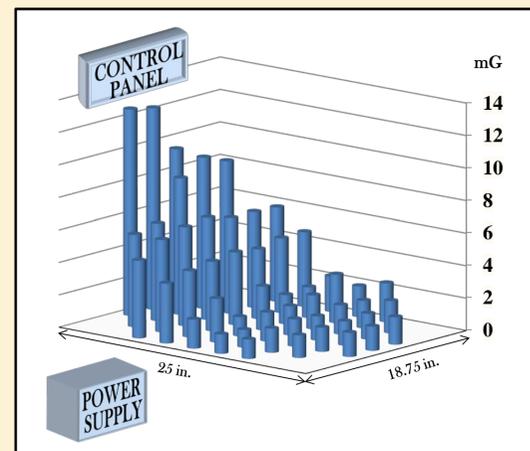
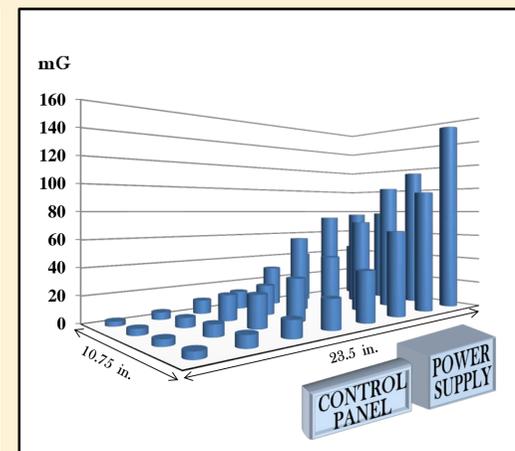


Figure B: Transport Incubator



Surrounding equipment added 0.7 mG to baseline ELF-MF readings.

#### Standard Incubator (Fig. A):

- In heating mode, ELF-MFs with a range of 1.5 - 12.7 mG, mean of 4.0 ( $\pm 2.8$  SD) mG were measured inside the incubator. Stronger fields were detected near the control panel.
- ELF-MFs detected outside standard incubator ranged from 0.4 to 281 mG, with highest values adjacent to the power supply located below the control panel.

#### Transport Incubator (Fig. B):

- In standby mode, ELF-MFs with a range of 3.6 - 151.8 mG, mean of 41.3 ( $\pm 37.6$  SD) mG were found inside the incubator. Stronger fields were detected above power supply.
- ELF-MFs detected outside transport incubator ranged from 0.3 to 102.4 mG, with highest values adjacent to the power supply.

### Conclusions

Magnetic flux density of ELF-MFs within and outside standard and transport incubators exceeds values correlated with negative health consequences<sup>2</sup>, and is highest near the power supply for the heating element of these incubators.

Mechanical design of incubator models should incorporate strategies to reduce ELF-MF exposure.

### Clinical Implications

In the standard incubator, if the infant's head is oriented toward the control panel and/or power supply, the developing brain is exposed to 8-fold the ELF-MF magnetic flux density it would receive if oriented away from the control panel.

In the transport incubator, if the infant's head is oriented adjacent to power supply, the developing brain is exposed to over 40-fold greater emissions. Little is known about the clinical relevance of these fields on the developing newborn brain.

NICU staff, pregnant or otherwise, could minimize exposure by not standing near the control panel and electrical components of either incubator type while tending to patients.

### Selected References

1. Li DK, Chen H, Odouli R. Maternal exposure to magnetic fields during pregnancy in relation to the risk of asthma in offspring. Arch Pediatr Adolesc Med. 2011 Oct;165(10):945-50.
2. World Health Organization. ELF environmental Health Criteria Monograph No. 238 (2007). Geneva: WHO..