

**Biological effects of low level exposure to
trichloroethylene (TCE): Recent findings from
the National Cancer Institute**

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Rationale

- **To study early biologic effects of TCE at airborne exposure levels below the U.S. occupational standard, 100 ppm as an 8-hour time weighted average.**
- **To provide insight into carcinogenic mechanism of TCE exposure, especially for non-Hodgkin lymphoma and kidney cancer.**

Molecular Epidemiology Study of TCE

Study design:

- 40 factories in Guangdong, China were screened to identify factories that used TCE with none to minimal use of other chlorinated solvents
- 6 metal cleaning factories selected: 80 workers exposed almost exclusively to TCE were enrolled
- 96 unexposed controls were enrolled from 2 clothes and 1 food factory
- Extensive personal air monitoring for TCE
- Blood and urine samples collected





Leucocyte (white blood cells) Subsets

- **Myeloid lineage**

- » **Granulocytes**

- » **Platelets**

- » **Monocytes**

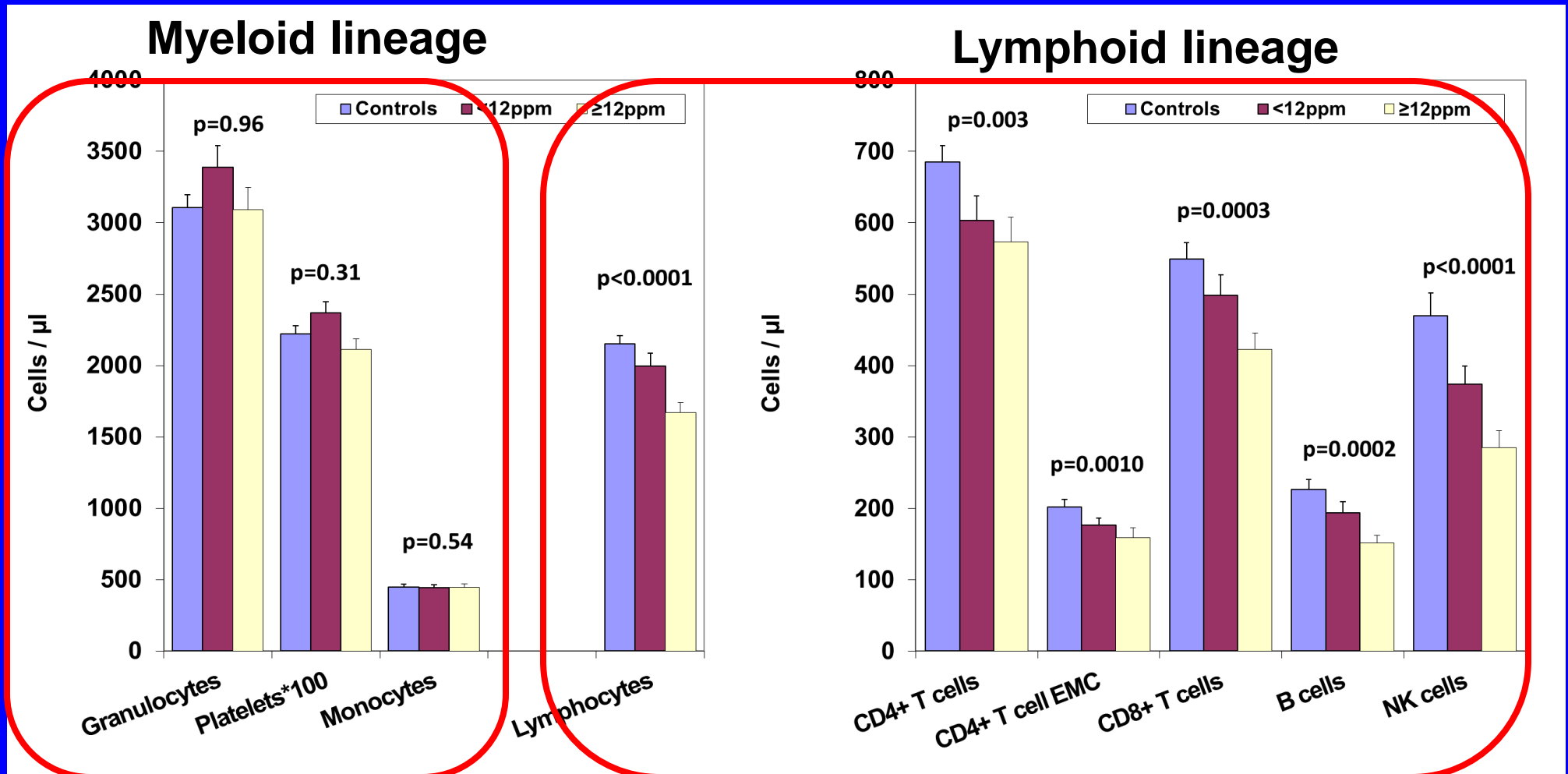
- **Lymphoid lineage**

- » **T-cell subsets**

- » **B cells**

- » **NK cells**

TCE Exposure and Peripheral Blood Cell Counts and Lymphocyte Subsets



p values are for trend

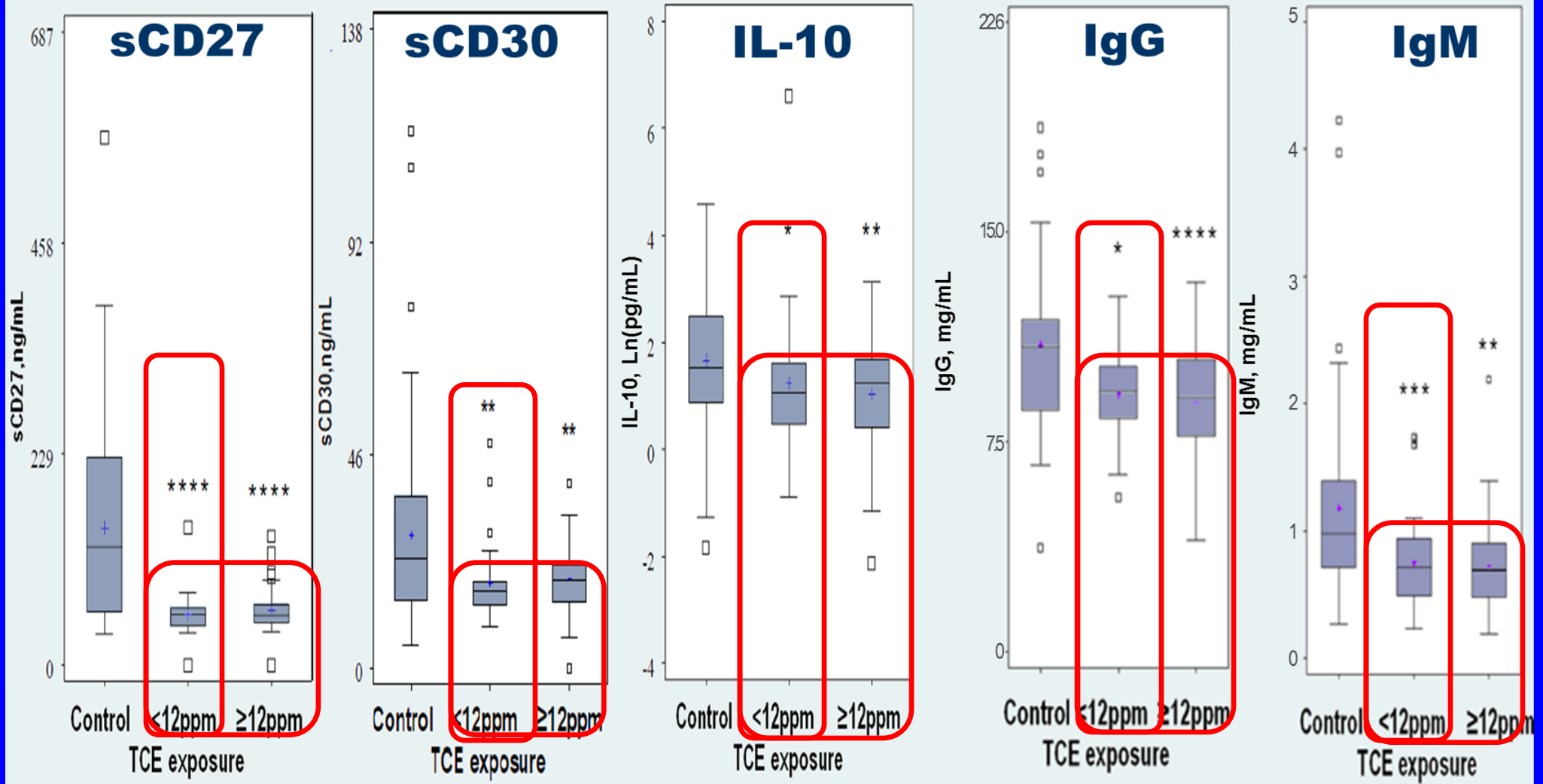
Lan et al., Carcinogenesis 2010
Hosgood...Lan, Front Oncol 2012

Cytokines and Antibodies in Peripheral Blood Serum

- ***Cytokines*** are cell signaling molecules that aid cell to cell communication in immune responses:
 - sCD27
 - sCD30
 - IL-10
- ***Antibodies:***
 - IgG
 - IgM

TCE Exposure and Immunologic Markers

*: p<0.05; **: p<0.01; ***: p<0.001; ****: p<0.0001



Conclusions and Implications of TCE Study

- TCE exposure → alterations in multiple immune markers
- Supports biological plausibility that TCE may cause NHL
- All effects occurred at exposures < 12 ppm, raising a concern about the current US OSHA standard of 100 ppm

Impact of Research Findings

- **IARC Monograph (Volume 106, 2012) – Group I**
 - TCE causes kidney cancer, and possibly NHL
- **EPA risk assessment of TCE exposure (2014)**
 - TCE is carcinogenic to humans

- **Lan et al. (2010) Occupational exposure to trichloroethylene is associated with a decline in lymphocyte subsets and soluble CD27 and CD30 markers. Carcinogenesis 31:1592-6.**
- **Hosgood et al. (2012) Decreased numbers of CD4+ naïve and effector memory T cells, and CD8+ naïve T cells, are associated with trichloroethylene exposure. Frontiers in Oncology 1:1-6.**
- **Vermeulen et al. (2012) Elevated urinary levels of kidney injury molecule-1 among Chinese factory workers exposed to trichloroethylene. Carcinogenesis 33: 1538-41.**
- **Bassig et al. (2013) Occupational exposure to trichloroethylene and serum concentrations of IL-6, IL-10, and TNF-alpha. Environ Mol Mutagenesis 54: 450-4.**
- **Zhang et al. (2013) Alterations in serum immunoglobulin levels in workers occupationally exposed to trichloroethylene. Carcinogenesis 34: 799-802.**

