Intensive care unit (ICU) patients are often administered several different continuous intravenous (IV) drug perfusions simultaneously, but their IV accesses are usually limited (i.e., two- or three-lumen central venous catheters). As a result, several drugs must be administered together in the same IV line (see Figure 1). Assessing their mutual physicochemical compatibility is therefore important to avoid precipitate formation or chemical inactivation of one or more drugs.

For many years the pharmacy department of our university hospital has been providing nurses in the adult ICU with a black-and-white table of drug (in)compatibilities based on literature data. Unfortunately, data are still missing, even for commonly used drugs.

To apprehend this problem we conducted an investigation in the ICU to assess if patients' IV medications were administered according to this table (known compatibility data), identify the most important missing data and begin filling the gaps through laboratory tests.

**Study design**
An observational prospective study was carried out over 72 days, between April and July 2005, in the 34 beds of the adult
ICU of Lausanne University Hospital. Patients receiving more than one IV drug in the same line simultaneously (Y-site injection or mixed in the same container) were included. For each patient, all IV drugs were recorded together with their concentration, infusion solution, administration rate and location on the IV line system.

Compatibilities between drugs were assessed pairwise, even if more than two drugs were often administered in the same IV line, since this is how most compatibility data are reported.

Physicochemical compatibilities between most frequently administered drugs were compiled from the literature. In the absence of available information, visual tests were performed in our quality control laboratory. The concentrations of drugs tested were as commonly used in the ICU. For each pair of drugs, four different tests were performed (see Figure 2), namely: a) 1+1ml, no mixing (to mimic a Y-site injection); b) 1+1ml, mixing; c) 1+4ml, mixing; and d) 4+1ml, mixing. Drugs were considered compatible if no precipitate, colour change or gas emission was visible within 24 hours.

Results
A total of 1,913 associations between two or more drugs were observed, among which 783 (41%) involved only two drugs. On average, 3.1±0.8 (2-9) drugs were administered together in the same IV line. These 1,913 associations were decomposed into 6,583 pairs, from which 4,242 pairs (64.4%), involving the 17 most used drugs, were evaluated (see Table 1).

According to the literature, 71.6% of the observed pairs were considered compatible and 1.1% incompatible (see Figure 3). However, 27.3% of the pairs were not interpretable because of differences between local usage and literature conditions (drug concentration, solute, excipient) or due to lack of data. After laboratory tests, 81.4% of the pairs were considered compatible, 1.4% incompatible and 17.2% could not be tested for a variety of technical reasons.
Moreover, our laboratory tests showed that some literature data were inconsistent with our own results or inapplicable to local conditions (eg, dopamine in which excipient is different).

What did we learn?
This work showed that the associations made by the nursing staff were usually considered as compatible, at least pairwise. However, a small percentage of the drugs (1.1% of the associations) were administered together despite being classified as incompatible in the literature. In addition, our laboratory tests revealed some previously unknown incompatibilities.

The compatibility table was then modified by adding the new data and by highlighting compatibilities (green) and incompatibilities (red) with colours. Teaching is also being provided to the nursing staff.

How can we progress?
Knowing that ICU nurses often mix more than two drugs on the same IV line, checking pairwise compatibilities was one of the major limits of this study. Thus, we envisage continuing this work by assessing compatibilities between three or four drugs, first with visual tests and later using HPLC dosing.

References

3. Trissel LA, Leissing NC. Trissel's tables of physical compatibility. 1st ed. Lake Forest, IL, USA: MultiMatrix Inc; 1996.