Department of Anesthesiology at Nagoya City University Hospital:

Preventing the Erroneous Administration of Drug During Anesthesia using the GS1 DataBar

The Department of Anesthesiology at Nagoya City University Hospital has developed a system to prevent the erroneous administration of drug during anesthesia that: 1) reads the barcode (GS1 DataBar) marked on a drug (ampule or vial); 2) creates a syringe label that is categorized by color, according to the drug efficacy; and 3) uses two-dimensional barcodes printed on the syringe label for safety check and for automatic recording. The system was introduced in November 2014.

Outline of Nagoya City University Hospital

The hospital, established in 1931, is a medical institution located in the Nagoya metropolitan area. As of 2014, the hospital has 808 beds, an average of 1,785 outpatients per day, an average of 677 inpatients per day and performs 7,393 surgeries per year (with an average of about 20 per day).

Drugs Used During Anesthesia and the Issues Involved

Anesthesia is indispensable when conducting surgeries. An anesthesiologist uses various drugs

Fig. 1 Nagoya City University Hospital

(such as vasopressors, hypotensive agents and muscle relaxants) to stabilize a patient's condition, while maintaining the depth of the anesthesia by adjusting the doses of anesthetic. Most of these drugs are adjusted to have an immediate effect, and can therefore be extremely dangerous in the case of an incorrect administration of the drug. The erroneous administration of drug during anesthesia is a major issue around the world, but decisive steps to prevent such errors have not yet been established. According to a survey by the Japanese Society of Anesthesiologists, the erroneous administration of

drug during anesthesia was reported about 0.04 percent (39.2 in 100,000 cases). The most common reason for an error was the mixing-up of drugs or of syringes loaded with drug. This is because the package designs and names of the drugs are often similar, and the shapes and labels of the prepared syringes can look almost the same. The difficulty of reading handwritten labels is also an issue.

GS1 DataBar Marked on Drugs

In 2006, preventing the erroneous administration of drug, the Ministry of Health, Labour and Welfare issued "Implementation Guideline for Barcode Labeling of Prescription Drugs" (issued on September 15, 2006, and partially revised on June 29, 2012) to industry groups. Following this guideline, all injections since 2008 have been labeled with GS1 DataBar Limited or GS1 DataBar Stacked, in principle. Additionally, when a lot number and an expirataion date are need to be marked into the barcode, in such cases as specific biological products, a composit symbol is used (see Fig. 2).

Fig. 2 GS1 DataBar Limited and its Composite Symbol

(17)181231(10)ABC12345

(01)04912345123459

GS1 DataBar Limited

(01)04912345123459
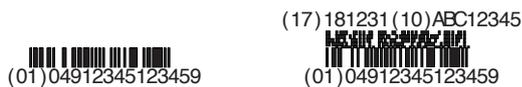
GS1 DataBar Limited Composite Symbol

The Composite Symbol shows (17) Expiration Date and (10) Lot Number in addition to (01) GTIN

What is the Syringe Label with Color Code?

To prevent the erroneous administration of drug, the ISO and anesthesia societies from around the world have standardized syringe labels that use common design including such as notaion of drugs and color codes to categorize the drug efficacy, and recommend their use. In March 2015, the Japanese Society of Anesthesiologists made a similar proposal. The code is expected to reduce the number of incidents of the erroneous administration of medicine by making the labels easier to be recognised. In the proposal from the Japanese Society of Anesthesiologists, the drugs are sorted into 13 categories depending on the drug efficacy, using nine background colors that appear with or without stripes. For example, muscle relaxants are given a red syringe label, while the relaxant reversal agents are given a red syringe label with white stripes (see Fig. 3).

Fig. 3 Color Code

Drug classification	Color sample	Color name and pattern
Induction agents		Yellow
Benzopdiazepines		Orange
Benzopdiazepine antagonists		Orange with diagonal stripes
Muscle relaxants		Red
Relaxant reversal agents		Red with diagonal stripes
Opioids		Light blue
Opioid antagonists		Light blue with diagonal stripes
Vasopressors		Purple
Hypotensive agents		Purple with diagonal stripes
Local anaesthetics		Grey
Anticholinergic agents		Green
Anti-emetics		Salmon
Miscellaneous drugs		White

(Source) Japanese Society of Anesthesiologists "Measures to Prevent Perioperative Medication Errors and Erroneous Administration of Medicine –Proposal For Syringe Labels on Medicine"

For the Safer Use of Drugs

About 300 types of drugs are available in the operation rooms of Nagoya City University Hospital, and average 10 - 20 types of drugs are used in one operation.
The Department of Anesthesiology of the hospital has developed the NOS-SA (Nagoya City University Operation Room Safety-Smart Assistance) system, which combines a color-coded syringe label-printing device with a barcode reader called the Safe Label System (SLS500i™) (Codonics Limited KK.) and an automatic anesthesia recording system called ORSYS-TETRATM (Philips Electronics Japan, Ltd.) that records a patient's condition during the anesthesia, such as the blood pressure and heart rate as well as the drugs that arebeing used. The hospital began using this system in all of its operation rooms in November 2014.
The flow of preparing a syringe at a operation room is shown in Fig. 4. First, the GS1 DataBar on the drug to be used (the ampule or vial) is held up to the Safe Label System (SLS500i), where it is scanned and confirmed visually and audibly (Fig. 4 I). While a color coded syringe label is being printed, the drug is loaded into a syringe, and the printed syringe label, on which Data Matrixs are also printed, is then placed onto the syringe (Fig. 4 II and III).
Before administration of the drug to a patient, the Data Matrix is sccaned with a barcode reader connected to ORSYS-TETRA. (Fig. 4 IV) At this time, the name of the drug is displayed on the screen with the syinge label color and information about the

Fig. 4 Flow of NOS-SA

I. SLS reads the GS1 DataBar of the drug vial or ampule

II. Prepared medication is printed on the color label

III. Put the label to the syringe

IV. Read the 2D barcode on the prepared drug label

V. Read the drug name and other information, display and record the drug information in anesthesia record screen
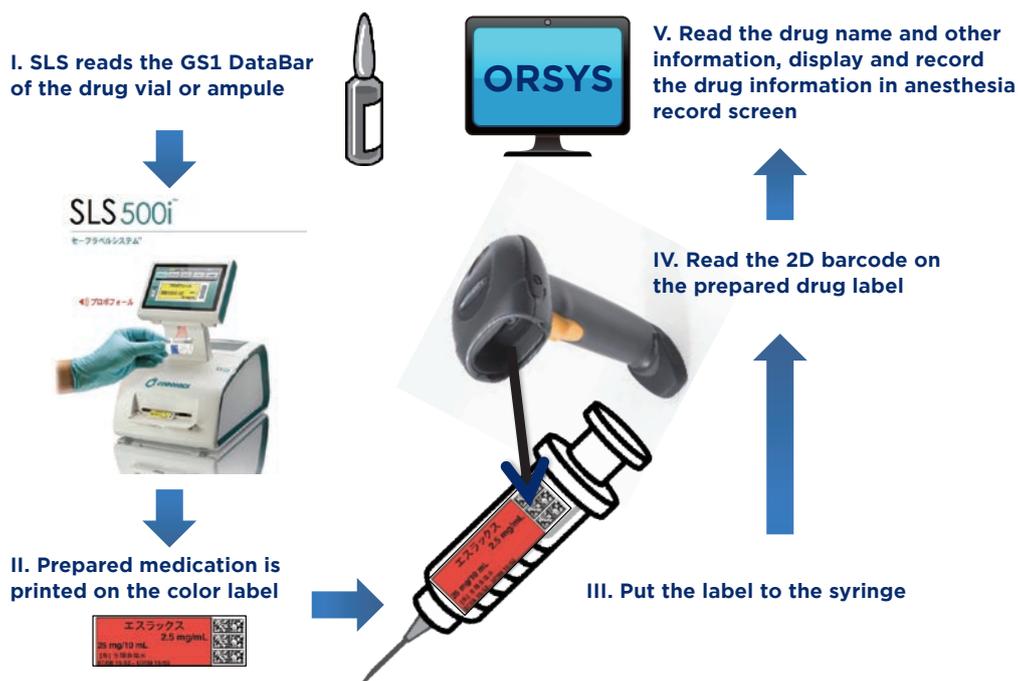
drug is presented as a voice (Fig. 4 V). Because the information is presented audibly, more than two people can confirm the information and the drug can be administered more reliably. The information about the scanned drug is also transferred to an automatic anesthesia recording system.

An actual example of a printed syringe label is shown in Fig. 5. The syringe label is colored according to the color code of the drug efficacy, and Data Matrixs that contains information about the drug, are printed on the right.

Fig. 5 Example of Printed Syringe Label

Total Dose/ Total Volume

Drug Name

Concentration

2D Barcode (DataMatrix)

Diluted Solution

Expiration Date

Color of Drug Efficacy
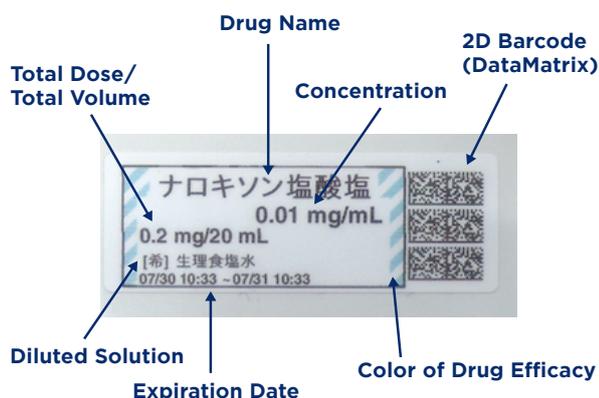
Improvement in Safety and the Spread of the GS1 DataBar Usage

The NOS-SA works together with an automatic anesthesia recording system, which saves anesthetist from the trouble of manually entering the information.. On top of preventing the erroneous administration of drug, the big advantage of this system is that it reduces the burden on doctors and nurses.

The NOS-SA, which incorporate the Safe Label System, is one of the most advanced system for patient safety during surgeries. And the effectiveness of the system is assured by the fact that all drugs in Japan are marked with a GS1 Databar at the point of production.

Several hospitals have already used GS1 DataBar for confirmation of the drugs at the dispensaries. Furthermore, several leading hospitals, including Nagoya City University Hospital profiled here, are working on the next step in which GS1 DataBar could be also used at the time of administering drug to a patient. Going forward, more medical institutions are expected to work on the effective use of GS1 DataBar in order to improve patient safety.