NEUTROPLAST

BOUTIQUE FACTORY

# DOSEA Whitepaper

# Abstract

The packaging industry is undergoing a digital transformation, enabling the implementation of data-driven technologies, which optimise the efficiency of manufacturing processes and improve product interaction with consumers. Technologies, such as NFC, have an immense impact on this transformation process, allowing data to be quickly read and written on flexible labels, adding functionality and traceability to existing products. In the pharmaceutical industry, one possible functionality added to drug vials is the automatic validation of medication intake, improving the efficiency of medical treatments for chronically ill and recovering patients, thus providing a traceability tool to facilitate clinical trials and validation of new treatments.

Towards these goals, Neutroplast, together with CeNTI and BeyonDevices, presents DOSEA smart labels. DOSEA is an intelligent, low-cost system, adaptable to different medication vials, which allows the programming of visual alarms to assist in taking medication in a simple and intuitive way. Programming can be done directly on the label or through smartphones with NFC technology, allowing programming in a simple way and with just one touch. The DOSEA project has 3 different versions, in order to meet the needs of different audiences: DOSEA Basic, DOSEA + and DOSEA Omni, with technological increments in each version, optimising the user experience and ensuring better medication adherence and user interaction results. This innovation is a testimony of Neutroplast's contribution to a smarter, interconnected and user-focused pharmaceutical industry, improving the quality of medical treatments and clinical trials through an intelligent, flexible and low-cost system.

# Smart Packaging, a Market Revolution


There is a growing digital transition in the current context of manufacturing, logistics and packaging. In fact, it is a trend of an ever more demanding market, thrust by reduced dimensions, reduced electronic component cost and Internet accessibility, which has a higher product quality and information availability as the outcome. Therefore, companies' attention to it is natural, a way to face the new market reality.

Also, Internet of Things is a recent trend in decentralisation of communication systems and device control, which allows for these devices to communicate between themselves and the user, independently and making it possible to send large quantities of data to scalable and integrated platforms of many devices at the same time. These technologies have been widely used in diversified applications, mainly for customising devices, data collection systems and inserting technological components in previously much simpler products, such as packaging.

Smart Packaging is a recent concept as well, one which is being increasingly adopted by the food, cosmetics, pharmaceutical and logistics industries. It is also different from regular packaging, as it resorts to the integration of communication interfaces on said packaging, opening a wide variety of possible uses, by allowing it to communicate both with the customer as with other devices and platforms. As for smart labelling, new possibilities are also created for companies to interact with their customer through their products packaging, using RFID and NFC technologies.

The practical implications for the product are many, though. Integrating temperature and humidity sensors can be used to measure those parameters inside the packaging, for example, guaranteeing the final product is being kept in ideal conditions until it is consumed. NFC tags and LED's, on the other hand, can be used to provide up to date information about the products conditioning, such as time of the products production, nutritional information (for food), ways to use the product or suggesting proper ways to shed the packaging.

These technologies can also be use as marketing tools, by generating hyperlinks for the user to establish a contact with the manufacturer's sales channels.

In fact, the possibility of access to information regarding the product, in a simple way, through the consumers smartphone, creates a bond between client and company. Alarm systems can also be integrated, where data, such as the products expiry date and details on the way the package is conditioned, can be transmitted visually to the consumer, certifying the product is in proper use conditions.

Embedded electronics systems, such as RFID or NFC, are widely used in Smart Packaging, as they allow for recording and reading data, simply and directly, which makes them a valuable tool to guarantee the communication between products and consumers. NFC, for example, has been widely used, for its low cost and simplicity, allowing for consumers to access relevant information just by approaching a smartphone to a label on the packaging.

This communication can be established by reading a tag applied to the cap of a bottle, for example, but is also used on more complex electronic systems, which monitor the internal conditions of the bottle and communicate with the user through an integrated alarm system.

Several markets have been reacting to these Smart Packaging innovations. Specifically, sound and visual alerts have been integrated with alarm systems, in ways that warn consumers about faulty usage conditions or when a product reaches its expiry date. The pharmaceutical industry, for example, has chosen custom alarms set into medication bottles that warn the patient when to take said medication, which brings us to the first time Neutroplast developed a Smart Packaging solution.

# GLORIA, Smart Packaging and Clinical Trials: The Path So Far

In clinical trials validation, one of the most common errors is the fact that patients might not take their medication at the requested times. This hampers the studies and also makes them costly, a problem often resolved by collecting larger samples of data. On the other hand, in hospital environments, managing medicines for a large number of patients is a challenge associated with heavy monetary costs.

These are situations where Smart Packaging technologies allow for a control and medicine manipulation, through independent systems, for example by using NFC technologies to identify the correct medicine to be given to each patient. The efficient use of these systems is also connected to the need for a platform that unifies this data, allowing for systems to connect in an orderly way and following patterns.

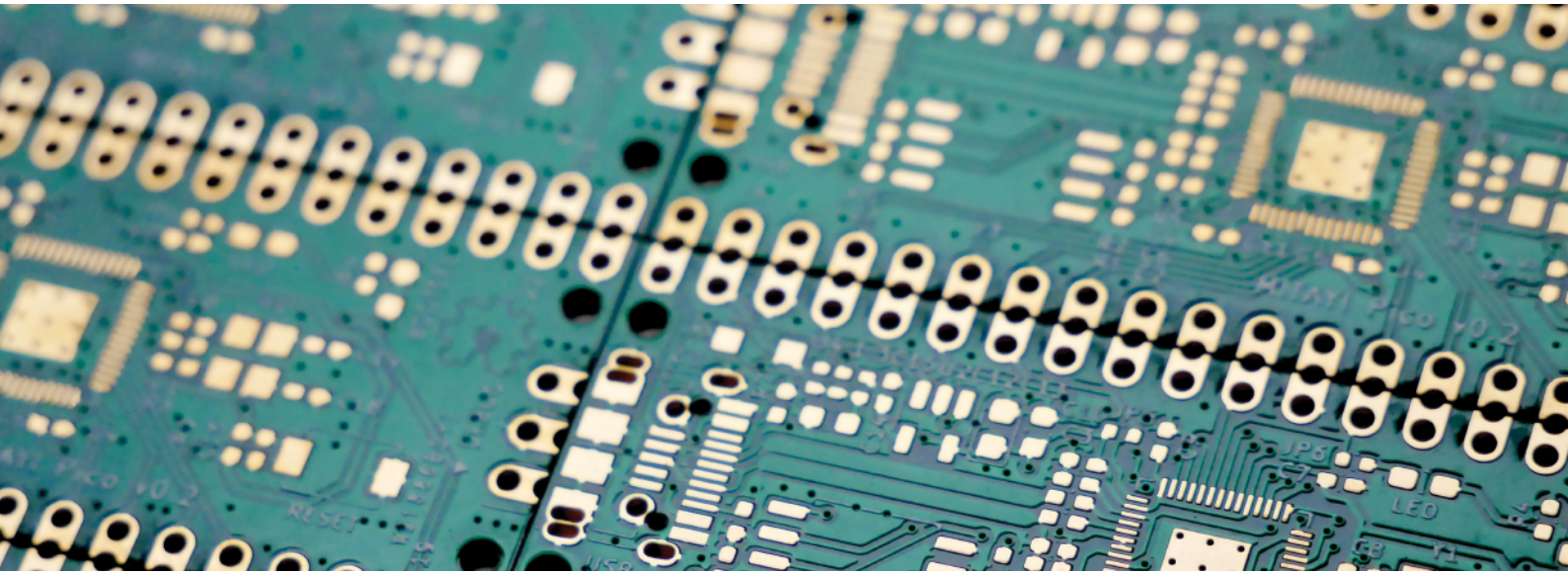
Similarly, an alarm system, integrated with a flexible, low cost, high autonomy, electronic component, can aid chronic patients to not miss the correct time to take their medication. The elderly and their caregivers, for example, have much to gain with these technologies, which allow for a simpler medication management, usually a process that takes place at multiple times throughout the day. Particularly, light or sound warnings, inserted directly in a bottle,

avoid the use of smartphones or smartwatches, recent technologies that the elderly might find hard to use.

Besides alarms systems, packaging with intelligent integrated systems can collect data about the packaging and decode them into useful information for the patients. It is possible to predetermine a time interval for taking the medication and, through collecting data on the date and time of opening the package, estimate the difference between the defined schedule and the actual time of taking the medication. This way, information on the intake of medication is generated and an assessment on the following of the prescription times is possible. The data can also be made available to the patient's relatives, caretakers or even the responsible physician, to warn them if the patient is not following the prescription intake schedule.

The GLORIA SmartCaps project is an example of such potential. Developed by BeyonDevices, a company which is part of the Neutroplast group, it applies monitoring technologies and data storing to evaluate the history of patient's medication intake and is extremely helpful when running clinical trials. By using the SmartCaps to monitor the medication of arthritis rheumatoid in several countries, one of these clinical trials verified that there was a relation between patients' adherence to the medication schedule and a reduction in the illness levels. It is a proof that a device that increases adherence, such as the GLORIA SmartCaps, is, in fact, a powerful tool for improving patient health, guaranteeing a higher performance when conducting clinical trials and, furthermore, allows for the control of treatments in hospital environments.

Connecting data with additional, individual, patient information is another important aspect of this equation. This information is readily available in hospital platforms and, by executing data analysis that takes advantage of it, behavioural and correlation trends can be pinpointed to the levels of patients' adherence with variables such as geographic location or social practices. This way, a clinical trial validation and medication efficiency tool can evaluate how specific patient profiles can affect those factors.



# DOSEA: Advancing Adherence to Medication

Neutroplast, in partnership with CeNTI and BeyonDevices, is developing a flexible and low-cost solution to improve adherence to medicine prescriptions. The DOSEA project stands for creating a simple and efficient way of creating devices to control and manage medication intake, be it for home or professional use. To that effect, different versions of the device are in the pipeline, varying both in complexity and integrated functionality. They are the DOSEA Basic, the DOSEA+ and the DOSEA Omni.

DOSEA Basic is a single use tag, created for lower cost and higher simplicity. Through printed buttons, the user can configure it with extreme ease, defining the treatment's total duration and defined interval for the medication intake. The system comes with three predefined duration settings (3, 7 and 14 days) and three intervals (every 6, 8 or 12 hours). These parameters were generated from research with Health providers, for it to be adaptable to the largest part of current treatments. Through an integrated alarm system, the tag lights up at the programmed time, alerting the patient that it is time to take their medication. After the patient takes the medication, the patient presses a "OK" button, which validates the event and starts a countdown to the next intake. The system is powered by an ultra-thin battery, developed for the products specification, which guarantees the tag is functional throughout the treatment's period. This is a low-cost system that allows for the improvement of medication adherence and guarantees a single treatment is effective.

The DOSEA+ version has similar functionalities to the Basic version, with the advantage of consisting in a re configurable system, powered by a rechargeable battery, and it can be used in several treatments. This solution is made for patients who depend on regular medical treatment, who can take advantage of a better cost-benefit relation of the tag. In this iteration, the tag is equipped with an integrated screen, that shows information about the medication intake, such as the configured parameters, the remaining time until the next dosage, the total number of doses taken and a global adherence calculation. This version can be managed through a mobile app, which allows the both the user and the caretakers to program the tag with the intake times, to manage the type of alarms the tag emits and to collect data about the adherence to the prescription.

Last, but definitely not least, the DOSEA Omni is the most complete version, with an extended array of solutions for accuracy and reporting. Besides presenting every DOSEA+ functionality, the DOSEA Omni is equipped with a level sensor, printed and embedded on the tag. This sensor will allow for the measurement of the variation of the amount of medicine inside a bottle, if it is a powder or liquid formula, and therefore validate the medication intake. It comes with an Omni Station, a tool for charging the device and monitor environmental conditions.

The Omni Station will be specifically targeted at the management of multiple medication, where more than one smart label can be charged, through a technology that allows several Omni Stations to be used simultaneously. It will also include an information management system, as well as humidity and temperature sensors, to monitor the storage conditions. Through this device it will also be possible to transfer information from the tags to the device, as to make the system data-oriented and integrated into a single treatment management platform.

# The Future of Packaging is Neutroplast

Neutroplast is conscious that its products and services quality, in parallel with pushing for the correct use of said products and services, can generate better adherence on medical treatments requiring the intake of pharmaceutical substances. Through interconnected and disruptive technologies, integrating Smart Packaging systems in our packaging with allow for increased adherence, improve the users experience with the products and guarantee that these products are reaching their highest potential. Optimising packaging user-friendliness and interactivity, we are not only increasing product functionality through the use of cutting-edge technology, but also opening the gates for innovation and interactivity on multiple levels of the pharmaceutical industry. From circular economy optimisation of productive processes to achieving intuitive ways for the users to use the products our packaging holds, the room for improving the way packaging is thought, produced and used is wide. That's why the DOSEA projects' premise lays not only in improving medical prescription adherence, but also to be an intuitive device that answers to the needs of its users, approaching Neutroplast's bottles to its customers and guaranteeing a better use and connection of the users with the packaging of sensible, and sometimes lifesaving, products. Our path's priority is towards improving the health and quality of life of our customers and, with that objective, we believe in adding value, by delivering the best of what technology has to offer at critical points of consumers lives.

**DOSEA, DOSEA+ and DOSEA Omni are the result of an R&D project, conducted under the Portuguese national innovation measures.**

Project Title: **DOSEA - Dosing Sensor & Alarm**

Project Number: **POCI-01-0247-FEDER-033664**

Project Duration: **July 2018 to November 2021**

Eligible Cost: **708.606,45 €**

FEDER Financial Grant: **494.009,63€**

Instrument: **SI I&DT Empresarial - Copromoção**

Intervention Area: **Centre and North of Portugal**

NEUTROPLAST

BOUTIQUE FACTORY