Development of a Unique Indicator Label

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Abstract

Ryerson University has teamed up with Lunanos Inc., a Torontobased company, to develop a method for the production of its IndiClean label on a flexographic label press. This involved research into the right combination of anilox rollers to be used, to the correct screen tint for applying the proprietary indicator ink and also finding the best way to apply a protective layer over the label, so that the indicator functions to specifications. The application of the protective layer involved some innovative thinking in regards to the application and diecutting process.

Many surfaces in medical facilities are consider high traffic touch points and need to be disinfected on a regular basis to avoid the spreading of germs and infections. Environmental surfaces provide an excellent environment for pathogenic microbes to live and reproduce. Many microbes are able to survive for extended periods of time on everyday surfaces such as bed rails and ultrasound machines. These potentially multidrug resistant bacteria are then able to spread by contact with patients, staff, and visitors, resulting in healthcareassociated infections (HAIs).

Improper cleaning can lead to increased HAIs. HAIs are the fourth largest cause of death in developed countries, resulting in more deaths than breast cancer, AIDS, and traffic accidents combined. Even though 3050% of these cases are preventable, they affect 1 in 10 Canadian hospital admissions, leading to 8000 deaths every year, and it is estimated that an HAI can increase individual treatment costs by $6,000 to $45,000 as well as lengthen inpatient treatment time by 4 to 14 days.

Infection prevention and control professionals have said that tracking the cleaning of the over 10,000 pieces of equipment in a hospital is very difficult, pointing particularly to mobile equipment—like IV poles, carts, and wheelchairs. Although hospital cleaning personnel know that they play a key part in patients' care, they are often under tremendous time pressure to complete their tasks, and they are looking for an automatic method to note whether a particular surface needs to be recleaned.

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Currently, there is no product on the market that can address that issue. Traditional methods, like log sheets or writing time of cleaning on pieces of tape, require hospital staff to remember to pause cleaning in order to make notes; while advanced methods, like using proximity sensors, are very costly and require extensive training.

Lunanos Inc. has developed a proprietary indicator coating technology, which they have incorporated into a prototype label, that will help healthcare facilities improve disinfection procedures of environmental surfaces by clearly identifying surfaces and equipment that require cleaning. The label (IndiClean) can be placed upon numerous surfaces, including pieces of mobile equipment that travel from room to room in hospitals. When a staff member uses a liquid disinfectant to wipe down a surface, the proprietary polymer technology that coats IndiClean will cause a visible color change. The company is currently developing a method to control the time it takes for the color to return to the initial state, allowing for differences in each facility's protocols regarding when cleaning is required. Cleaning staff will be trained to identify the initial color (i.e. before cleaning), and to proceed with cleaning after observation of the "unclean" color. The labels automatically activate, preventing the need for staff members to remember what they need to clean and what they have cleaned already. Training will be provided to staff to strategically place labels in a strategic location on each high traffic touch point surface in order for staff to easily see the indicator during their normal routine. IndiClean has been designed clearly such that there will be minimal difficulties with interpreting its message. Currently, there are no such cleaning indicator products on the market, making IndClean a whole new product class.

Lunanos Inc. was successful in creating handmade prototypes of their label; however, these prototypes varied considerably in consistency due to the uncontrollable variability associated with the hand crafting process. In addition, the current method of assembly does not allow for mass production of the labels, nor is it economically viable. Ryerson's role in this project was to develop a process that would allow consistent and repeatable results for generating good labels at a mass scale, at a reasonable costperunit.

This research paper details the research, testing, and progress to date associated with developing a successful, reliable, and reproduceable IndiClean label.

Introduction

Background

This paper discusses research into the use of flexographic printing to create a unique and proprietary indicator label designed to interact with common disinfecting agents to provide a visual indication of the current state of a surface's cleanliness.

The School of Graphic Communications at Ryerson University was approached by Lunanos Inc., a new start up company originating from the University of Toronto in Ontario, Canada, to assist with further development of a unique and proprietary label that can be used to track and monitor the frequency and effectiveness of surface disinfection for high volume touch points found in critical facilities such as hospitals. Lunanos developed a unique indicator substance that chemically reacts with the various leading standard disinfecting agents.. When the disinfectants come into contact with the indicator substance, it changes color, providing a visible cue that shows disinfectant has been applied to a specific area. Lunanos has combined this indicator with a proprietary finishing layer that controls the time it takes for the ink to change back to its original color. The result is a reusable indicator label, which Lunanos has branded as IndiClean, which can be applied to high traffic touch points with a prescribed cleaning regiment. For example, there may be a 12hour label for areas that need disinfecting twice a day, or a 24hour label for once a day cleaning.

When Lunanos contacted the School of Graphic Communications Management, they had already successfully hand produced a small batch of prototype labels, the company needed to develop a process to automate manufacturing and to improve batchtobatch consistency and reproducibility for the product, while achieving feasible production costs to make the product affordable. The research conducted and reported in this paper discusses the progress to date that has been made towards achieving affordable, mass production of the indicator label.

***Figure 1:** IndiClean concept art*

The Lunanos IndiClean indicator label has the potential to greatly reduce the likelihood of germs being spread through physical contact of high traffic touch points by providing a clear visual indication of the status of a surface's cleanliness as part of a comprehensive environmental surveillance and cleaning strategy. In typical a healthcare facility, there can be over 10,000 pieces of equipment that would be considered a high volume contact point device. For the sanitization staff, it can be very difficult to keep track of which devices require disinfecting. An automatic method to keep track of these devices would be ideal, since it would ensure every device met the hygienic standard. The Lunanos indicator label could be placed on most pieces of equipment that require daily inspection and will easily tell the user if that device is sufficiently cleaned or not. When a staff member wipes a disinfectant onto the surface, it causes the indicator ink to change color. Based on certain parameters, the label can control how long this color change will last (essentially if the surface needs cleaning every 24 hours the label will be produced to keep a color change for 24 hours, or 18 hours, 12 hour, and so on). Health care workers and custodial staff will know when a surface needs cleaning again when the color of the indicator label returns to its original state. The label is such that it could be used on all sorts of surfaces, such as door handles, intravenous poles, light switches, wheelchairs, hospital beds, and much more.

Relevance of the Research Outcomes

Proper sanitization can be a key issue for high traffic public facilities. Throughout the day, many surfaces such as door knobs, handles, elevator buttons, and chairs may come in contact with bacteria, germs, and even infectious diseases simply due to the sheer volume of people touching them. Many strains of bacteria and viruses can survive on a surface for extended periods of time, making the transfer of infectious diseases between people quite prevalent.

In certain facilities such as a hospital, proper sanitization is a very critical issue for many of the patients, health care workers, and visitors. In these situations, high volume contact points must be disinfected on a regular basis to minimize the spreading of germs. Improper sanitization can lead to patients developing new sicknesses and health conditions that they did not have when they were first admitted to the hospital. Illnesses contracted while in hospital are known as health care associated infections (HAIs). A health care associated infection can be defined as “a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s) that was not present on admission to the acute care facility” (Narayanan, 2014, p. 85).

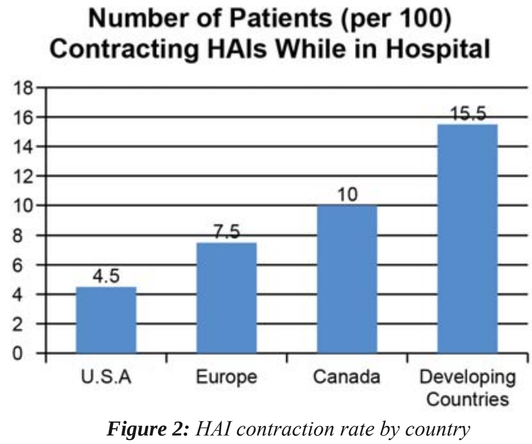

Figure 2: *HAI contraction rate by country*

Health care associated infections are a serious and growing concern for both developed and developing countries. The Centre for Disease Control in the U.S. estimated that in 2002 there were approximately 1.7 million cases of HAIs in U.S. hospitals alone, and that out of those 1.7 million cases, 99,000 were fatal (Narayanan, 2014). This means that in the approximately 4.5 patients per 100 admitted to hospital contract some form of an HAI. In Canada it is estimated that 10 out of every 100 patients contract an infection while in the hospital (Boscart et al., 2008), and that these HAIs lead to over 8,000 deaths per year (Zoutman et al., 2003). Similarly, the European Centre for Disease Prevention and Control has reported an incident rate of 7.1 per 100 patients contract some form of an HAI in Europe (Allegranzi et al., 2011). The estimates the rate of contraction of HAIs for developing countries is significantly higher, with conservative estimates at 15.5 out of 100 patients contracting an HAI while under hospital care (Allegranzi et al., 2011).

The development of a specialized indicator label for monitoring the sanitization of high contact touch points in hospitals is both relevant and timely. According to McNamara, health care associated infections rank among the top 10 causes of death in the U.S., and anywhere from $4.5 billion to $6.5 billion U.S. is spent each year treating HAIs, making the prevention of HAI a national priority (McNamara, 2009). In Canada, it was estimated that the cost of treating HAIs in 2005 ranged between $54 million and $110 million Canadian dollars (Valiquette, Chakra, & Laupland, 2014). The health and financial implications of HAIs are quite significant, especially when one considers that the majority of HAIs are easily preventable (The Lancet, 2015, Zoutman et al., 2003). Further, many experts agree that HAIs can be controlled and prevented using inexpensive tools and techniques that are targeted around proper surface cleaning and hand hygiene. The Association of periOperative Registered Nurses stresses that "environmental cleaning focuses on keeping perioperative personnel safe in achieving the goal of a clean environment, which in turn keeps patients safe… A clean environment keeps pathogens at bay" (Blanchard, 2007, p. S83). Similarly, McMamara, states that "regular environmental surveillance and cleaning" is one way to reduce the spread of HAIs (McNamara, 2009, p. 41). Further, the Centre for Disease Control has data that suggests that "implementation of existing infection prevention strategies could lead to a U.S.$25–31,5 billion saving in medical costs and a 70% reduction in HAIs" (The Lancet, 2015, p. 304). In Canada, Valiquette, Chakra, and Laupland believe that HAI prevention and control should be emphasized as a national priority:

> "We believe that these data are needed to convince health care administrators to prioritize infection prevention and control resourcing according to the magnitude of this problem. In our personal experiences, funding of infection prevention and control efforts occurs at a small fraction of the cost likely incurred by nosocomial infections, while in some jurisdictions worldwide, use of funding penalties has been implemented in an attempt to motivate health care institutions to reduce nosocomial infection incidence. (Valiquette et al., 2014, p. 72)"

The Lunanos indicator label has the potential to greatly reduce the likelihood of germs being spread through physical contact of high traffic touch points by providing a clear visual indication of the status of a surface's cleanliness as part of a comprehensive environmental surveillance and cleaning strategy. In typical a healthcare facility, there can be over 10,000 pieces of equipment that would be considered a high volume contact point device. For the sanitization staff, it can be very difficult to keep track of which devices require disinfecting. An systematic method to keep track of the sanitization these devices would be ideal, since it would ensure every device met the hygienic standard. The Lunanos indicator label could be placed on most pieces of equipment that require daily inspection and will easily tell the user if that device is sufficiently cleaned or not. When a staff member wipes a disinfectant onto the surface, it causes the indicator ink to change color. Through the proprietary finishing process of the label it is possible to control how long this color change will last (essentially if the surface needs cleaning every 24 hours the label will be produced to keep a color change for 24 hours, or 18 hours, 12 hour, and so on). Health care workers and custodial staff will know when a surface needs cleaning again when the color of the indicator label returns to its original state. The label is such that it could be used on all sorts of surfaces, such as door handles, intravenous poles, light switches, wheelchairs, hospital beds, and much more.

Desired Outcomes and Challenges

The main goal of this research project is to develop an affordable process of producing the Lunanos indicator labels at a sufficient rate while still maintaining the required quality control standards of the product. The main focal point has been the implementation of a flexographic printing press to produce the labels. The flexographic press is utilized to produce the various layers required in the label design. These layers include the design layer, the indicator layer, and the finishing layer to protect the label. The flexographic press is also used to die cut the label to its desired shape, allowing for the entire label to be printed and finished in a single pass through the press.

There were two main challenges faced by the researchers at the onset of this project. The first challenge had to do with the proprietary indicator substance itself. While the substance formulation was such that it could be applied in small batches by hand within a lab, its properties did not lend themselves to being run as ink on a flexographic press. Second, the proprietary finishing process that regulates the duration of color change is not only complex, but requires the precise placement of multiple parts inline while the product is being printed at production run speeds.

Experimental Procedure

The purpose of this research project is to determine whether the Lunanos IndiClean Label can be mass produced at a viable cost per unit while maintaining strict quality assurances from label to label. In essence, the research needs to solve a manufacturing problem. In the early stages of the research, several different printing processes were considered, including commercial offset printing, screen printing, inkjet printing, and flexography. Through a process of elimination, it soon became apparent that neither inkjet printing nor commercial offset printing were well suited to the project. This resulted in several prototype design solutions for both flexographic printing and screen printing. The physical characteristics of the proprietary indicator substance made it very difficult to achieve immediate success due to the properties of the ink not being very compatible to screen printing or the flexographic press. Many revisions to the initial design process were made in attempt to correct the issues that developed throughout the research period. Changes such as reformulations of the indicator substance for better press compatibility as well as changes in the design structure and sequence were considered and tested. The research methods used for testing the viability of screen printing and flexography printing are discussed in the following sections.

Research Methods for Screen Printing

The first printing process that was considered for the printing of the IndiClean label was screen printing. Screen printing can achieve relatively thick ink film thicknesses, and it was hypothesized that this printing process would be most forgiving and flexible for applying the proprietary indicator substance.

To test the viability of screen printing for the IndiClean label, a standard 110 mesh polyester screen was chosen. It was decided that for the initial test, only the indicator substance would be printed to determine how well its characteristics would reproduce. The screen was hand coated with a DIAZO photo emulsion and dried according to manufacturers directions. A film positive was electronically imaged to form the shape of the chevron that the indicator substance must form, and then the positive was used to expose the screen using a 250watt photo flood bulb in accordance to the manufacturers instructions.

The indicator substance was forced through the screen using a soft edged squeegee onto a dark colored paper substrate. The first and second print produced reasonable results, but by the third print the quality of the printed image began to drastically degrade in that the shape and opacity of the printed result diminished. By the tenth print, none of the indicator substance was transferring onto the substrate.

A post mortem on the initial test round revealed that the reason why the print quality degraded was that indicator substance began drying almost immediately when it was forced through the screen, which in turn clogged the screen and prevented the transfer of the indicator substance through the mesh onto the paper.

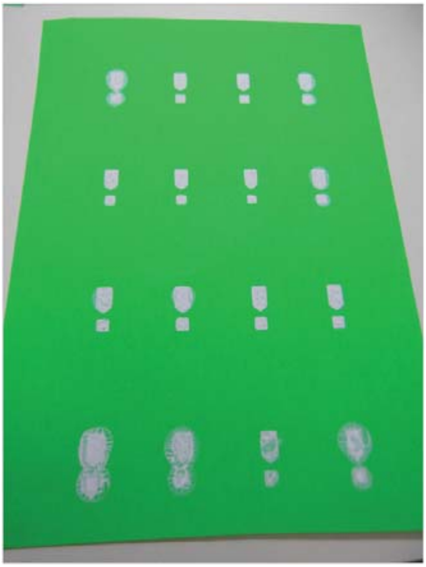

Figure 3: *Printed result of indicator ink using screen printing*

Based on the preliminary print test, Lunanos reformulated the indicator substance to be more “inklike”, which resulted in the substance now being identified as the indicator ink. In addition, the 110 mesh screen was replaced with a coarser 86 count mesh. The rest of the procedures remained the same as the first trial. Unfortunately the results of the second trial were not better than the first trial. In fact, the resulting prints were actually worse quality than the ones created in the first round trial.

Based on the results of these two trials, it was determined that screen printing was not a preferred method for applying the indicator ink onto the substrate. A sample screen print from the second screen print trial is shown in Figure 2.

Research Methods for Flexographic Printing

There were many research problems that needed to be addressed while producing the label, including how the indicator ink would perform on the flexographic press. In order to analyze this and determine if the indicator ink would perform predictably on press, the very first set of press runs was dedicated to testing the indicator ink’s runability and opacity. Rectangles of the indicator ink were printed side by side showing the opacity differences between 1, 2, and 3 hits of indicator ink over a solid black background. During these first tests, the doctor blades were removed in efforts to apply more ink onto the printing stock. The indicator ink anilox rollers were also varied between 7 12 BCM in order to analyze the opacity differences. These initial tests did not show desirable results therefore, the focus shifted on new ideas to increase ink opacity. The indicator ink exhibited unappealing characteristics such as a high viscosity and a fast evaporation rate. The high viscosity prevented even flow of the ink onto the printing rollers and the fast evaporation rate creating `caking' on the plates as well as the idler roller. Wetting agents were added to new ink reformulations in efforts to produce an ink that would be more compatible to the press. These new formulations exhibited much better fluid characteristics, producing a higher opacity. To solve the caking on the idler roller, further tests were conducted where longloop idler roller was installed between each of the indicator ink print stations to give the indicator ink more time to dry between print applications. Over the course of these tests, improvements in overall runability and opacity were achieved.

The next set of press runs focused on the other major research problem, a protective finishing layer for the indicator ink. One of the first ideas tested in a press run involved printing the indicator ink on the adhesive side of a transparent film by feeding the stock through the press upside down. The full label without the indicator ink layer would be printed on the chosen opaque label stock and then be fed from the waste wind roller in reverse and merged on top of the indicator printed adhesive roll. This procedure worked in theory but through actual experimental testing, it was determined that it was too difficult to properly align the two roller feeds so that the indicator ink aligned on the design layer. Another problem that occurred during these print runs involved the adhesive backing coming in contact with the idler rollers. This significantly decreased the adhesive strength when merged with the design layer.

After thorough research and testing, it was determined that the ideal method to apply a protective coating onto the label was to spot print a liquid adhesive to the printed label and laminate a clear film on top instead. In this scenario, the liquid adhesive was applied in a particular pattern and a nonadhesive clear layer was be merged using the waste wind roller. Several liquid adhesives were tested before finding one that possessed the characteristics of high fluidity for the press, and high adhesive strength for the label. For this series of tests, the design layer was printed using flexographic ink. The indicator ink was placed in another printing station instead of traditional flexographic ink. The liquid adhesive also used a print station on the press The chosen label stock was fed through the printing press with the first printing station used to print the design layer of the label. The remaining print stations were used to apply the indicator ink layer, and the adhesive before the finishing layer was laminated to the label. This technique provided a sufficient way of mass printing the IndiClean label with improved accuracy and consistent results. Several good quality printed samples were generated resulting in the ability to construct several sufficient prototypes.

Determination of Adhesive Label Stock

Another concern that had to be addressed was that the IndiClean label will be exposed to many repetitions of wiping using harsh cleaning agents. Since the label will be exposed to harsh cleaning chemicals, the label substrate and its adhesive must be able to withstand hundreds of repetitive wipes before starting to show any effects of chemical or physical wear. Furthermore, the adhesive that bonds the label to the cleaning surface must not only be strong enough to withstand harsh cleaning agents, but must also be such that the label can be easily removed without leaving substantial residue when an old label needs to be replaced with a new one when its maximum lifespan is reached.

Various types of label stock were tested amongst various cleaning agents and the end result determined the ideal material to be used as the base stock for the label. This test was carried out in the Lunanos lab setting and Figure 4 below demonstrates how the different substrates were compared with each other. Each large box represents a different printing stock type and each smaller box represented a different chemical used.

The harsh chemicals were also tested against the actual printed label to witness any degradation effects of the design layer. It was proven that degradation effects on the design layer started very quickly. The outcome of this test reaffirmed the requirement of a protective finishing layer over the printed design layer that would help prevent the label from degrading.

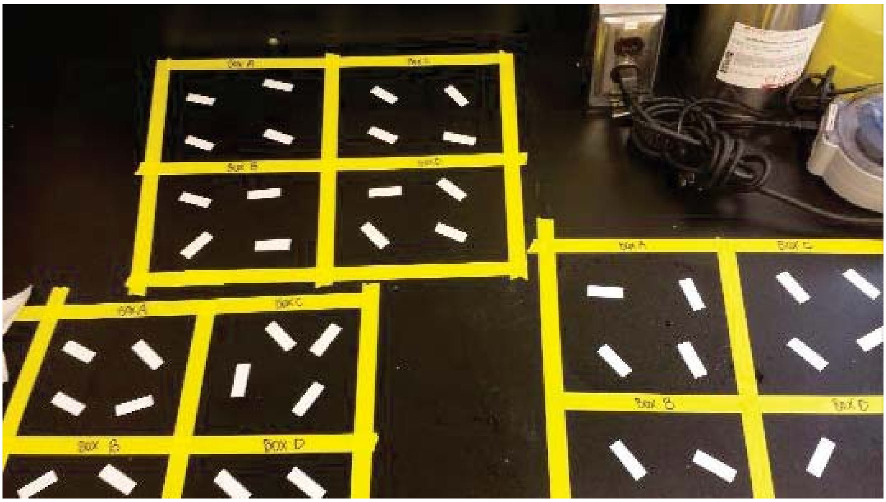

Figure 4: *Testing the durability of various label stocks*

Other Experimental Considerations

Throughout each press run, certain steps were taken to ensure smooth runs. The indicator ink needed to be properly sealed after each press run and properly mixed before and during each press run to ensure ideal viscosity and fluidity. Throughout each press run the print stations containing the indicator ink would have to be mixed using a mixing stick to ensure the ink properties were not changing throughout the press run, creating variations in the opacity from start to finish.

The indicator ink exhibited very unique characteristics, despite several reformulations. Unlike conventional flexographic ink, the indicator ink would begin to gel on press, and dry on the anilox rollers. It was also very difficult to clean up after the press runs. Strong chemicals such as acetone were used to clean the equipment, and a strong ceramic gel (CeramClean II) had to be used to clean the anilox rollers after each run. The cleaning process was very labor intensive but was very much necessary after each press run given the nature of the indicator ink.

Results and Discussions

Prior to the start of this project Lunanos hand assembled several prototypes of the IndiClean label that were tested successfully in the lab at Lunanos. For the hand assembly of the IndiClean label, Lunanos used a spray gun and a stencil to apply the indicator ink to the label base, and then hand assembled a multipart finishing layer to the label. This was a labor intensive process and required that the ink formulation to be compatible with the spray gun applicator. The ink formulation had to be changed so it can perform on a flexographic printing press.

The first set of press runs on a Comco Cadet 700 label press were used to find out how many hits of the indicator were needed to achieve optimum opacity. For the first press runs a single hit of black ink was printed and than up to three hits of indicator ink. The anilox roller combination for this test was 12 BCM, 7.7 BCM and 5 BCM. An example of this test can be seen in Figure 4 below.

Figure 5: *Triple hit of indicator ink over black*

It is clearly visible from Figure 5 that the coverage of the triple hit indicator ink, seen at the bottom of the figure, did not cover the black ink very well; consequently, as a next step the doctor blades were disengaged to attempt a thicker (and more opaque) ink film. The result from this test can be seen in Figure 6.

Although this set of test parameters gave a better opacity result it can be seen that there are some extra deposits at the end of each printed bar which would be detrimental if this type of set up would be used for the the production of the labels. During the first few press runs it was observed that the ink started to gel up rather quickly in the ink fountain and that the ink fountain roller was creating a cave and was not in contact with the indicator ink.

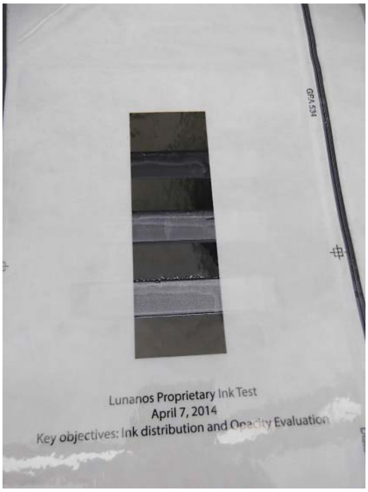

Figure 6: *Triple hit of indicator ink with no doctor blades*

After this press run Lunanos made changes to the ink formulation. They added wetting agents to the indicator ink, which helped slightly with achieving a better ink coverage of the black test bar. Despite the improvements, the indicator ink still could not achieve 100% of the target opacity. It was decided to use another anilox roller with 12 BCM. This resulted in a further improvement to ink coverage and opacity, but it was still not satisfactory.

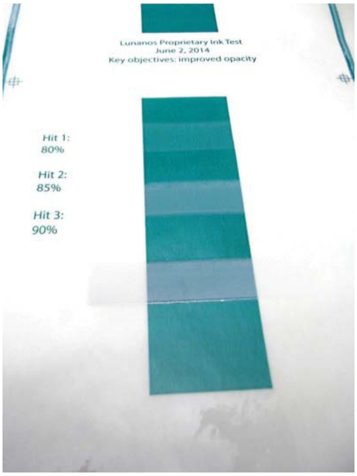

Figure 7: *Improved opacity through different percentages of indicator ink*

Another consideration with regards to opacity related to how the electronic file that made the plates was designed. In the initial press run mentioned above, the rectangles of indicator ink were designed as solids. In flexographic printing, greater density can often be achieved by printing a tint value of a color rather than printing it as a solid. The reason for this is that when a color is printed as a solid, the plate makes absolute contact with the substrate and the ink is compressed between the solid surface of the raised image area of the plate and the substrate. This can force the ink away from the center of the impact site towards the outer edges, resulting in a lighter density in the middle and a darker, denser "halo" of color close to the edges. This is quite similar to the results one would get when they push down to firmly on a rubber stamp. Given that this is a known phenomenon, it was plausible that the solid image areas were not achieving optimal density and opacity. Consequently, in the next step of the project, we experimented with different high tint percentages for the triple hit of indicator ink to see if it was possible to achieve a better opacity. The results can be seen in Figure 7.

Although many opacity and density improvements had been gained with the indicator ink during the various flexo press runs to date, the opacity results were still not 100% satisfactory and the indicator ink still did not have the characteristics of a flexo ink when on press. For these reasons, it was decided to enlist the expertize of a respected flexo ink manufacturer to assist with the optimization the indicator ink formulation to achieve optimum press performance combined with maximum opacity. Currently the ink manufacturer is working with Lunanos to get the desired results.

With the ink manufacturer working on the indicator ink formulation, the focus of the press runs shifted to the inline finishing aspects of the IndiClean label. For the next press run, the design of the IndiClean label was changed so the production of the label could be achieved in the following way:

1. Print the artwork of the label and laminate the artwork for protection against the cleaning solvents
2. Apply triple hit of indicator ink plus a waterbased glue for the lamination of the proprietary finishing layer over the indicator ink and laminate.
3. Diecut the labels in such way that the special properties of the indicator ink can work with cleaning solvents used in hospitals.

An example of the new design can be seen in Figure 7 below:

Figure 8: *Tricolor design of the IndiClean Label*

Figure 8 shows a partially completed label. Here we have a three color design layer that has been covered with a selfadhesive clear film. This clear film protects the printed surface from the harsh cleaning chemicals that would otherwise breakdown the inks.

The next steps in the process would be to print the indicator ink in a chevron shape overtop the green chevron, followed by a spot application of the proprietary finishing layer. In its initial state the indicator ink will be an opaque white. Once the cleaning agent has been applied to the label, the chemical reaction between the cleaning agent and the indicator ink turns the indicator ink transparent, revealing the green chevron below, thus indicating that the surface the label has come into contact with the cleaning chemical, and is therefore clean.

The multi-step manufacturing process described above proved i m practical. This was discovered after another test run, where the design had been preprinted and the clear protective selfadhesive film had been applied. During the printing of the indicator ink, where the printed roll was fed through the printing press a s e c o n d t i m e , a stretching effect was observed every time the press was stopped. It was impossible to achieve register of the double hit of the indicator ink onto the green chevron.

The design of the IndiClean label was further modified to compensate for the issues noted above, and the artwork was changed to a single colour (black) layout.

Figure 9: *Prototype IndiClean Label before and after the application of cleaning solvent*

The press run would now look as follows:

1. Print the artwork using black ink in print unit 1
2. Print two hits of indicator ink from print units 2 and 3, using two 12 BCM anilox rollers
3. Spot print a layer of waterbased glue from print unit 4 with a 7 BCM anilox roller
4. Laminate the label and apply the proprietary finishing layer
5. Diecut the label

Altogether 15 press runs were performed to test the i n d i c a t o r ink performance and find the best combination of anilox rollers and finishing techniques to achieve the best results. During the various press runs different clear films for the laminating process were tested, and it was determined that the laminating film had to have a level of more than 38 dynes/cm in order to properly accept the indicator ink and the adhesive adhesive layer.

One point worthy of note is that the laminating and finishing components of the press run were conducted using a makeshift process that was created to compensate for a lack of capabilities of the press being used, and this likely contributed some of the problems that were observed. To correct this, a laminating arm has been purchased for the flexo press and will be installed shortly.

Next Steps for Further Study

As previously mentioned, the research team called upon the expertise of a well respected flexographic ink manufacturer to assist with the reformulation of the indicator ink perform better on the flexo press. This is a unique challenge, as any ink that is developed must be formulated in such a way that the proprietary functionality of the indicator ink is not compromised. At the time of publication, the ink manufacturer was in the final stages of developing a very promising ink formulation.

The new laminating arm that will be installed shortly on the flexo press will allow for more flexibility, experimentation, and control of the unique parameters of the IndiClean label's unique finishing requirements.

The next steps for this research will be to test the new ink formulation and revise if necessary, followed by the experimentation of different finishing techniques to achieve the simplest and most costeffective finishing steps possible.

Conclusion

Through the various research trials it was established that a double hit of indicator ink with 12 BCM anilox rollers almost achieves a sufficient enough opacity for the IndiClean label to function as our research partners have envisioned it. The design layer has to be protected with a lamination film so the harsh cleaning solvents used in hospitals to disinfect multitouch surfaces will not destroy it. With a new ink formulation from the flexo ink manuafacturer, and the introduction of a proper laminating arm on press, it should be possible to mass produce these indicator labels at a reasonable costperunit. Once these parameters have been tested and perfected, it will be necessary to print enough labels to conduct a field test. Assuming the field test proves successful, Lunanos will have to partner with a flexographic print company that can produce these labels on a frequent basis.

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References:

Blanchard, J. (2007). Preventing Health Care–Associated Infections. AORN Journal, 86, S82–S84. http://doi.org/10.1016/j.aorn.2007.11.013

Boscart, V. M., McGilton, K. S., Levchenko, A., Hufton, G., Holliday, P., & Fernie, G. R. (2008). Acceptability of a wearable hand hygiene device with monitoring capabilities. *Journal of Hospital Infection*, 70(3), 216–222.

McNamara, L. (2009). Health Care–Associated Infection. American Journal of Critical Care, 18(1), 41–41. http://doi.org/10.4037/ajcc2009483

Narayanan, N. (2014, November). Confronting the challenge of health careassociated infections [Electronic version]. Pharmacy Times, 80(11), 8595

Allegranzi, B., Nejad, S. B., Combescure, C., Graafmans, W., Attar, H., Donaldson, L., & Pittet, D. (2011). Burden of endemic healthcareassociated infection in developing countries: systematic review and metaanalysis. The Lancet, 377(9761), 228–241. http://doi.org/10.1016/S01406736(10)614584

The Lancet . (2015). Health careassociated infections in the USA. The Lancet, 385(9965), 304304. doi:10.1016/S01406736(15)601015

Valiquette, L., MD MSc FRCPC, Chakra, C. N. A., MSc, & Laupland, K. B., MD MSc FRCPC. (2014). Financial impact of health care associated infections: When money talks [Electronic version]. The Canadian Journal of Infectious Diseases & Medical Microbiology, 25(2), 71–74.

Zoutman, D. E., Ford, B. D., Bryce, E., Gourdeau, M., Hébert, G., Henderson, E., & Paton, S. (2003). The state of infection surveillance and control in Canadian acute care hospitals. *American Journal of Infection Control*, 31(5), 266–273. http://doi.org/10.1067/mic.2003.88