Lirio’s Custom Communications Deliver Results

lirio

Communication that Moves People

Accelerating Out of COVID-19's Crisis Curve

Effective communication is key to engaging patients in virtual care, in-person care, or self-care during and after the COVID-19 pandemic. The present, rapidly shifting healthcare landscape requires informing patients of available resources and safely guiding them to care when they need it.

Lirio's behavior change AI platform moves people along their unique journey to better health through person-centered communication. The company brings together the power of behavioral science with AI to learn the most effective way to communicate with people in a particular context. That insight is applied to create personalized behavior change programs for health systems—resulting in improved engagement and outcomes.

The Role of Behavior Change AI

Lirio is a leader in behavior change artificial intelligence (AI). Our platform combines behavioral science solutions with AI technology (i.e., our machine learning [ML] agent) to assemble and deliver hyper-personalized communications matched to each person within a population. These communications move a population and the individuals within it on their unique journeys to better health.

We use over 200 behavioral science solutions and multiple channels (e.g., signage, print, email, SMS texts) to communicate more personally and effectively. Messages engage, motivate, and inspire action for each person on their terms, driving the entire population forward—even high-cost, hard-to-engage segments.

Several key advantages of behavior change AI:

1. Lirio's ML agent uses a unique optimization method to efficiently handle complex problems.

For one client, hyper-personalized email open rates quadrupled in only four months from 12% to 48%.

2. Ditching one-size-fits-all messaging increases conversions.

With the same client, hyper-personalized emails saw 2x greater conversions relative to open rates than non-personalized control emails.

3. Hyper-personalization messages engage the hard-to-engage.

Hyper-personalized communications allow health systems and care providers to effectively engage at-risk patients, particularly patients with lower incomes or those who do not have commercial insurance.

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Developing Communications That Move People

Hyper-Personalization Addresses Dynamic Barriers to Engagement and Action

Human behavior is complex because patients and their environments change. The COVID-19 pandemic illustrates this all too well. Healthcare is different as a result of COVID-19, and patients are different too. Effective engagement depends on matching the right message to each person and their ever-changing circumstances. Messages must be smartly dynamic, continually overcome today's relevant barriers to engagement and action, and adjust over time to keep patients engaged.

Most marketing efforts use experimentation. A target population is randomly sampled and then randomized to receive different emails. Messages with the most opens, clicks, and conversions are deemed the best messages. These messages are selected to be sent to the entire population.

Rather than doing a single experiment to decide on the best message, behavioral reinforcement learning continuously experiments, using a balance of new and tried-and-true messages (*i.e., exploration and exploitation*) to decide what message works for each individual patient. An ML agent tests the performance of a small number of messages on a single patient. The patient's responses are tracked and synthesized by the ML agent, providing feedback to create and deliver a better-performing message with each communication sent. The ML agent sends subsequent messages to each patient, knowing what it sent before and what the reaction (or lack thereof) was to the prior messages. It leverages interactions with a single patient to better predict the effect of its choices for other, similar patients. This offers the ML agent time to explore messages that may address subtle or uncommon barriers to engagement and action.

Behavioral Reinforcement Learning Enables Hyper-Personalization at Scale

Lirio is pioneering the use of behavioral reinforcement learning to enable effective, hyper-personalized healthcare messaging. For example, our ML agent assembles complete emails from a library of content items (subject lines, nudges, images, and calls to action; See **Table 1**). Each content item is developed with a behavioral science solution to overcome the barriers a patient may experience around scheduling and attending an appointment.

The combination of behavioral science and machine learning is critical. Careful application of behavioral science solutions in the development of content items is needed to address dynamic behavioral barriers and biases to engagement and action to be solved by the ML agent. Without human involvement, the ML agent combines content items to create thousands of unique emails. Over time, as the ML agent learns from responses and non-responses, future combinations of content items are hyper-personally matched to each patient.

Table 1. Example overview of the number of behavioral barriers addressed, email message content items, and possible email messages to be sent to female patients of a Lirio client who were eligible for an annual women's wellness visit.

	Hyper-Personalized	Control
Barriers Addressed	13	1
Subject Line Content Items	45	3
Nudge Content Items	30	3
Image Content Items	63	3
Call to Action Content Items	23	3
Messages Delivered	25,959	3,443
Recipients	9,249	1,390
Number of Unique Email Combinations Delivered	21,735	3
Number of Emails Planned Per Individual	3	3

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Hyper-Personalization Gets Smarter Over Time

With time and experience, the ML agent discovers which combinations of email content items crafted with a behavioral science solution create messages with the highest probability of eliciting behavior from each patient, given their data. The ML agent begins by randomly combining content items to create email messages. Its choices remain highly exploratory until sufficient feedback from email opens, clicks, and appointments scheduled is obtained to align content with patients. Previous interactions with each patient and generalized knowledge from feedback on content effectiveness with other individuals—those who share degrees of similarity with a given patient—is used to create message-to-patient alignment. Educated guesses are then formulated as to which content items and, in turn, what messages might be most likely to succeed for a new patient with whom the ML agent has yet to interact.

Over time, with enough data, the ML agent refines its decisions based on the feedback it receives. This depends both on the patient sample size and the time for feedback data to be collected. A large sample size and longer data collection time drives stronger predictions from the ML agent. Case study results presented later in this document should therefore be reviewed through the lens of a small sample size and a short, 4-month time frame. Despite these constraints, both a significant improvement in the ML agent's performance and its impact on patient behavior were observed. Performance improvements will continue and be more pronounced as the sample size and program duration increase and as technical improvements to the ML agent are made.

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Women's Wellness Case Study

A Lirio client's traditional email marketing campaign promoting women's wellness appointments delivered an impressive 1.4x higher-than-average open rate compared to the healthcare industry benchmark[1]. However, the client's campaign did not convert patients to schedule and attend their appointments at a comparably impressive rate. For this client, Lirio:

- Identified the full range of decision-making biases and barriers to scheduling and attending a women's wellness appointment.
- Mapped behavioral science solutions to overcome identified barriers to action. Barriers to women attending a women's wellness appointment include, but are not limited to:
  - Being embarrassed about the appointment
  - Forgetting to schedule the appointment
  - Fearing an undesirable result
  - Fearing pain during the appointment
  - Believing the visit is unnecessary
- Used behavioral science solutions to inform tens of thousands of content items that, when combined, created >20,000 unique, hyper-personalized messages in the women's wellness program.
- Continues to optimize women's wellness conversion rates within the client's existing communication channel as Lirio's ML agent becomes more sophisticated.

Key Result 1: ML Agent Learnings Lead to Significant Open Rate Improvements

Lirio's women's wellness program launched in November 2019. Initially, the ML agent selected email content items at random. The ML agent improved its choices after both early email delivery issues were resolved and it received feedback from its early, random selections. From November 2019 to February 2020, the maximal open rates from delivered emails increased from ~12% to ~48% (See **Figure 1**).

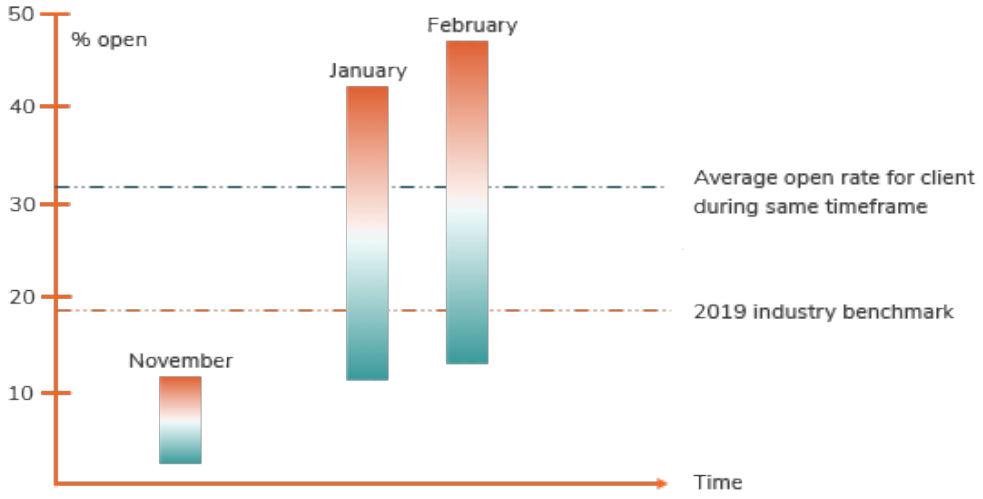

Figure 1. As the ML agent learns, hyper-personalized email open rates improve. Maximal open rates (top of the colored bars) increased from ~12% in November 2019 to ~48% in February 2020. Maximal open rates were not outliers.

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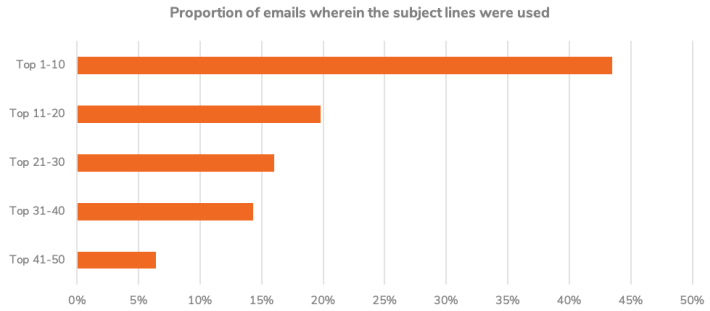
From November 2019 to January 2020, the ML agent learned what subject line content items were generally effective for getting patients to open an email message. In February 2020, the ML agent's 10 most effective subject lines were selected 43.5% of the time (See **Figure 2**), resulting in a 37.2% open rate. Subject lines with lower open rates represent the ML agent exploring new selections, rather than exploiting proven selections. As the ML agent continues learning which content items are optimal for certain segments – ultimately moving to one-to-one matches – open rates continue to improve.

Figure 2. The ML agent determined and favored the 10 most effective subject lines, used in 43.5% of all hyper-personalized emails sent in February 2020. These top 10 subject lines produced an average message open rate of 37.2%.

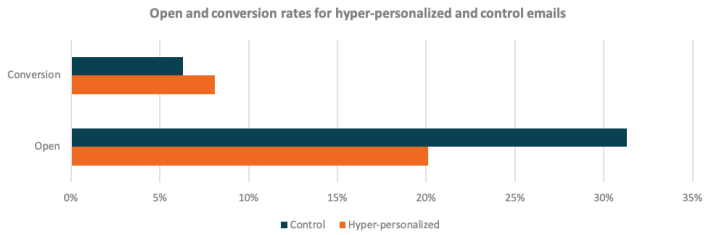


Key Result 2: Ditching One-Size-Fits-All Emails Resulted in 2x the Conversions

Achieving an email open rate of 37.2% is winning the battle, but not yet the war. Converting opened emails into scheduled and attended women's wellness appointments depends in part on what is communicated within the email message—that is, the behavioral science solution operationalized in the nudge, image, and call to action content items. Lirio's ML agent uses data captured in each of these content items, data characterizing recipients, and data from recipients' responses (or lack thereof) to select the most effective content items and assemble them into more effective email messages.

A limited sample of 10,639 patients eligible for an annual women's wellness visit with a Lirio client was randomly assigned to one of two messaging conditions to receive up to three communications of either (1) Lirio's hyper-personalized emails (hyper-personalized group) or (2) the client's best performing, one-size-fits-all, static emails (control group). Control emails showed an open rate of about 32% and a conversion rate of 6.3%. This means that about 20% of patients who opened a control email converted based on the receipt of that email. In contrast, Lirio hyper-personalized emails showed an open rate of about 20% and a conversion rate of 8.1%. This means that about 40% of patients who received a hyper-personalized email converted based on the receipt of that email. Therefore, the open-to-conversion rate of the Lirio hyper-personalized emails was 2x the rate of control emails (20% vs. 40%; See **Figure 3**).

Figure 3. Despite 35.8% lower overall open rates, Lirio's hyper-personalized emails saw a 28% higher overall conversion rate than the client's control emails. The open-to-conversion rate for the hyper-personalized emails was 2x higher than that of control emails.



Lirio's 28% higher conversion rate translates to 861 appointments in a single quarter versus 670 control appointments in that same quarter. MD Save[2] sets the national average charges from women's wellness visits at $317. Projected out, Lirio's hyper-personalized emails would generate a minimum of $1.09 million in charges per year, a gain of just over $240,000 compared to control emails. As the ML agent continues to learn, optimize, and improve with each email send, the number of appointments made per quarter (i.e., > 861) should increase, resulting in greater-than-projected additional annual revenue for the client. That estimate does not take into account revenue generated from additional services such as lab work and follow-up appointments.

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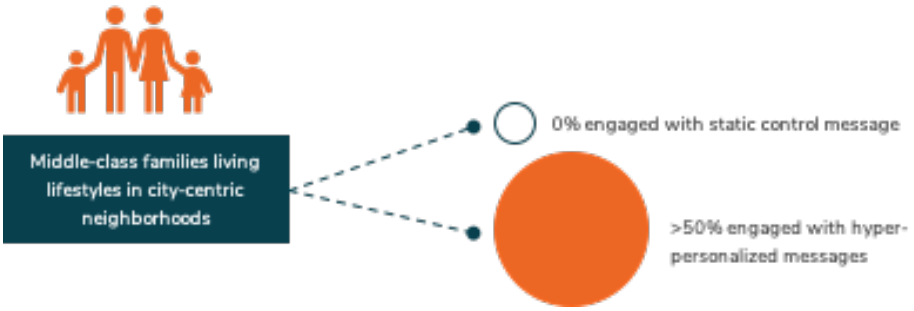
Key Result 3: Hyper-Personalization Engages Hard-to-Engage Patients

A hyper-personalized approach engages patients otherwise left behind. Certain segments of the client's patient population had never opened the client's best-performing email messages (i.e., the control group). Upon receipt of Lirio's hyper-personalized messages, over 50% of the harder-to-engage segments opened the message (See **Figure 4**). In addition to a better open rate for these patients, hyper-personalized messages resulted in harder-to-engage patients scheduling and attending their women's wellness appointments.

Reaching Women of all Ages

Increasing age was associated with a small increase in scheduling and attending a women's wellness appointment. Both Lirio's hyper-personalized emails and control emails performed similarly among the youngest (18-20 years old) and oldest (35-40 years old) recipients. Among millennial patients, Lirio's hyper-personalized emails performed better than control emails (See **Figure 5**). Peaking in the 25-30-year-old age range, hyper-personalized emails converted >8% of recipients who opened the messages while control emails converted 6% of recipients who opened the message.

Figure 4. Lirio's hyper-personalized emails engage when one-size-fits all, static emails do not.



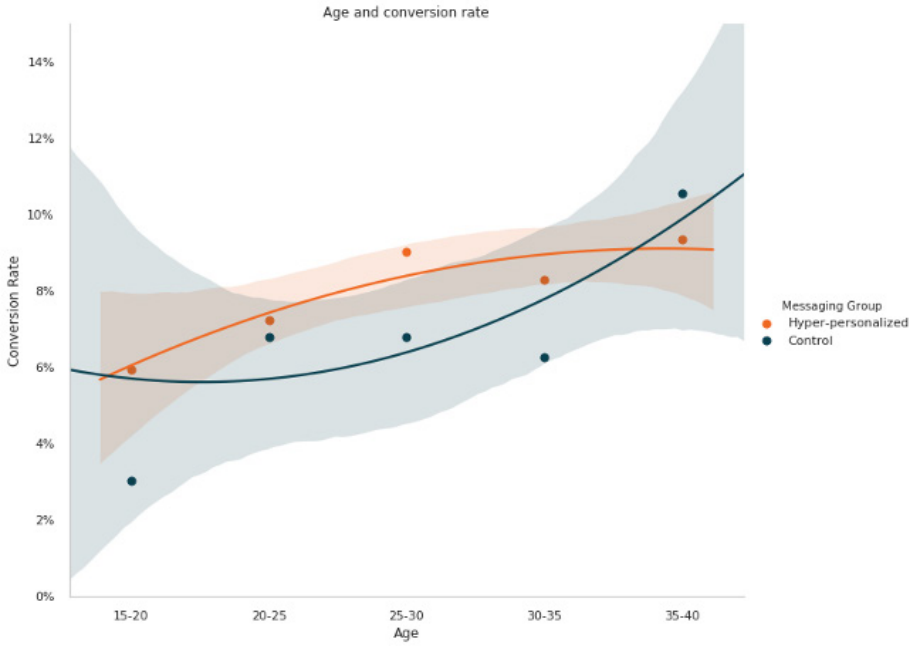


Figure 5. Hyper-personalized and control emails had similar conversion rates at the upper (35-40) and lower (15-20) age ranges. For intermediate age groups, hyper-personalized emails had higher conversions than control emails. Shaded area indicates margin of error.

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Reaching the Most Vulnerable

Women in the lowest income brackets were least affected by control emails. Control email conversions increased as a function of income, ranging from ~2% in the lowest income brackets to ~10% in the highest income brackets. Hyper-personalized emails, in comparison, showed similar conversion rates across income levels (See **Figure 6**). For the lowest income brackets, the conversion rate was ~8%. For the highest income brackets, it was nearly 9%.

Additionally, engagement differences emerged in association with health insurance status. Hyper-personalized emails and control emails converted women with commercial insurance at about the same rate (~7.5%). However, for women with non-commercial insurance, hyper-personalized messages generated a significantly greater conversion (15%) than control messages (2.5%; See **Figure 7**).

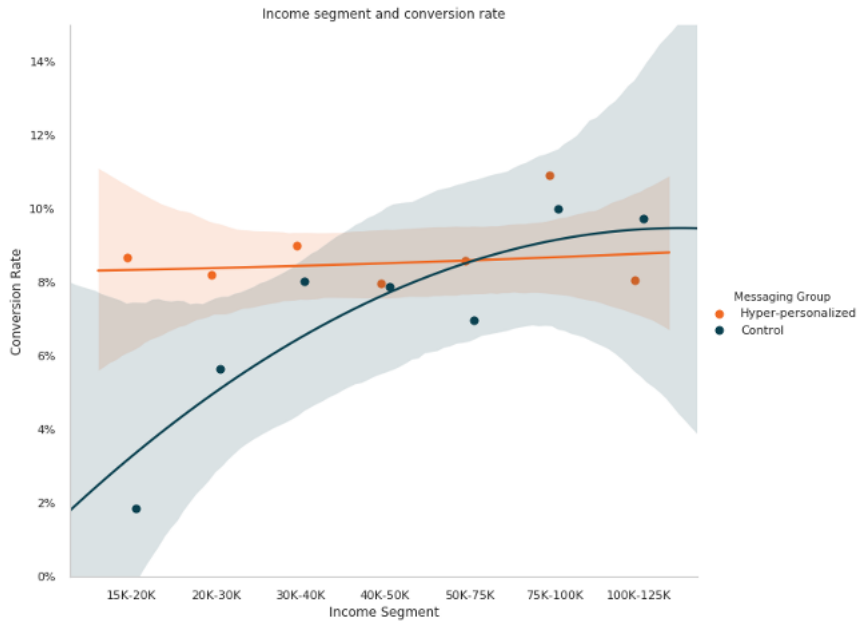

Figure 6. Hyper-personalized emails were more effective at converting women regardless of income level and were especially effective at converting low-income women compared to control emails. Shaded area indicates margin of error.

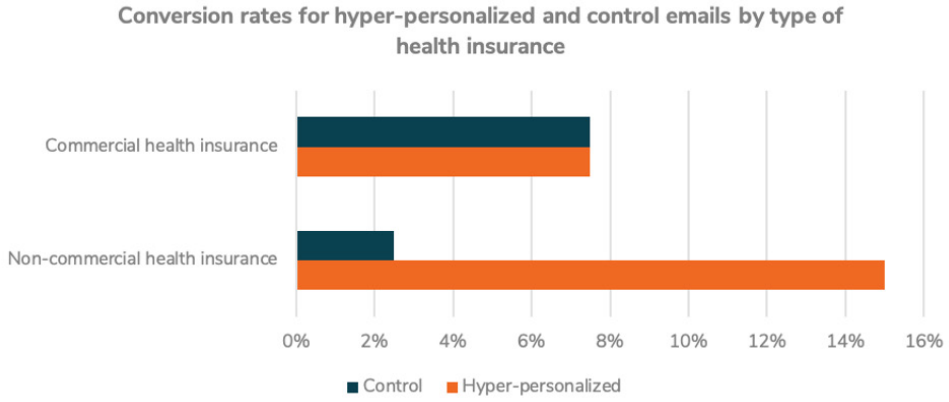

Figure 7. Lirio's hyper-personalized emails converted women with commercial insurance at the same rate as control emails did. Lirio converted more women with non-commercial health insurance relative to the control group.

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Different Subject Lines Speak to Different Behavioral Barriers

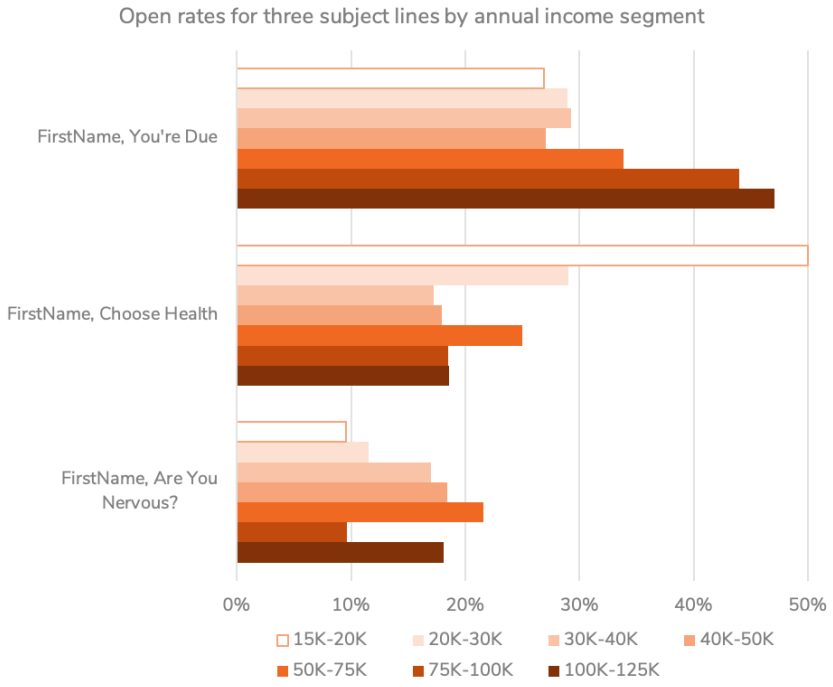
The open rates of each subject line in the hyper-personalized emails varied as a function of women's annual income (See **Figure 8**). For example, emails with the subject line containing the language, "You're due," showed the greatest open rates (45%) for women in the highest income bracket, and the lowest open rate for women in the lowest income bracket. "Choose health," conversely, saw strong open rates (50%) among women in the lowest income bracket, but lower open rates (20%) for women in the highest income bracket. Meanwhile, the subject line, "Are you nervous?" showed open rates less consistently predicted by annual income.

Behavioral Science Solutions Address Individual Barriers

Lirio's hyper-personalized women's wellness emails use behavioral science solutions to solve for a wide range of cognitive biases and barriers to scheduling and attending a women's wellness visit. Hyper-personalized emails were compared to static emails solving for a single barrier: forgetfulness. Income and other individual characteristics may signal what barriers need to be addressed for whom.

The psychology of scarcity[3] suggests people with limited resources (e.g., people with low incomes, people without health insurance, or people who have Medicare or Medicaid) tend to experience an unconscious cognitive strain that can compromise effortful decision making and the ability to assess long-term risk. People with greater pre-existing demands on their cognitive capacity must rely more heavily on automatic decision making influenced by mental shortcuts, heuristics, and certain cognitive biases. Effective messaging must solve for the wide range of cognitive biases and barriers prevalent among populations, segments, and individuals.

Figure 8. Subject line, "You're due," generated greater open rates for individuals at the highest income level compared to lowest level. Subject line, "Choose health," generated greater open rates for individuals at the lowest income level compared to the highest level. "Are you nervous?" showed open rates less consistently predicted by annual income.



The ML Agent's Adolescence and Young Adulthood

Lirio's ML agent will be increasingly valuable for any client as it continues to learn how to generate high-performing, high-converting emails for an entire patient population, population segments, and the individuals within them.

Through the current ML agent's continued exploration and exploitation, better-performing emails can be delivered without necessitating technical improvements to the ML agent. Nevertheless, Lirio's ML agent 2.0 will include technical improvements such as additional agent features, embedded behavioral science solutions, and tuned optimization parameters to provide stronger insights.

Expanding beyond women's wellness visits, as with this client, similar ML agents can be applied for additional healthcare services like early disease detection and patient portal enrollment and engagement. With scalability to broader patient populations, Lirio can strengthen client communications with patients by increasing conversion rates and revenue, engaging the hard-to-engage, and moving all patients on their unique journeys to better health.

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Opportunities for Your Organization

Given the fast-changing healthcare landscape in the world of COVID-19, there is a prevalent need for a more robust patient communications strategy. This is where Lirio comes in.

With over 200 behavioral science solutions and multiple channels, like email, SMS, and print communications, Lirio helps healthcare clients meet patients where they are and move them to where they need to be. For prospective healthcare clients seeking to better manage a population's health, drive patients to telehealth, or safely re-engage patients in traditional, in-person care, Lirio's custom communications solutions are the answer.

We begin with the following steps:

Define the Client's Goals

From an initial kickoff meeting between Lirio consultants and client stakeholders and executors, we set expectations and mobilize the team to reach desired goals

Understand the Current State

Lirio consultants perform a behavioral discovery that includes an audit of the client's current state. This audit identifies barriers and biases in patient populations, client processes, and other areas where behavioral science can be leveraged to improve outcomes. Targets are established based on the scope of the goals and the value to be added for the client.

Synthesize and Report

Lirio synthesizes data from the audit, matches behavioral science solutions to overcome the identified barriers and biases to engagement and action, and delivers a comprehensive report detailing the custom communication solution. This process requires 40-60 days to complete, depending on the time it takes the client to contribute to the audit and the number of audience segments, communication mediums, and actions requiring solutions.

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The Final Word

As seen in a short time frame, hyper-personalized communications powered by Lirio's expertise in behavior change AI can meet each patient where they are, moving every individual along their unique journey to better health and wellness.

In this case study, Lirio's hyper-personalized emails performed better than the client's high-performing emails. This outcome holds for the client's hardest-to-engage women, who were more likely to schedule and attend a women's wellness appointment upon receipt of a Lirio email compared to the client's static email. In this way, Lirio is the tide that lifts all boats and is uniquely poised to augment and accelerate industry-leading communication efforts.

Overall, Lirio both increased this client's rates of engagement and identified characteristics of women associated with the greatest lift in accessing preventive care services. Short-term results illustrate an early, yet notable impact on driving women to preventive care.

Lirio's ML agent will continue to demonstrate a compounded, markedly greater lift on the uptake of preventive care as it stands and will do so even more with forthcoming enhancements. The ML agent will create greater value as it receives more data (i.e., from new patients who become eligible for care and feedback from prior recipients' behaviors) and make increasingly better-informed decisions.

With this evolving and ever-richer dataset, Lirio's ML agent will become more precise and effective at identifying segments of patients and, ultimately, individuals within a population that respond to each possible email. This will elucidate which messaging is most widely effective and emphasize the value of messages optimal both for smaller, niche patient groups and for each patient within each group. Together, these advances will allow Lirio clients to more effectively communicate with all patients.

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