The HealthBeacon Injection Care Management System reduces the risk of discontinuation and improves persistence over one year

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Background

Considerable declines in treatment persistence occur in the months following initiation and contribute to suboptimal recovery in patients. Within just 12 months, persistence rates to rheumatological, dermatological and gastroenterological treatments may be as low as 59.5% [1]. HealthBeacon's Injection Care Management System (ICMS) aims to improve persistence rates by enhancing patient support and accommodating daily routines with their Smart Sharps Bin technology and patient support platform. To determine the impact of this system on persistence, we followed patients on injectable treatments in each of these therapeutic areas for 12 months. Persistence rates were compared with those previously reported in the literature for each therapeutic area to test for relative improvements provided by HealthBeacon's ICMS.

Methods

Participants

This study included 7,489 patients (53.7% female) at least 18 years of age on injectable rheumatological (n=3 242, 43.3%), dermatological (n=1 003, 13.4%), or gastroenterological (n=3 244, 43.3%) treatment. Participants were categorized in age as 18-29 (14.5%), 30-44 (30.1%), 45-59 (32.4%), 60-80 (22.1%), or 81-95 (0.8%). Injections were monitored for 12 months or until discontinuation on the HealthBeacon system.

Evaluating Persistence

For the purposes of this study, persistence was defined as the time from a patient's first use of the HealthBeacon system, i.e. the first injection device associated with a treatment deposited into the Smart Sharps Bin, until deactivation of a patient on the ICMS. In this way, the length of time a patient used the HealthBeacon ICMS was considered as a proxy for their persistence to therapy. This was compared with a comprehensive study of therapy discontinuation over 12 months in these same therapeutic areas [1], in which discontinuation was defined as 90 days or more without therapy. It was of central interest whether the HealthBeacon ICMS resulted in a reduced risk of discontinuation both overall and within each area. Notably, while these definitions of discontinuation differ somewhat, they are still largely comparable. It is also noteworthy, that HealthBeacon's measure is stricter than the definition of persistence used in the comparative study. Therefore, any reported improvements in persistence may underrepresent the actual gains provided by HealthBeacon's ICMS.

Statistical Analysis

Cox proportional hazard modelling was used to first assess persistence over 12 months and second test whether differences in persistence during this time frame were significantly associated with therapeutic area, sex, or age groups. All three of these predictor variables were captured categorically. Kaplan-Meier curves were estimated overall and on each dimension.

Hazard ratios were calculated for each group relative to a reference group. A hazard ratio of 1.0 indicated no relative difference between groups in the risk of discontinuation, while a hazard ratio higher or lower than 1.0 indicated a higher or lower relative risk of discontinuation, respectively. Those with a 95% confidence interval that excluded 1.0 indicated a significant difference in the risk of

discontinuation relative to the reference group. Model estimates were additionally converted to Z values to calculate parametric estimates of significance (*p*), where significance determined at $p<0.05$.

Results

Persistence

Overall, 70.6% of patients remained engaged in treatment at 12 months, representing an 18.7% relative increase over previously reported persistence rates during the same time frame [1]. Regarding specific therapeutic areas, at 12 months, persistence was 67.4% for those on rheumatological treatments (+21.2% relative to previous reports), 73.9% for dermatological (+28.0%), and 72.3% for gastroenterological treatments (+13.1%).

At 12 months, the persistence rate in males was found to be 74.4%, relative to females at 67.5%. Regarding age, persistence at 12 months steadily declined as age increased, from 18-29 (75.9%), 30-44 (72.4%), 45-59 (69.7%), 60-80 (66.7%), to 81-95 (63.5%).

Predictors of Persistence

There was a significant effect of therapeutic area in predicting persistence ($\chi^2=15.68$, DF=2, $p<0.001$), with higher risk of discontinuation in rheumatological treatments relative to both dermatological (Z=3.09, $p=0.002$) and gastroenterological (Z=-3.33, $p=0.001$) treatments. Hazard ratios for these effects are outlined in Table 1. Persistence in dermatological and gastroenterological treatments did not significantly differ (Z=0.81, $p=0.417$).

Table 1 Hazard ratio (HR), 95% confidence interval (CI), and effect significance for each of age, sex, and therapeutic area (TA). Effects are shown relative to a reference category.

	Group	Reference	HR	95% CI		Z	*p*
Age	30-44	18-29	1.15	1.00	1.33	1.90	0.057
	45-59	18-29	1.25	1.09	1.45	3.10	0.002
	60-80	18-29	1.38	1.19	1.61	4.23	0.000
	81-95	18-29	1.39	0.91	2.14	1.51	0.131
Sex	Female	Male	1.31	1.20	1.43	6.20	< 0.001
TA	Gastroenterology	Dermatology	1.06	0.92	1.22	0.81	0.417
	Rheumatology	Dermatology	1.24	1.08	1.42	3.09	0.002
	Gastroenterology	Rheumatology	0.85	0.78	0.94	-3.33	0.001

Age was associated with a significantly reduced persistence ($\chi^2=35.81$, DF=4, $p<0.001$). Specifically, the hazard ratio of each age group was incrementally higher than the last, beginning with 18-29 years. This reduction in persistence relative to the youngest age group was significant in 45-59 and 60-80. Lastly, females showed a significantly lower persistence ($\chi^2=43.28$, DF=1, $p<0.001$).

Kaplan-Meier curves are shown in Figure 1, demonstrating the survival functions (probability of persistence over time) overall, as well as broken down by subgroups along each of the three tested dimensions (gender, age, therapeutic area).

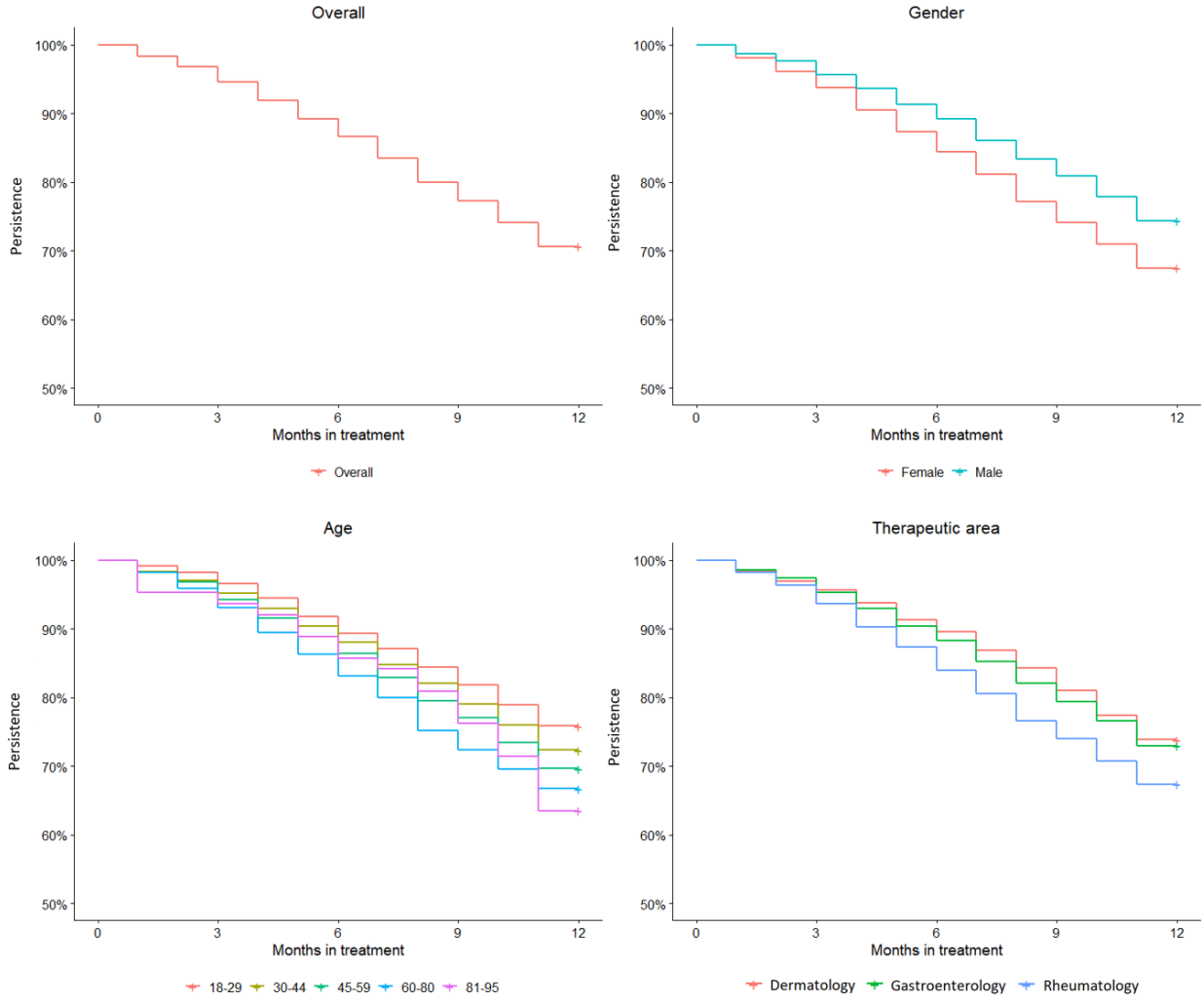

Figure 1 Survival functions depicting the probability of persisting in treatment overall and by subgroups along each of gender, age, and therapeutic area.

Age and Therapeutic Area Cross-Sections

We performed post-hoc testing in the cross-section of age and therapeutic area to test first whether specific age groups fared better in one area than another, and conversely whether age groups differed in specific areas regarding persistence. All comparisons were corrected for multiple corrections using a Bonferroni adjustment.

First, we investigated the differences between therapeutic areas within each age group. In the 45-59 years group, the risk of discontinuation was significantly higher in rheumatology treatments (Estimate=0.31, SE=0.10) relative to dermatology (Estimate=0.09, SE=0.08; p=0.045). In the 60-80 years age group, risk was higher in rheumatology treatments (Estimate = 0.41, SE=0.10) relative to

gastroenterological treatments (Estimate=0.25, SE=0.11; *p*=0.016). No other comparisons were significant. These findings suggest that older patients in rheumatological treatments showed overall lower persistence relative to patients of the same age on treatments for other therapeutic indications.

Second, we investigated the differences between age groups within each therapeutic area. All significant differences were found in rheumatological treatments. Within this group, risk was significantly lower for those aged 18-29 (Estimate=0.08, SE=0.07) relative to those aged 45-59 (Estimate=0.31, SE=0.10; *p*=0.045), as well as those aged 60-80 (Estimate=0.41, SE=0.10; *p*=0.003). In addition, risk was lower in those aged 30-44 (Estimate=0.22, SE=0.11) relative to those aged 60-80 (Estimate=0.41, SE=0.10; *p*=0.012). These results suggest that the significant effect of age on persistence was most identifiable in those on rheumatological treatment and was less evident in other areas.

Conclusions

These findings suggest that HealthBeacon's ICMS provided a considerable improvement in persistence when compared with previous reports, with a relative 18.7% increase across all therapeutic areas, including rheumatological (21.2% increase), dermatological (28.0% increase), and gastroenterological treatments (13.1% increase). Interestingly, relative improvements were strongest in rheumatological treatments, suggesting that other factors may differentially impact persistence.

In conclusion, the present findings suggest that HealthBeacon's ICMS provided a decreased risk of discontinuation both overall and within each therapeutic area, relative to previous reports. Hence, the HealthBeacon system represents a considerable step in improving treatment persistence across numerous conditions.

Discussion

This study compared HealthBeacon's persistence rates to those reported in a large, observational retrospective cohort study. Although only comparing HealthBeacon's data to one reference may be seen as a limitation, the study referenced involved a significant number of patients, providing a good level confidence in its results. The two patient populations were also very similar with regards to gender split and therapeutic indications. The HealthBeacon system also operates with a stricter definition of persistence than this study, meaning that the actual improvement in persistence with the ICMS may be higher than reported.

Some interesting patterns in persistence were found and relative gender differences were replicated, with females showing a higher risk of discontinuation relative to males. Counterintuitively, while previous reports, and indeed other HealthBeacon data suggests that although overall adherence is higher in older age groups, the risk of discontinuation over time is also significantly higher as age increases, as demonstrated in this research. These findings highlight that persistence to therapy cannot be adequately measured in a single metric, and that the cross-section of adherence at a given time, and the risk of discontinuation over time, can negate one another. Rather, both should be considered targets for improvement to maximize therapeutic gains.

References

[1] Marshall et al. (2018). Impact of the adalimumab patient support program's care coach calls on persistence and adherence in Canada: An observational retrospective cohort study. *Clinical Therapteutics*, 40(3), 415-429.