Digital Transformation of Traditional Pharmaceutical Companies – Case Study of Renhe Group's Acquisition of Dingdang Health

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Digital Transformation of Traditional Pharmaceutical Companies – Case Study of Renhe Group's Acquisition of Dingdang Health

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Abstract

In recent years, the emerging “Internet + X” concept has ushered all industries into a new era of digital transformation in China. The traditional pharmaceutical industry, which is beset by convoluted and costly distribution channels, slow payment cycles, a dearth of pharmacies in underdeveloped regions, an uneven distribution of medical resources, and patients’ unjustified distrust of smaller hospitals, faces difficulties in meeting the higher-level medical needs of the people. All these issues are readily addressed by the two new business models enabled by “Internet + X”: healthcare e-commerce and online diagnosis and treatment. To some extent, this new trend is forcing traditional pharmaceutical companies to carry out digital transformation.

The digital transformation of traditional pharmaceutical companies is made mainly in combination with e-commerce or mobile health through several specific routes, such as B2B, B2C, and O2O. This study analyzes the impact of the digital transformation of pharmaceutical companies represented by Dingdang Health from the dimensions of pharmacies, pharmaceutical companies, and user experience. Specifically, the analysis of pharmacies is focused on operational capabilities and the single-store profit model; that of pharmaceutical companies is focused on financial data; and that of user experience is focused on third-party reviews, drug prices, and online diagnosis and treatment.

This study finds that pharmaceutical companies’ smart pharmacies significantly outperform traditional pharmacies in terms of operational capabilities, especially in inventory turnover, product lineup, service radius, and average store revenue; with the rising penetration of online drug stores, the single-store profit model suggests that smart pharmacies perform substantially better than their traditional counterparts. The financial data of pharmaceutical companies reveal that fulfillment expenses comprise a major part of online pharmacies’ expenses, but that digital transformation does not decrease their marketing costs, as one might expect. In terms of user experience, smart pharmacies hold a clear advantage over traditional pharmacies in terms of third-party reviews, ratings, drug prices, and online diagnosis and treatment. However, the immediacy and professionalism of drug consumption dictate that traditional pharmacies cannot be completely replaced by smart pharmacies.

Keywords: Digitization; Smart Pharmacies; Transformation; O2O

Tables of Contents

Disclaimer……2
Abstract……3
Content……4
List of Figures and Tables 5
Chapter 1 Introduction 6
1.1 Research Background 6
1.2 Approach and Methods 8
1.3 Purposes and Implications 8
1.4 Thesis Structure 9
Chapter 2 Literature Review 10
2.1 "Internet + X" and "Internet + Medicine" 10
2.2 Healthcare E-Commerce 12
Chapter 3 Current Picture and Study Hypotheses 15
3.1 Present Challenges 15
3.1.1 Pharmaceutical Companies and Pharmacies 15
3.1.2 Users 16
3.1.3 Study Hypotheses 16
3.2 Directions for the Digital Transformation of Traditional Pharmaceutical Companies 17
3.2.1 Traditional Pharma and e-Commerce 17
3.2.2 Traditional Pharma and Mobile Healthcare 20
Chapter 4 Models for the Digital Transformation of Traditional Pharmaceutical Companies ……..21
4.1 Upstream Resources: Heli Internet of Things (M2F) 21
4.2 Commercial Distribution: Dingdang Pharmacy (B2B) 22
4.3 End Users: B2C Platform Partners and Dingdang Kuaiyao (O2O) 22
4.4 Empowerment of Online Diagnosis and Treatment 23
4.5 Empowerment of Technologies 24
4.6 Summary 24
Chapter 5 Contributions of Digital Transformation 26
5.1 Pharmacies 26
5.1.1 Operations Capabilities 26
5.1.2 Single-Store Profit Model 28
5.2 Pharmaceutical Companies 30
5.3 User Experience 31
5.3.1 Third-Party Review and Analysis 31
5.3.2 Drug Price Analysis 34
5.3.3 Analysis of Online Diagnosis and Treatment 37
Chapter 6 Conclusions and Recommendations 38
References……40
Resume of the Author 43

List of Figures and Tables

Figure 4-1 Business Layout of Dingdang Health 25

Table 5-1 Dingdang Health Vs. Traditional Pharmacies 26

Table 5-2 Dingdang Health vs. Traditional Pharmaceutical Companies 30

Table 5-3 O2O Business of Pharmacies in Dapuqiao Subdistrict 32

Table 5-4 O2O Business of Pharmacies in Lianyang Community 33

Table 5-5 Prices of Lianhua Qingwen Capsules (OTC) 34

Table 5-6 Prices of Malingyong Diosmin Tablets (Prescription Drug) 35

Table 5-7 Prices of By-Health Protein Powder 450 g (Food Supplement) 35

Table 5-8 Delivery Charges of O2O Platforms 36

Chapter 1: Introduction

1.1 Research Background

Each technological revolution definitely brings about opportunities for industries to make advancements or transformations. Today, mobile healthcare is here to stay in our lives, as big data, mobile Internet, sensors, and other digital technologies are being integrated with the pharmaceutical industry. The Internet-driven digital transformation of the traditional pharmaceutical industry is translated into a new development mode to promote the sustainable development of China's pharmaceutical industry. The booming mobile Internet supported by full-fledged smartphones, mobile terminals, and 4G and 5G technologies has also created favorable external conditions for pharmaceutical e-commerce. In addition, the thriving logistics industry ensures convenient delivery services for pharmaceutical e-commerce. Moreover, the integration of the pharmaceutical industry and mobile Internet enables the provision of handy, safe, economic, customized, and readily available pharmaceutical services to address users' needs and empowers pharmaceutical companies with technical support for their diversified services, leading to stronger customer stickiness.

With respect to medical services, China, as a populous country, has long been beset by the uneven distribution of medical resources and the dearth of quality medical services, which stem from the unbalanced development of its various regions. Although China has maintained a strong medical system for the treatment of critical illnesses, it can do more to address the extensive needs of patients who have minor ailments and do not require a hospital visit. However, mobile healthcare, riding on the wave of the Internet and the popularization of 4G and 5G networks, represents another revolution in the medical industry over recent decades. Mobile healthcare allows people to consult doctors or access health information anytime and anywhere. Mobile technologies have greatly saved the time, energy, and cost of appointment, queue-up, and transportation and, thus, guide people in changing their habit of medical drug use and being more prevention conscious.

With respect to medicine, China's traditional pharmaceutical industry has been plagued by counterfeit drugs, high distribution costs, and convoluted distribution channels. As a new development model, medicine e-commerce can bring about the maximum benefit to pharmaceutical manufacturers, regulatory authorities, research institutes, and pharmaceutical companies. Such e-commerce can be applied to the procurement of raw materials, market surveys, determination of production plans, circulation links, and pharmaceutical consumption, thus improving the economic benefits of and social impacts on pharmaceutical companies. Statistics show that China's traditional pharmaceutical industry has an average circulation turnover of 4 times, with the circulation costs accounting for 12.6% and even up to 30% of total healthcare costs, far behind the 15 times and 2.6% of those in the U.S., which boasts Internet-empowered medicine distribution. Apparently, the extensive application of medicine e-commerce can optimize China's pharmaceutical circulation, improve its circulation efficiency, and ultimately lead to a boom in its pharmaceutical industry.

Regarding physical examination, the progress of society and the rapid development of the national economy have improved people's understanding of health and a shift in the medical consumption concept from cure consciousness to prevention consciousness. Physical examination, with the emergence of "health management" as a new concept, has become an important subject in healthcare. As healthcare services flourish, physical examination centers must figure out how to improve their service quality and market share, thus establishing sound mechanisms for physical examination. Under the traditional physical examination mode, an examinee must go to a physical examination center to receive his or her examination report from the on-site examination that they received on a previous day and is normally troubled by such an easy-to-lose and unhandy paper report. Examinees now expect more efficient and convenient physical examination mechanisms that allow for the online inquiry of reports, door-to-door examinations, and other customized services. In response, physical examination centers have been exploring and innovating, and the Internet-based report inquiry system and online booking of door-to-door examinations have been devised to meet market demand.

With respect to medical insurance, China's increasing coverage of basic medical insurance, accelerating population aging, and changing disease spectrum have put the country under harsher stress from medical insurance expenditures and led to expenditure control becoming the new norm. However, the existing insurance expenditure control measures, including the single disease payment program based on the clinical pathway, payment with an electronic social security card/e-certificate for basic medical insurance, and ex post facto audit, have failed to effectively curb the soaring medical costs or solve the difficulties faced by patients in receiving reimbursement. In contrast, these measures place a heavier burden on medical insurance users. In digital transformation, face or fingerprint biometrics, big data, and AI technologies are adopted to identify insured patients, perform smart audits and supervise the use of medical insurance throughout medical treatment, support card-free online payments, and enable the real-time supervision and settlement of medical insurance expenses. The benefits of such a system include improved medical insurance services, better patient experience, more application scenarios of medical insurance, and less pressure being placed on insured individuals and hospitals. The use of new technologies also helps resolve the problems besetting medical insurance supervision, safeguard medical insurance funds, improve medical insurance governance, and boost medical insurance's function of value creation. As digitalization is here to stay, the emergence of a unified online medical insurance settlement system and card-free payments are expected.

In general, China's traditional medical and pharmaceutical industries are now faced with the tremendous opportunity for digital transformation in the areas of medical service, medicine, physical examination, and medical insurance. As medical reform is in a more challenging phase, the Internet, and other digital technologies, by virtue of their unique logic and business model, empower healthcare reform and change the operational models of traditional medical and pharmaceutical industries.

1.2 Approach and Methods

This study first reviews the literature on the digital transformation of traditional pharmaceutical companies and, on this basis, analyzes where these companies are now, proposing the study hypotheses. Then, this study analyzes how this transformation is achieved by Renhe through its newly acquired subsidiary, Dingdang Health.

First, centering on the subject of the "digital transformation of traditional pharmaceutical companies", this study briefly introduces the major e-commerce models, with a focus on O2O, through a review of the literature on "Internet + X", "Internet + Medicine", and healthcare e-commerce.

Second, to analyze the current state of traditional pharmaceutical companies, this thesis compares the main problems faced by the traditional pharmaceutical industry from the perspectives of pharmacies, pharmaceutical companies, and users. On this basis, this work puts forward study hypotheses and analyzes the primary approaches to digital transformation for the pharmaceutical industry.

Finally, in the case study and comparative research sections, this study introduces Renhe Group's digital transformation with its acquisition of Dingdang Health and discusses the outcomes in detail. Based on the analysis, recommendations for better approaches to digital transformation for traditional pharmaceutical companies are provided.

1.3 Purposes and Implications

With the popularity and rapid development of Internet technologies, the digital transformation of the pharmaceutical industry is both expected in this new age and necessary for the sustainability of traditional pharmaceutical companies. For China's listed pharmaceutical manufacturers, traditional marketing has long lost its edge in both the medicine and capital markets. It is safe to say that transformation is imperative for traditional pharmaceutical companies.

Digital technologies provide a strong impetus for the transformation of traditional pharmaceutical companies and point out the development direction of the national healthcare system in this new era. Themed on the "digital transformation of traditional pharmaceutical companies", this study analyzes the current state of China's traditional pharmaceutical industry and examines how digital transformation is achieved using Renhe's acquisition of Dingdang Health as a case study and comparison of related data.

In practice, digital transformation helps evolve the marketing model of traditional companies, which, as a laggard in this Internet era, can be easily replicated. Pharmaceutical companies failing to make breakthroughs in marketing can hardly maintain an edge over their opponents under fierce

competition. “Internet + Medicine” requires companies to apply Internet thinking to marketing rather than simply selling medical drugs online. Therefore, for companies that rely heavily on traditional marketing, such transformation brings about tremendous change.

In general, digital transformation benefits the pharmaceutical industry in the following areas: lower drug distribution costs, the improved profitability and management efficiency of companies, the satisfaction of consumers’ new needs, and easier supervision for regulatory authorities. Therefore, the study of the digital transformation of traditional pharmaceutical companies can provide meaningful insights for industry insiders and other stakeholders.

1.4 Thesis Structure

The main body of this thesis consists of the following parts:

Chapter 2 introduces “Internet + X”, “Internet + Medicine”, and the B2B, B2C, and O2O modes of healthcare e-commerce through a review of existing domestic and international literature on the digital transformation of traditional pharmaceutical companies.

Chapter 3 analyses the challenges faced by traditional pharmaceutical companies in digital transformation from the perspectives of pharmacies, pharmaceutical companies, and patients and, on this basis, puts forward the three basic hypotheses of this study. This chapter also discusses the digital transformation of traditional pharmaceutical companies from the perspectives of the application of e-commerce and mobile diagnosis and treatment.

Chapter 4 presents a case study of Renhe Group’s acquisition of Dingdang Health to introduce the models and strategic plans of pharmaceutical companies’ digital transformation and examines their relevant empowering efforts to this end.

Chapter 5 presents data-based validations of the hypotheses presented in the previous chapter, paying particular attention to the outcomes of the digital transformation of traditional pharmaceutical companies through a comparative analysis of the operational data of Dingdang Health and other related data from the perspectives of pharmacies, pharmaceutical manufacturers, and user experience.

Chapter 6 presents the conclusions of this paper, summarizes the preceding analyses, and gives suggestions and recommendations that can guide pharmaceutical companies in their digital transformation.

Chapter 2: Literature Review

2.1 "Internet + X" and "Internet + Medicine"

To date, scholars both at home and abroad have not provided a unified and clear definition of "Internet + X". The first mention of this concept in China can be traced back to 2012, when Yu Yang, Chairperson of eGuan, formally proposed "Internet + X" to summarize the digital transformation of traditional companies. Moreover, Ma Huateng, CEO of Tencent, described "Internet + X" as follows: "the Internet can empower a traditional industry with modern capabilities or external resources and an enabling environment that would help upgrade the industry to a new level." According to Huang Juan, Associate Professor of the School of Government, Peking University, "'Internet + X' is an upgraded integration of informatization and industrialization. It is more than the Internet-empowered industrialization. Instead, the Internet, the core of informatization, merges with industries, commerce, finance, and other service industries in such a manner that produces a profounder effect than putting them simply together. It is only through innovation that the combination brings meaningful outcomes." In 2015, the State Council issued the *Guiding Opinions of the State Council on Vigorously Advancing the "Internet + X" Initiatives*, stating that "Internet + X" aims to infuse Internet innovations into all economic and social fields in a bid to promote the technological advancement, better efficiency, organizational restructuring, and stronger innovation capability and productivity of the real economy and develop a more pervasive social and economic development model that features Internet-empowered infrastructure and innovation. The integration of the Internet with different sectors of the economy and society leads to a new round of sci-tech revolution and Industrial Revolution and, thus, has a strategic and global impact on China's economic and social development.

"Internet + X", with the Internet at its core, can better facilitate drug development and improve application efficiency in alignment with the current development needs of pharmaceutical companies. However, compared to other traditional industries, the pharmaceutical industry is comparatively slow in its application of the Internet because domestic pharmaceutical companies usually lag behind their overseas counterparts in accepting and digesting cutting-edge technologies. In general, "Internet + X" is an initiative that advocates the innovation-driven deep integration of the Internet and traditional industries. For "Internet + Medicine", a doctor may diagnose a patient remotely and prescribe medicines online; a patient can order a medical drug online anytime and anywhere and have it shipped directly to his or her home. This model could be the future of pharmaceutical companies, and whoever adopts such new business models first can gain a prominent advantage in the market. For ordinary patients, "Internet + X" equates to more convenient drug purchase channels, while, for pharmaceutical companies, it equates to more innovative development strategies and more patient-oriented business operations.

"Internet + Medicine" involves mainly the formulation of standards for online pharmacies, mobile medical services, and wearable devices. Some traditional pharmaceutical companies acquire

or invest in hospitals, pharmacies, or Internet companies to expand their presence in the medical and pharmaceutical industries, with well-developed pharmaceutical e-commerce companies being among their favorite targets in the market. In the future, “Internet + Medicine” will, as a part of the “Health China” concept, propel the rapid development of the pharmaceutical industry, medicine, and pharmaceutical e-commerce.

Bujnowska-Fedak & Mastalerz-Migas (2015) argued that at the early stage of “Internet + Medicine”, the Internet brings about a great impetus to the development of pharmaceutical companies, as it facilitates interactive communication between pharmaceutical companies and their users and provides users with needed information. Moreover, Hong (2016), focusing on traditional Chinese medicine (TCM) companies, introduced the impact of Internet-based innovations on TCM companies as well as the different business transaction models enabled by “Internet + TCM” and their effects, believing that it has long been imperative for the TCM industry to adopt the “Internet + TCM” strategy. Furthermore, the above author also elaborated the future of “Internet + TCM” from four aspects—marketing, products, management, and business.

Guo Bingjie et al. (2014) analyzed the current state and models of Internet-facilitated drug sales both at home and abroad, concluding that Japan, Europe, and the U.S. have well-established laws, strict market supervisory mechanisms, and convincing technical standards. These countries have witnessed the thriving “Internet + Medicine” industries that boast high productivity and profitability. In comparison, China’s “Internet + Medicine” industry is under fledged and should draw on the experience of these countries to improve online drug sales. Wang Xiangnan (2016) expressed a similar opinion in his paper, dividing the strategic transformation of China’s pharmaceutical companies into three stages, namely, the fast growth stage, the stage of vying proponents and opponents, and the stage of challenges and opportunities. Regarding advanced practices, Meng Lingquan and his colleagues (2013) suggested one direction. For instance, the U.S. has established sound online pharmacy registration and official certification mechanisms and a highly self-regulatory pharmaceutical industry, the U.K. has comprehensive procedures for guiding consumer consumption and selling prescription drugs, Germany provides social insurance for medicine expenses, and Japan has multidimensional medical operations and services.

With “Internet + Medicine” being in full swing, Xia et al. (2016) analyzed its future development trend from a macro perspective, arguing that the “Internet + X” transformation of pharmaceutical companies is essential for improving the transparency of the pharmaceutical industry. This transformation allows companies to trace drug information and eliminate illegal drugs, thus enhancing the efficiency of the supply chain and benefiting people’s livelihood.

However, while most scholars have shown strong confidence in the digital transformation of pharmaceutical companies, Guo & Tang (2017), Li Fan et al. (2017), and other researchers saw the dilemma of pharmaceutical companies in their “Internet + X” transformation journey. According to

Guo & Tang (2017), many problems during digital transformation, including less innovative thinking, scattered resources, obscure business strategies and directions, and a lack of preliminary surveys, are likely to blemish, or even cause the performance of pharmaceutical companies to decline. Li Fan et al. (2017) used the structure-behavior-performance (SCP) model to analyze the market structure, companies' behavior, and operational performance of China's pharmaceutical distribution industry since 2010, arguing that state-owned pharmaceutical companies show less satisfying performance in general, although such companies have been expanding through M&As and new models, such as pharmacy alliances, which are booming. The above authors advised that the fundraising and mergers of companies be further encouraged, and that supply-side structural reform can be implemented throughout the pharmaceutical distribution industry to support the Internet-driven advancement of the operational models in the entire industry.

Despite the various challenges emerging in the progress of "Internet + Medicine", Zhan & Liu (2016) suggested that as the integration of the traditional pharmaceutical and Internet industries is accelerating, it is apparent that the "Internet + Medicine" approach will bring their superiority into full play in the long run.

2.2 Healthcare E-Commerce

Before 2013, healthcare e-commerce existed primarily in the form of B2B and B2C. B2B, a business-to-business e-commerce model, is carried out on a third-party healthcare e-commerce platform. In other words, a competent authority builds a transaction platform on which pharmaceutical companies conduct transactions. B2C, however, involves companies selling medical products directly to customers. In recent years, with the rise in the Internet healthcare and O2O model, many studies on and practices of healthcare O2O in China have been conducted.

Chinese scholars have conducted many academic studies on "healthcare e-commerce", most of which suggest that healthcare e-commerce in China has ample development opportunities. For example, Lv Wenlong (2010) published an article in an Internet weekly magazine proposing that compared with the U.S. healthcare e-commerce market, with an average annual revenue of hundreds of billions of dollars, that of China is a "blue ocean", with vast development space. However, China's pharmaceutical B2C model lags far behind the overall development of the pharmaceutical distribution industry, indicates directly that healthcare e-commerce in China is developing slowly and occupies a small market share. Regarding this issue, Chen Yuwen pointed out, as early as 2006, that the behindhand digital level of domestic traditional pharmaceutical companies accounts for the slow development of China's healthcare e-commerce. Moreover, Wang Guoni (2010) pointed out that laggard government policies are another important reason for such slow development. In particular, the outdated institutional design exposed by traditional pharmaceutical distribution and the uneven quality of online pharmacies, which leads directly to consumers' lack of confidence in

online medicine consumption, thus restricting the rapid development of China's healthcare e-commerce.

Scholars, in addition to pinpointing the above problems, have put forward recommended solutions as well as expectations. For example, Li Jiangning (2006) proposed countermeasures from the perspective of regulatory systems for healthcare e-commerce. However, most scholars have suggested that China directly copy the practice of foreign developed countries for the digital transformation of traditional pharmaceutical companies. Moreover, Meng Lingquan et al. (2006) provided a detailed analysis of the full-fledged healthcare e-commerce of the U.S. Although studies on the healthcare e-commerce of developed countries can serve as a reference for that in China, the process obviously varies given the different needs of people for medical drugs and the discrepant informatization level of the pharmaceutical industry in each country and region.

In terms of O2O application in healthcare, in 2013, Zhou Yutao diversified online and offline medical services with advanced information technology and developed pharmaceutical O2O under the existing policies. Moreover, Ma Zunzhong et al. studied how to combine micromedia platforms (such as Weibo and WeChat) with medical services and turn mobile communication tools into telemedicine terminals. Additionally, Yu et al. (2015) put forward specific applications; for example, medical institutions could develop their own WeChat official accounts to connect with patients through functions such as online appointments, healthcare consultations, and information inquiries. For now, WeChat-based services vary, as hospitals have different characteristics and medical processes, but as WeChat improves its own interfaces and makes more external interfaces available, such services will become more successful. Furthermore, Luo et al. (2015) argued that introducing online payments, the most important function of O2O, into medical payments not only frees patients from standing in one queue after another, thus saving them time, but also reduces the burden of hospitals and improves the efficiency of clinical consultation.

Some large hospitals in China have also designed and launched O2O medical services based on their actual needs to transform traditional healthcare models and optimize the process of medical services. Sun Guoqiang et al. (2015) chose the First Affiliated Hospital of Zhejiang University School of Medicine, the first public hospital in China to provide online medical services, including online specialist clinic consultation, 7-day services during lunch breaks, and cloud-based access to personal healthcare data, as the case study. Moreover, Wang Jianlei et al. (2015) discussed the data platform built by Peking Union Medical College Hospital in cooperation with Internet companies. This platform, based on the "Internet + Medicine" architecture, builds an ecosystem comprising medical and peripheral industries with the hospital as the mainstay. The above studies also considered Peking University International Hospital, which achieved data integration and business collaboration of HIS, CIS, and HERP and developed an Internet-based diagnosis and treatment management program, as represented by the online registration service supported by its WeChat official account. Additionally, Chen Xiaopeng et al. (2015) studied the updated traditional diagnosis and treatment model of the

First Affiliated Hospital of Wenzhou Medical University, which pioneered an "out-of-hospital medical care system" that enables several online medical services and designed a set of corresponding assessment indicators. Moreover, the Central Hospital of Wuhan set up an online department to provide services for follow-up patients and those with chronic diseases, for which doctors from different departments provide services in shifts. In addition, the hospital joined Ali Health's pilot "Village Taobao" program, which connects hospitals with rural Taobao service stations to extend medical service accessibility to general villagers. Furthermore, Wang Jianxiu et al. (2015) studied the Kangmei Hospital of Kangmei Pharmaceutical Co., Ltd. By taking Kangmei's mobile healthcare, pharmaceutical e-commerce markets, and chain pharmacies as the case study, the above researchers explored the patterns of the Internet-based transformation of private hospitals and large pharmaceutical companies. The above applications have brought convenience to patients in the form of access to medical services and promote the development and revolution of the medical industry.

Chapter 3: Current Picture and Study Hypotheses

3.1 Present Challenges

As domestic pharmaceutical companies are developing rapidly, they are also facing many challenges. Specifically, rapid economic and social development and a substantial improvement in people's material standards of living impose higher requirements on the healthcare sector, leaving traditional pharmaceutical companies feeling at loss as to how to adapt to the new requirements of social productivity development. Additionally, the burgeoning technological revolution, especially new business models enabled by "Internet + X" in the pharmaceutical industry, is forcing traditional pharmaceutical companies to transform by correcting their exposed problems.

3.1.1 Pharmaceutical Companies and Pharmacies

First, the traditional pharmaceutical industry adopted a multi-invoice system for medical drug distribution, by which medical drugs were distributed from pharmaceutical factories to hospitals or pharmacies through convoluted distributor layers. The lengthy distribution chain drove up pharmacies' operating costs and made distribution management and drug traceability more difficult and less transparent. In addition, the traditional pharmaceutical distribution was accompanied by a slow payment cycle.

Second, in some lower-tier cities and small-town and rural markets, physical pharmacies are so sparsely located that they cannot meet patients' needs. Patients often have to spend more time purchasing drugs in cities with a full range of medical supplies. Another problem of traditional physical retail pharmacies is the limited variety and poor quality of the medical drugs available. Such small premises prevent these pharmacies from offering a wide range of product lineups, let alone drugs for uncommon diseases. In addition, due to the more scattered patient population and inconvenient transportation, pharmacies in areas with scarce medical resources source and exchange medical drugs less frequently than do their peers in areas with rich medical resources.

Finally, China's traditional physical retail pharmacy market is characterized by fierce competition, low concentration, and regionalization. In 2020, the top four private retail pharmacy chains—DaShenLin, Laobaixing (LBX), Yifeng, and Yixintang—accounted for 3.2%, 3.0%, 2.9%, and 2.8% of the total market, respectively. Geographically, DaShenLin focuses on South China, Laobaixing focuses on Central and East China, Yifeng focuses on South and Central China, and Yixintang focuses mainly on Southwest China. These four retailers share a similar expansion path, i.e., first securing a high market share in a low-tier region and then seeking to expand to other regions. The time-consuming integration of outlet stores, market competition facing newcomers, and local protection, coupled with the overvaluation of target pharmacies by the primary market in M&A deals

in recent years, have curbed the expansion of physical pharmacies. As a result, to date, there are very few physical pharmacies with a nationwide presence.

3.1.2 Users

China's healthcare resources are becoming increasingly diverse and robust, as evidenced by the growing number of hospitals and health facilities in the country. However, these resources are still falling short of meeting the needs of China's enormous patient base. The difficulty of patients in accessing medical services and expensive medical costs are still considered the "new disease" of the medical industry.

In terms of access to medical services, China is still in serious need of medical resources. Ward beds in Grade A tertiary hospitals are nearly 100% occupied, indicating the unguaranteed quality of medical services. Across China, the extremely uneven distribution of premium medical resources presents three challenges to patients. The first is the difficulty in accessing medical services. As medical resources are unevenly distributed, with premium resources being concentrated in cities, patients have an unreasonable level of distrust in the medical services of primary hospitals and, thus, are reluctant to see doctors there. Instead, many patients with common and chronic diseases go to secondary and tertiary hospitals. Second, there is a long wait time. In large hospitals, a patient generally waits three hours before the doctor sees him or her and gives a diagnosis in five minutes; thus, he or she is prone to being dissatisfied with the medical system. Third, there are expensive medical costs. Although hospitals are gradually relying less on drug sales to support their viability as medical reform advances, medical costs are still expensive for patients. Many patients are reduced to poverty or repoverty due to expensive medical costs. This situation is especially true for rural patients. A patient who has a serious disease has to go to a secondary or tertiary hospital, rather than a primary hospital, and despite supporting higher-percentage medical reimbursement, such a hospital may not be able to cure him or her due to limited capabilities. Consequently, he or she has to bear higher medical costs.

Regarding drug purchase, as discussed above, in some lower-tier cities and small-town and rural markets, physical pharmacies are so sparsely located that they cannot meet patients' needs. Even worse, these pharmacies can neither ensure the availability of full-range, high-quality medical drugs nor source and exchange medical drugs as frequently as needed due to their small premises and inconvenient transportation modes. Clearly, these pharmacies cannot meet users' needs in terms of drug variety, quality, and even price.

3.1.3 Study Hypotheses

As shown by the above problems, whether for pharmaceutical companies and pharmacies or for user experience, the traditional pharmaceutical industry is in dire need of resolving these problems.

As the “Internet + X” model is here to stay, the development of different modes of medicine e-commerce empowered by “Internet + Medicine” is an optimal solution that can effectively address the uneven distribution of domestic medical resources, shorten the lengthy drug distribution chain, improve the operating capacities of pharmacies, enhance the profitability of pharmaceutical companies, and ultimately duly meet users’ needs. Additionally, the online consultation services provided by healthcare e-commerce can also help reduce medical service time and save medical resources.

Therefore, this thesis proposes the following hypotheses based on the above analysis:

H1: Digital transformation can improve the operational capacity and revenue of pharmacies.

H2: Digital transformation can significantly increase the revenue of and reduce the costs for pharmaceutical companies.

H3: Digital transformation can significantly improve patient experience.

3.2 Directions for the Digital Transformation of Traditional Pharmaceutical Companies

Currently, China’s A-share market houses a number of listed companies seeking transformation through “Internet + Medicine”, including traditional pharmaceutical companies, Internet companies, and even real estate companies. These traditional companies are represented by Jinhua Conba, Beijing TRT Group, Jointown, BaiYunShan Pharmaceutical, and Renhe Group, mostly showing a vibrant momentum for transformation.

The digital transformation of traditional pharmaceutical companies is generally implemented in two directions: healthcare e-commence and mobile healthcare. Each direction has a different business model. Finding a suitable business model and transformation path is the starting point for the digital transformation and strategic planning of these companies.

3.2.1 Traditional Pharma and e-Commerce

The combination of traditional pharma and e-commerce can be said to be the prototype of “Internet + Medicine”. However, due to the lack of policy and technological support, entrenched market climate, established consumption habits, and other restraints, those healthcare e-commerce companies adopting this model in its early days did not rise to become the mainstay of the pharmaceutical sales channels. With the emergence of “Internet + X”, such a combination not only breaks through the above restraints but also generates new business models. By user type, healthcare e-commerce is divided into B2B and B2C and is operated in three main models, i.e., B2B, B2C, and

O2O. At present, except for the channel of direct medical drug purchases from hospitals, healthcare e-commence has been adopted in other parts of the distribution process. In terms of the operational model, B2B connects drug suppliers, distributors, and hospitals. The B2C model is used by drug suppliers and physical pharmacies to directly sell medical drugs to users. On the customer side, users can also place orders with O2O platforms, including proprietary (e.g., Dingdang Kuaiyao) and third-party platforms (e.g., Meituan, Eleme).

1. B2B Healthcare E-Commerce

Simply put, business-to-business (B2B) e-commerce, also known as wholesale e-commerce, refers to electronic business transactions among companies. This model serves businesses in the medicine distribution industry, involving raw material processing and pharmaceutical production and wholesale as well as other segments. Compared with the lengthy traditional distribution process, that of B2B substantially reduces the distribution cost and allows for the tech-powered tracking of the flow of medical drugs. At present, representative B2B companies include Jointown, yao.jd.com, and YSB Inc.

In January 2017, eight departments of the State Council jointly issued the *Opinions on Implementing the Two-Invoice System in the Drug Procurement of Public Medical Institutions (For Trial Implementation)*, marking the formal launch of the two-invoice system. Under this system, medical drugs are invoiced when they are sold first from pharmaceutical factories to distributors and then from the latter to hospitals. This system innovation considerably shortens the circulation process from pharmaceutical factories to hospitals.

In alignment with the core idea of the two-invoice System reform, B2B healthcare e-commerce, whether through government platforms, the proprietary platform of pharmaceutical companies, or third-party platforms, enables pharmaceutical manufacturers to display their products. Moreover, such e-commerce allows distributors, hospitals, pharmacies, and other buyers to procure medical drugs at any time on the platforms. Migrating the transaction process online can help reduce distribution costs and improve regulatory efficiency. In addition, the B2B model can help resolve the problem of the slow flow of funds often besetting the traditional pharmaceutical circulation process, as the more transparent data disclosure by B2B platforms facilitates cooperation with financial institutions. To conclude, the core objective of the two-invoice system is to reduce the distribution cost of medical drugs by reducing the intermediaries in the circulation process while enhancing the transparency of circulation information to achieve more efficient regulation. B2B healthcare e-commerce fully serves the objective of this reform.

2. B2C Healthcare E-Commerce

In general, business-to-customer (B2C) e-commerce refers to electronic transactions between businesses and individual consumers. To date, B2C e-commerce has boasted robust two-way communication, flexible transaction means, fast logistics and delivery services, and cost-efficient operations. The B2C healthcare e-commerce model, as a channel for the online purchase of medical drugs, provides customers with a wider range of product lineups at less expensive prices. B2C transactions can occur via proprietary and third-party platforms, with the former being represented by yiyaojd.com, 111, Inc. and Ali Health Pharmacy and the latter being represented by JD Health and yao.tmall.com.

B2C healthcare e-commerce is distinctly superior to physical pharmacies in terms of product lineup. For general traditional retail pharmacy chains, the stock keeping units (SKUs) of key stores are above 3,000 in number, and those of ordinary stores are up to 2,000. As of March 2021, the number of SKUs of medical and health products sold on Ali Health had reached 33,000,000 in number, and those on Ali's proprietary platform exceeded 46,000. Furthermore, as of June 2021, the number of SKUs of medical and health products sold on JD Health reached 40,000,000 in number.

3. O2O Healthcare E-Commerce

Online-to-offline (O2O) e-commerce is an extension of the B2C model. Based on the B2C model, the O2O model is designed to divert online customers to physical stores, by which customers place orders online and pick up the products from physical stores or have them delivered by third-party delivery service providers. Compared with B2C customers, O2O customers are more purpose specific. Their needs usually fall into one of the following five aspects. First, they purchase medical products for emergency use, such as drugs for diarrhea, heat stroke, bruises, and injuries, as well as gauze and iodine. Second, they purchase medical products at night and require 24-hour home delivery. Third, they purchase medical products to be used in their private life, such as aphrodisiac drugs, gynecological drugs, contraceptive pills, pregnancy tests, and adult products. Fourth, they purchase medical products from home or the workplace. Fifth and finally, they need specialized consultation services from pharmacists to buy drugs for cold and flu, gastrointestinal disorders, chronic diseases, etc.

With drug quality assurance, the O2O model meets the demand for immediate delivery. Currently, O2O healthcare e-commerce in China serves primarily as a marketing means for pharmaceutical companies and pharmacies to enhance their interactions with consumers or for an e-commerce platform to divert hospitals' patients or provide contactless medical services. With O2O service, consumers can consult with physicians and select drugs based on their needs via the platform; then, they purchase the desired products online and pick them up from physical stores or have them delivered. If the consumer chooses the home delivery of drugs, then the O2O platform may arrange

for the nearest pharmacy or a third-party delivery service provider to complete the delivery. Currently, representative companies adopting the O2O model include Jingdong Medicine Emergency Delivery, Dingdang Kuaiyao, JD-Daojia, Meituan, etc.

In addition, prescription outflow has catalyzed the rise of direct-to-patient (DTP) services. Under this model, a pharmacy, after a patient gets a prescription from a hospital, not only delivers the prescribed drugs directly to his or her home but also advises and follows up on the usage of the prescribed drugs.

The above models of healthcare e-commerce are widely adopted in the sales and development of the current "Internet + Medicine" model. Different platforms have different profit patterns and cater to different customers and consumers. By comparing different models and their representative websites, apps, and companies, a company can find a healthcare e-commerce model suitable for its own development.

3.2.2 Traditional Pharma and Mobile Healthcare

Currently, as medical reform further advances, the Internet, by its own unique logic and business model, is technically promoting the reform of and changing the operational pattern of the healthcare industry. Building a mobile healthcare service platform means creating a new model for mobile healthcare. A well-developed mobile healthcare service platform should seamlessly combine complementary online and offline resources, including doctors, appointments and consultations, payment services, remote monitoring, health big data, and wearable terminals, to offer healthcare services. The platform is required to effectively segment and explore in-depth users' demands to provide full-fledged services ranging from healthy diet, special shopping, smart residence, senior citizen care and regimen, healthcare, cultural tours, and daily life diagnosis and treatment to psychological rehabilitation.

Mobile healthcare is saliently characterized by telemedicine or online diagnosis and treatment. The fast-growing Internet, together with the popularization of 4G networks and the commercialization of 5G networks, is advancing online diagnosis and treatment into a new growth period and transforming it into another revolution in the medical industry over recent decades. This approach allows us to acquire doctors' advice or health information anytime and anywhere. The adoption of mobile communication technology not only greatly saves the time, energy and costs we previously spent on appointments, waiting in line, and traveling to hospitals but also guides and changes our habits of life and drug usage, making us more prevention conscious as consumers.

Chapter 4 Models for the Digital Transformation of Traditional Pharmaceutical Companies

This chapter chooses Dingdang Health as the case study to introduce the digital transformation modes for traditional pharmaceutical companies. The birth of Dingdang Health is closely linked to that of Renhe Group, a listed traditional pharmaceutical company that has a definite goal of digital transformation. To this end, Renhe Group has made a clear strategic plan, developed a considerable number of related businesses, and achieved notable outcomes.

Incorporated in 2001, after 17 years of development, Renhe Group has grown into an OTC powerhouse in China. As a well-known trademark in China, Renhe owns multiple brands that are familiar to everyone, such as Renhe Kelik, Youkadan and Fuyanjie. Renhe Group has been striving to leverage the traditional resources at its disposal to seek Internet empowerment and transform into a digital pharmaceutical company.

4.1 Upstream Resources: Heli Internet of Things (M2F)

As a pharmaceutical manufacturer, Renhe can hardly satisfy users' medication needs with its own output. In comparison, thousands of medical drugs are showcased on Dingdang Kuaiyao. To address the shortage of drug resources and integrate drug resources, other pharmaceutical companies should join the supply chain. This consideration has given birth to the manufacturer-to-factory (M2F) model, an innovative business model pioneered by Renhe for Internet + Medicine. On January 12, 2015, Renhe and over 200 pharmaceutical companies jointly initiated the "Heli Internet of Things (Heli IOT)" platform in Sanya, which is designed to unite all pharmaceutical companies for the centralized procurement of raw materials, packaging materials, and production equipment in a bid to reduce production costs, facilitate transactions of related industries, and cut down drug prices. This model is called the M2F model.

The Heli IOT created by Renhe, the primary function of which is to integrate all kinds of resources, optimize the supply-production relationship, and build a national B2B platform for the suppliers of raw materials, auxiliary materials, packaging materials and medical drugs, conforms to the trend of the transition from the Internet to the IOT and represents an innovation in the Internet thinking mode of the pharmaceutical industry. Marking a great leap forward toward Pharma 4.0, Heli IOT allows companies to analyze and share big data. Moreover, Heli IOT decreases the costs of many links. First, centralized procurement lowers the procurement costs of raw materials, auxiliary materials, and packaging materials, thus driving down drug prices. Second, under the IOT, without going through convoluted distribution channels, drugs are directly supplied to consumers at the most preferential prices. Finally, and most importantly, standardized, and unified procurement ensures that members of the alliance have access to high-quality raw materials to guarantee product quality.

In addition, the development of similar alliances with the industrial Internet urges members to improve their overall quality management, use funds more efficiently, and reduce their cost of fund occupation and thus is conducive to the overall transformation and upgrading of China's pharmaceutical manufacturing industry.

4.2 Commercial Distribution: Dingdang Pharmacy (B2B)

If Heli IOT is an Internet-enabled platform that addresses the production resource problems of pharmaceutical companies, then Dingdang Pharmacy, a B2B platform, serves the procurement-supply requirements of physical pharmacies as a distribution channel by integrating upstream and downstream resources. For the traditional pharmaceutical industry, the commercial distribution is ill organized: convoluted distribution channels nibble away at the profit, while lengthy distribution increases the hidden danger of low drug quality. Relevant surveys reveal that online consumers are more concerned with whether the drugs delivered have deteriorated or are counterfeit than with when the drugs will be delivered. Therefore, professional logistic services comprise one of the key preconditions for the development of healthcare e-commerce. Through the strategic acquisition of the target company, Renhe Pharmacy can optimize its resource allocation.

4.3 End Users: B2C Platform Partners and Dingdang Kuaiyao (O2O)

On the user side, Renhe Group partners with B2C platforms such as taobao.com, tmall.com and JD.com to horizontally expand its business and develop evident complementary advantages with these platforms. Moreover, it has put all-out efforts into building Dingdang Kuaiyao, its own O2O platform, a solution to last-mile delivery problems.

The O2O platform of Dingdang Kuaiyao operates in the form of self-operated pharmacies or in partners with other pharmacies. Users browse drug information using the Dingdang Kuaiyao app, receive medication consultation services from pharmacists, and then place orders. The drugs ordered are delivered by physical partner pharmacies. To date, Dingdang Kuaiyao has successfully entered 14 cities, including Beijing, Guangzhou, and Hangzhou, running 304 self-operated pharmacies. Moreover, Dingdang Kuaiyao has quickly developed O2O business thanks primarily to the four advantages presented below.

First, there are high-quality traditional offline resources. Backed by the industrial and commercial system of Renhe Group, Dingdang Kuaiyao has expanded its business quite rapidly. Moreover, relying on Renhe Group's powerful supply chain, sales resources and pharmacy resources, Dingdang Kuaiyao is able to avoid the "cold start" problem faced by other startups, organizing systematic training for the delivery personnel of pharmacies and establishing assessment criteria to ensure the service quality of partner pharmacies. For partner pharmacies, cooperation with Dingdang Kuaiyao has added an important source of traffic, with their existing customer base remaining intact.

The second is empowerment by Internet thinking. A successful pharmaceutical O2O platform is not possible without the pharmaceutical, Internet, and operational professionals. Dingdang Kuaiyao is properly staffed, with its core team being composed of pharmaceutical talents and Internet talent who once worked at Amazon, JD.com, vip.com, vancl.com, and lefeng.com.

The third is the synergy of online and offline resources. The interconnectivity of online and offline information is most crucial for O2O, which imposes an enormous test on a company both technologically and financially. To address this challenge, Dingdang Kuaiyao installed an ERP system in all partner pharmacies to effectively monitor and track data. To ensure coordination, Renhe Group has acquired 50 pharmacies as their sole owner. Of these pharmacies, Dingdang Kuaiyao plans to cooperate first with those that meet "electronic fence" requirements, thus guaranteeing online and offline synergy to a certain extent.

The fourth is innovation ability. Dingdang Kuaiyao is the only pharmaceutical O2O platform that vows 28-minute door-to-door drug delivery for free. The secret behind its slogan is the standardized operation process for offline workers—it divides drug delivery into 32 subprocesses and optimizes them one by one.

4.4 Empowerment of Online Diagnosis and Treatment

Following the development trend of Internet hospitals, Renhe has launched online diagnosis and treatment services on the Dingdang Kuaiyao app to form a closed loop of diagnosis and treatment, drug sales and health management to empower its business.

By integrating its Hainan and third-party Internet hospitals, Renhe has formed its own medical team to provide users with medication guidance, online consultation for common and chronic diseases, and prescription renewal services around the clock. The Dingdang Kuaiyao app swiftly matches users with specialized doctors who are suited to their needs. Users, in addition to written communication, can receive medical advice via audio or video. In the course of diagnosis and treatment, some users may directly purchase OTC drugs by using the app. Moreover, patients may obtain prescriptions through online medical consultation services to directly purchase prescription drugs for common diseases such as cold and fever, cough, skin diseases, gastrointestinal diseases, chronic diseases, gynecological diseases, andrological diseases, and children's diseases. In addition, after diagnosis, treatment and drug purchase, patients' health records can be formed in the database to facilitate subsequent follow-up visits and repurchases, forming a closed loop of diagnosis and treatment, drug sales and health management.

4.5 Empowerment of Technologies

Renhe has established a proprietary technology platform that contains multiple technology systems to support its business operations and innovations. The key technologies applied are presented below.

Smart site selection: To select sites for smart pharmacies, Renhe utilizes big data and its own electronic fence system to select populous places with affordable rents and minimal overlap between smart pharmacies to achieve the best coverage of the smart pharmacy network.

Smart operations: Data analysis and operation are performed to realize the automated selection, packaging and distribution for drug orders, as they enable a number of functions, including smart purchases, selection, and delivery of drugs and the fine prediction of traffic, thus further improving the operational efficiency and business performance of pharmacies.

Smart delivery: Dingdang Health's smart delivery system, capable of real-time analysis of logistic progress and local traffic, provides a smart solution to route planning and delivery capacity scheduling, thereby enabling more efficient delivery. The smart delivery system is empowered by the following subsystems: (1) the smart order assignment system, which assigns orders in a cost-time balance manner by analyzing the order volume and labor force, with weather conditions and others taken into account, ensuring on-time delivery with the lowest possible delivery costs; (2) the route planning system, which collects delivery routing and traffic information to minimize delivery time; (3) the quality control system, which monitors the delivery team in real time to avoid problems such as missed deliveries; and (4) the cost optimization system, which can collect and analyze delivery cost information, optimize the delivery system from a financial perspective, and minimize costs while ensuring high-quality delivery services.

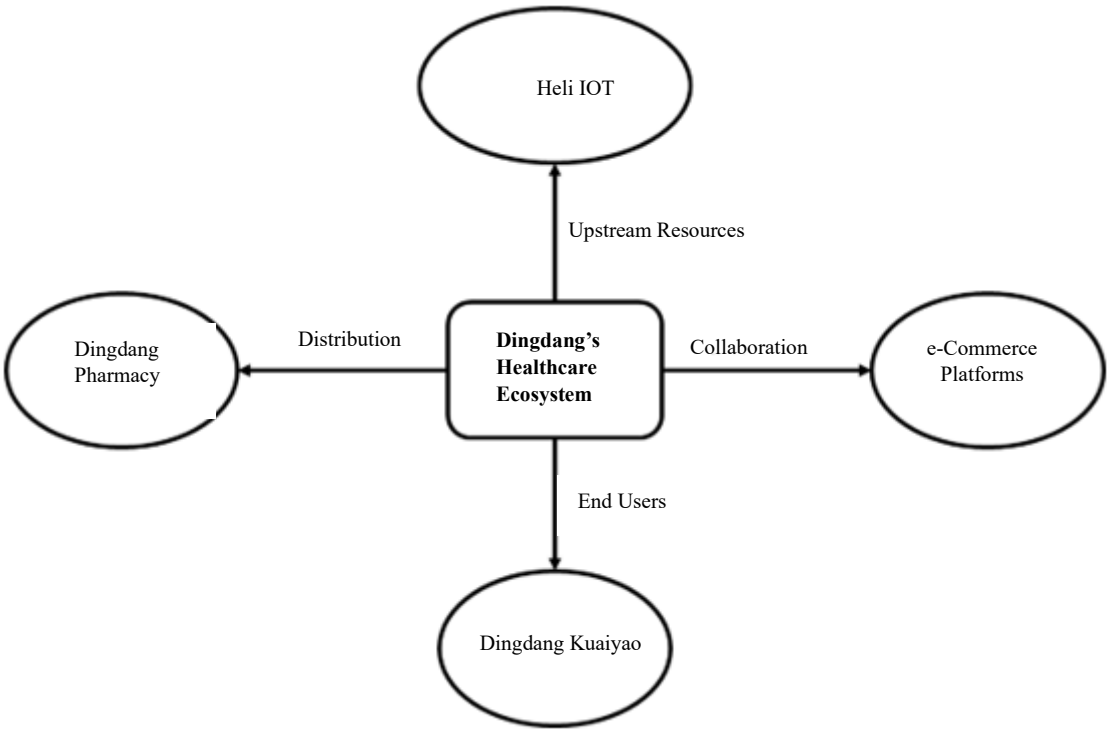
Smart marketing: Based on big data and artificial intelligence technology, Dingdang Health has built a multidimensional labeling system for users to form user health records. On this basis, the company uses deep learning, natural language processing and other artificial intelligence technologies to perform text analysis and semantic matching on customer needs, medical corpora, etc., to construct a knowledge graph while also achieving precise marketing and personalized recommendations for each user based on his or her purchase history, search records, drug courses, and a number of follow-up visits in a bid to enhance the efficient operation of Dingdang smart pharmacies.

4.6 Summary

In its acquisition of Dingdang Health, Renhe Group has sought improvements in the following five aspects: products, circulation, end users, medical teams, and R&D. First, for products, leveraging

its traditional resources and the M2F, Renhe integrates the resources of pharmaceutical companies, forming procurement, industry, and information alliance to reduce procurement costs and share information, thus lowering the price of drugs. Second, for distribution, Renhe has adopted B2B e-commerce to connect products with end users and build a supporting logistics system in line with the development of modern healthcare e-commerce. Third, for end users, Renhe has partnered with B2C platforms and made efficient use of each other's complementary advantages to horizontally expand its engagement in related industries. Renhe has linked pharmacies and users through Dingdang Kuaiyao to form an integrated O2O pharmaceutical service system and improve the availability of important drugs and user loyalty. Fourth, Renhe has built its medical team so that it can offer online diagnosis and treatment services, forming a closed loop of diagnosis and treatment, drug sales and health management. Fifth, Renhe has made continuous input in R&D so that underlying technologies such as big data and artificial intelligence can empower the digital transformation of various businesses. It is safe to say that instead of pursuing Internet-enabled transformation in a particular field only, Renhe, with the big picture in mind, seeks to form a complete pharmaceutical industry chain and create a broad healthcare ecosystem.

Figure 4-1 Business Layout of Dangdang Health



Chapter 5: Contributions of Digital Transformation

5.1 Pharmacies

5.1.1 Operations Capabilities

Dingdang Health has grown into the largest player in China's on-demand digital retail pharmacy market, with a market share of 8.5%. As of March 2021, Dingdang Health had over 28,700,000 registered users. To verify Hypothesis 1, this work compares operational data of Dingdang Health's smart pharmacies with those of traditional pharmacies.

Dingdang Health's smart pharmacy allows for the quick, timely, and convenient purchase of OTC drugs, prescription drugs, and other medical products for users. As of June 2021, Dingdang Health had opened 302 proprietary pharmacies in 14 cities across China. In addition to serving offline retailers, these smart pharmacies function as pre-warehouses for O2O delivery, by which products are delivered by the courier team after users place orders online. Now, the platform offers all-weather delivery of orders within 28 minutes. From 2018 to 2020, Dingdang Health received 14,100,000, 26,400,000, and 40,500,000 orders from O2O and offline channels, with the percentage of O2O orders rising from 87.7% to 90.8% and then to 92.9%, respectively.

Thanks to model innovation, Dingdang smart pharmacies outperform traditional pharmacies in terms of business operations. This study compares the pharmacy operation data of four leading listed pharmaceutical companies—Yifeng, LBX, Yixintang, and DaShenLin—with those of Dingdang Health in terms of inventory turnover, average store revenue, service radius, and customer experience. Although these four companies have also embarked on digital transformation for which B2C and O2O services are provided based on their retail networks of physical stores, the income from e-commerce has contributed no more than 5% to their total operating revenue. Given this fact, this work still classifies these companies into traditional pharmaceutical companies.

Table 5-1 Dingdang Health vs. Traditional Pharmacies

As of December 2020	Yifeng	LBX	Yixintang	DaShenLin	Average	Dingdang Health
Inventory turnover	4.08	4.34	3.85	3.79	4.02	6.02
Operating revenue (RMB 100 m)	130.9	139.2	126.2	145.2	135.4	22.3
Number of stores	5,356	4,892	7,205	5,705	-	302
Average store revenue (RMB 10,000/store)	244.4	284.5	175.2	254.5	239.7	738.4
Service radius	300-500 m				-	3-5 km
Management model	Chain stores				-	IT-facilitated management
Delivery mode	Take delivery from physical stores				-	On-demand delivery

As of December 2020	Yifeng	LBX	Yixintang	DaShenLin	Average	Dingdang Health
Business hours	Not all-weather				-	All-weather
Operating areas	Nine southern and central provinces and municipalities	Over 130 prefecture-level cities across 22 provinces	10 southwestern provinces including Yunnan and Sichuan	10 southern provinces	-	Dingdang Kuaiyao, an O2O platform, is available in 14 cities
Categories of drugs	For physical stores with an area < 100 m^2, the categories of drugs are < 3,000 in number For physical stores with an area of 100-300 m^2, the categories of drugs are < 3,600 in number For physical stores with an area > 300 m^2, the categories of drugs are ≈ 4,500 in number				-	SKUs average some 5,000 in number

In terms of inventory turnover, Dingdang Health's smart pharmacies boast much stronger stock management capability than do traditional pharmacies. In 2020, Dingdang's smart pharmacies recorded an inventory turnover of 6.02, while that of traditional pharmacies averaged 4.02.

The average store revenue of the four traditional pharmaceutical companies ranged from RMB 1,500,000 to 3,000,000, averaging 2,400,000, less than one third of that recorded by Dingdang smart pharmacy, which was RMB 7,384,000. Dingdang achieved this performance when traditional physical pharmacies still dominated China's pharmaceutical market and the penetration of online pharmacies was less than 5%. The income gap between online and offline drug stores is becoming further expanded as online pharmacies grow popular.

Regarding product lineup, physical pharmacies with an area smaller than 100 m^2 offer fewer than 3,000 types of drugs, and those with an area of more than 300 m^2 sell some 4,500 types of drugs. In contrast, technology empowered Dingdang smart pharmacies are able to respond rapidly to product lineup adjustments. In particular, Dingdang smart pharmacies decide what to sell and what SKUs to select based on user demand. Now, their SKUs average approximately 5,000 in number, which is basically sufficient to cover the needs of consumers while maintaining rapid inventory turnover.

Traditional physical pharmacies have a service radius of 300 to 500 m, while Dingdang smart pharmacies, empowered by O2O distant delivery, boast a service radius of 3,000 to 5,000 m. Moreover, Dingdang smart pharmacies serve an area that is 36 times larger than that served by physical pharmacies. In addition, Dingdang smart pharmacies are less location bound. Most traditional pharmacies are located in areas with high traffic, such as those in the vicinity of hospitals, downtown areas, and business centers, thus bearing higher rental costs. Smart pharmacies are less susceptible to location influence and have lower rental costs, as they are normally situated in places that allow for optimal efficiency and coverage and adopt online operations.

With respect to delivery efficiency, the O2O business model and application of the five technology-supported smart systems (electric fence, smart dispatching, smart order picking, route

planning, and sandbox) are at the core of Dingdang Health's promise of door-to-door delivery within 28 minutes. Unlike the traditional delivery mode in which couriers pick up goods and deliver them to customers, Dingdang Health's full-time delivery team directly sends the goods from its own physical pharmacies to customers, shortening the delivery mileage by half. In addition, with an electric fence, Dingdang Kuaiyao is able to reasonably plan the locations of Dingdang smart pharmacies through dry-run testing and pressure testing based on urban roads, traffic conditions and consumer coverage, thus expanding the service radius of individual pharmacies from 500 m to a maximum of 5 km. Furthermore, this technology enables more accurate coverage of users and seamless connectivity to ensure on-time delivery.

Dingdang Health has maximized delivery efficiency with a technology-empowered delivery system, adopting a big-data-based monitoring system for the holistic optimization of 32 processes, from order taking, order picking, and billing to delivery. The smart route planning system, smart order picking system, and smart dispatching system considerably speed up the dispatching, sorting, and delivery services, respectively.

The mobile order picking system is capable of location management by connecting the online order system with stock information from offline drug stores. This digitalized system, by matching pharmacy locations and stock information, enables goods picking within 1 minute for each order, thus significantly improving the work efficiency of pharmacy workers. The smart route planning system shortens the delivery time by 7 minutes for each order. The smart dispatching system greatly improves the courier's efficiency and delivery performance, leading to higher user satisfaction. With the application of unmanned vehicle technology, the future delivery mode that combines courier delivery and delivery by unmanned vehicles is expected to make up for the human resource shortage and further improve delivery efficiency.

5.1.2 Single-Store Profit Model

To reverify Hypothesis 1, this study uses model analysis for the logical deduction of single-store profitability.

Compared to the up to 30% market penetration of online drug purchases in developed countries that in China is not more than 5%. In 2019, online drug sales in China recorded RMB 39 billion, which was only 2.4% of the RMB 1.63 trillion gross drug sales.

Given the immediacy and professionalism of medical drug consumption, it is impossible to replace physical pharmacies entirely with online pharmacies. Based on the above factor, this work predicts that the advantages of the O2O model in terms of price, ample choice, and service will attract drug consumers to shift from offline to online pharmacies. Impacted by this change, pharmacies that operate offline only will see diminishing income, but fixed costs such as rents and salaries will remain

the same. The double whammy of these two factors will soon squeeze out the small and medium-sized pharmacies that fail to make ends meet. This lowered pharmacy density and wider service coverage are translated into an increase in single-store traffic and sales. Under the online operation mode, the steady overall expenses, expected improvements in the profit margin of pharmacies, and higher return on investment promise the benign circle of the business.

To verify the above prediction, this study compares the single-store profit models of physical and online pharmacies using the statistics provided in the foregoing two sections on the basis of the following three core hypotheses:

Hypothesis 1: All pharmacies are homogeneous, and incomes and costs like rent remain unchanged or rise with the fixed growth rate of GDP.

Hypothesis 2: Of revenue, the cost of goods purchased accounts for 65%, and the gross profit accounts for 35%. Fixed costs, accounting for 30% of the revenue, include rent, labor cost, marketing cost, and operation cost, which do not change with sales revenue.

Hypothesis 3: The popularity of online drug stores continues to grow in China, with their market penetration reaching that in developed countries, that is, 30%, in ideal cases.

Phase 1: When the market penetration of online drug stores is 0 of every RMB 100 income of a physical pharmacy, RMB 65 is the cost of goods purchased, and RMB 35 is the gross profit. Net of the fixed cost of RMB 30, the net profit is RMB 5. In other words, the net profit margin is 5%. Assuming that online drug stores become popular and O2O penetration grows to 20% with population aging, physical pharmacies, when not seeking digital transformation, will yield RMB 80 of income, as is thinned down by online stores. If the gross margin remains at 35%, then the gross profit will be RMB 28. If the fixed cost is still RMB 30, then the gross profit will be insufficient to cover the fixed cost. As a result, physical pharmacies will suffer losses as online pharmacies take away a part of their profits.

Phase 2: Assume that surviving physical pharmacies begin to take orders online and that their income grows to RMB 120. If the gross profit margin remains at 35%, then the gross profit will be RMB 42. Net of the fixed cost of RMB 30 and 10% fulfillment for online orders, the net profit will be RMB 10, and the net gross margin will be 8.33%.

Phase 3: Assume that the pharmacy density is reduced by half, while the service coverage of each pharmacy doubles; then, single-store income will also double. If the penetration of online drug purchases reaches 30%, then single-store income will hit RMB 260, and gross profit will be RMB 91 if the gross profit margin remains at 35%. Net of the fixed cost of RMB 30 and the 10% fulfillment for online orders, the net profit will be RMB 56, and the net profit margin will reach 21.5%.

From the above analysis of the single-store profit model, when the market penetration of online drug stores rises to 20%, it is difficult for physical pharmacies to continue to operate. Pharmacies that seek O2O transformation will see climbing profit margins with increasing penetration. The pharmaceutical market will ultimately achieve a benign circle.

5.2 Pharmaceutical Companies

To verify Hypothesis 2, this study compares some of the financial data of pharmaceutical companies. Compared with traditional pharmaceutical companies, those that adopt digital transformation and invest in digital pharmacies will gain higher profitability with the rising popularity of online drug purchases. The table shows a comparison of the financial data, including revenue growth rate, gross margin, and period expense ratio, of Yifeng, LBX, Yixintang, and DaShenLin with those of Dingdang Health. The data of JD Health, whose main business includes B2C medicine e-commerce, are also included for comparison.

Table 5-2 Dingdang Health vs. Traditional Pharmaceutical Companies

As of December 2020	Yifeng	LBX	Yixintang	DaShenLin	Average	Dingdang Health	JD Health
CAGR of operating revenue over the past three years	37.9%	21.4%	17.4%	28.3%	26.3%	95.2%	54.2%
Gross margin	38.0%	32.1%	35.8%	38.5%	36.1%	34.4%	25.4%
Fulfillment expense ratio	-	-	-	-	-	11.7%	10.8%
Sales expense ratio	24.6%	20.3%	24.1%	23.8%	23.2%	19.8%	7.4%
Management expense ratio	4.2%	4.7%	4.0%	4.8%	4.4%	5.4%	2.7%
R&D expense ratio	0.1%	0%	0%	0%	0%	3.7%	3.1%

According to the CAGR over the past three years, Dingdang Health has registered fast revenue growth since 2018, thanks to improvements in the environment for “Internet + Medicine” development and the pandemic-driven growth of digitalized big health. The CAGR from 2018 to 2020 reached 95%, and the operating revenue in 2020 was RMB 2.229 billion. In contrast, the average CAGR of the four traditional pharmacies was only 26.3%.

Analysis of the gross margin reveals that Dingdang Health’s continuous expansion in recent years, the growth of the smart pharmacy network, sales increase of prescription drugs, and more favorable subsidy policies for consumers drive the cost up and pull the gross margin down. From 2018 to 2020, Dingdang Health posted gross margins of 41.1%, 36.8%, and 34.4%, respectively, which were not much different from the average 36.1% recorded by the physical stores of its four traditional counterparts but better than the 25.4% gross margin registered by JD Health, which engages primarily in B2C business.

The sale expense ratios of Dingdang Health in the past three years were 24.1%, 21.8%, and 19.8%, declining year by year. This ratio is not much lower than the average 23.8% registered by the physical stores of the four traditional pharmaceutical companies but far higher than the 7.4% recorded by JD Health. The reason for this is that JD Health's established advantages in warehousing and logistics as well as in Internet traffic channeling from JD.com place pressure on sales and market promotion. As Dingdang Health's model becomes full-fledged and its brand becomes reputed, its sales expenses are expected to fall and close in on those of JD Health.

A comparison of the profit structure of online pharmacies like Dingdang Health and JD Health and the physical stores of traditional pharmaceutical companies also reveals that with the development of the O2O model and a decrease in sales expenses, fulfillment expenses become a major contributor to the expenses of online pharmacies, at a proportion of approximately 10%. Of fulfillment expenses, warehousing, logistics, and labor expenses, which are unavoidable, account for 70%. In ideal circumstances, less sales expense is the greatest strength of online pharmacies compared to physical pharmacies. The sale expense of online pharmacies is 15% less than that of physical pharmacies, as expenses on store rent and salespeople are avoided. However, management and R&D expenses do not differ much between online and offline pharmacies.

5.3 User Experience

5.3.1 Third-Party Review and Analysis

To verify Hypothesis 3, this study uses the physical and smart pharmacies opened by Dingdang Health in Dapuqiao Subdistrict and Lianyang Community, Shanghai, for the case study to explore what advantages digital transformation brings to user experience.

Dapuqiao Subdistrict is highly populated, with the elderly population accounting for a major proportion of the total population. The population aged above 65 years is 8,783 in number, or 14.9% of the total population. In this area, there are 14 pharmacies, including 6 traditional Chinese medicine (TCM) clinics. Of them, only two pharmacies offer O2O services, indicating their slow response to digital transformation. The pharmacies are densely located, with every pharmacy serving an area of 0.11 km^2 on average.

In Lianyang Community, the population is relatively young and highly international. The population aged above 65 years is 18,541 in number, accounting for 8.38% of the total population. In the community, there are six pharmacies, including one TCM clinic. Of them, four have launched O2O services, responding more quickly to digital transformation. The pharmacies are sparsely distributed, as every drug store serves an area of 0.88 km^2 on average.

This study compares five drug stores in Dapuqiao Subdistrict and Lianyang Community. To this end, this study collects users' ratings and reviews (negative reviews are in gray) in in-store and O2O

scenarios from Dianping, Eleme, and AutoNavi to discuss the impact of the digital transformation of pharmacies on patient experience.

Table 5-3 O2O Business of Pharmacies in Dapuqiao Subdistrict

	Shanghai Pharmacy (Yongchun Store)	Shanghai Pharmacy (Luwan Store)	Nepstar Drugstore (Xujiahui Store)	Guoda Pharmacy (Taikang Store)	Leiyunshang Pharmacy (Luwan Store)
O2O services offered or not?	No	No	Yes	Yes	No
Online SKU	-	-	Approximately 3,000	Approximately 2,000	
Rating for in-store services	3.5 AutoNavi 3.6 Dianping	4.5 Dianping	2.0 AutoNavi 3.0 Dianping	2.0 AutoNavi 3.0 Dianping	3.7 Dianping
Reviews of in-store services	Drugs are expensive, and improvement in service is expected, few product categories. Reliable as a state-owned pharmacy and professional service.	More expensive than online pharmacies; Varied choices, polite service, and clean and tidy store.	The preferential policy is a gimmick.	Prices of some drugs are expensive, and improvement in service is expected; Complete categories of products, reasonable pricing, 24-hour service, and professionalism.	The prices are 30-50% higher than those of other pharmacies; Warm service and complete categories of valuable Traditional Chinese Medicines
Rating for delivery	-	-	5.0 Eleme 5.0 Meituan	4.9 Eleme 5.0 Meituan	-
Reviews of Meituan	-	-	Warm service from the pharmacist. The seller is considerate enough to give prompts. Great service. Fast delivery. Certified products. Good service. Reasonable price. Wrong delivery.	Fast delivery. Good service from the delivery person.	-
Reviews of Eleme	-	-	Quality product and reasonable price. Fast delivery. Careful package. No package with my ointment. My order is short supplied. Poor quality of the thermometer.	Fast delivery. Guaranteed quality. Good service. Careful packages. Reasonable price. The delivery is slow, but the medicines are urgently needed (delivery takes 40 minutes).	-

Table 5-4 O2O Business of Pharmacies in Lianyang Community

	Guoda Pharmacy (Guangchang Store)	Nepstar Drugstore (Yinchun Road Store)	Yifeng Pharmacy (Taikang Store)	Shanghai No. 1 Pharmacy (Dingxiang Road Store)	Yifeng Pharmacy (Luoshan Road Store)
O2O services offered or not?	Yes	Yes	Yes	Yes	No
Online SKU	Approximately 2,000	Approximately 3,000	Approximately 3,000	Approximately 2,000	-
Rating for in-store service	2.96 Dianping	2.00 AutoNavi 2.97 Dianping	2.8 Dianping	4.34 Dianping	3.46 Dianping
Reviews of in-store service	Improvement in service is expected. The categories are few in number. Expensive medicines are recommended. Less frequent application of chronic disease management. The preferential policy for members is not implemented.	There are few drugs. Common drugs are not available. The prices are higher than those of online pharmacies. There are many food supplements, which are not covered by medical insurance. Many preferential policies.	Improvement in service attitude is expected. Canvassing. Nice experience. Covered by medical insurance. Free umbrella.	Attractive opening promotion. Customer-centered service. A wide choice of products. Complete categories of drugs. Professional pharmacist.	Drugs are high-priced. Improvements in professionalism of pharmacists are expected. Reasonable price. Good service and professionalism.
Rating for delivery	5.0 Eleme	5.0 Eleme 5.0 Meituan	5.0 Eleme 5.0 Meituan	5.0 Eleme	-
Reviews of Meituan	Nice attitude on the Meituan hotline service. Accurate delivery. Close expiration date.	Attentive and quick service. Reasonable price. Complete categories. Rapid response. Good service.	Rapid response of pharmacists. Rapid delivery. Drugs are low-priced. Good privacy protection.	Good package and rapid response.	-
Reviews of Eleme	Preferential price. Good quality. Proper packaging. On-time delivery.	On-time delivery. Reasonable price. Good packaging. Attentive service. Convenience.	Complete categories of drugs. Simple ordering operation. Rapid and good delivery. Good attitude of the delivery person. Room for improvement in packaging and delivery.	Rapid delivery. Cost-efficient. Good quality. Good service.	-

Given the reviews on in-store services and delivery, the consumers of offline drug stores put much value on reasonable drug prices (whether preferential policies are provided and implemented), complete product lineup, nice service attitudes, and professionalism (canvassing or not). They prefer drugs that are cost efficient, of an ample number of categories, covered by medical insurance, and readily available, finding drug canvassing disagreeable. For the consumers of online pharmacies, on-demand delivery and packaging are among those important considerations in addition to the listed factors.

From the ratings on in-store services and online order and delivery, ordinary physical stores are shown to receive low ratings, falling between 2-4 points, and few have ratings higher than 4 points. Ordinary pharmacies that offer O2O services generally receive higher ratings, mostly 5 points, and usually receive more positive reviews.

Based on the above factors, the O2O model is apparently superior to in-store consumption with respect to user experience and cost efficiency. Ratings on in-store service are mostly approximately 3 points, while those on O2O are 5 points. Compared to the O2O model, offline service receives more negative reviews and more complaints of unsatisfactory in-store experience. The medication immediacy requirement determines that physical pharmacies are irreplaceable. However, physical pharmacies have various problems, including incomplete types of drugs, high prices, limited opening hours, and the poor service attitudes of pharmacists. In O2O pharmacies, drug prices are lower, although not by much; the service is apparently cost efficient as delivery fees are generally deducted or exempted at the market introduction stage.

Based on the population structure and distribution of the two communities and the above two comparisons, it is not difficult to infer that population aging is positively correlated with pharmacy density but negatively correlated with the O2O development of medicine. The immediacy and professionalism requirements of drug consumption determine to a large extent that online pharmacies will not replace all physical pharmacies.

5.3.2 Drug Price Analysis

Using Lianhua Qingwen capsules, Mayinglong Diosmin tablets, and By-Health protein powder—an OTC drug, a prescription drug, and a food supplement, respectively—as a case study, this study compares the drug prices of some drug stores in the above two communities with those of Dingdang Health's smart pharmacy.

Table 5-5 Prices of Lianhua Qingwen Capsules (OTC)

	Store	Eleme	Meituan	JD Health
Nepstar Drugstore (Xujiahui Store)	RMB 28.8/48 capsules; RMB 42.9/72 capsules	RMB 28.8/48 capsules; RMB 42/72 capsules	RMB 28/48 capsules; RMB 42.8/72 capsules	RMB 29.8/48 capsules; RMB 42/72 capsules
Guoda Pharmacy (Taikang Store)	RMB 21.9/36 capsules; RMB 29.5/48 capsules	RMB 21.9/36 capsules; RMB 29.5/48 capsules	RMB 21.9/36 capsules; RMB 29.5/48 capsules	-
Guoda Pharmacy (Guangchang Store)	RMB 29.5/48 capsules	RMB 29.5/48 capsules	RMB 29.5/48 capsules	-
Nepstar Drugstore (Yingchun Road Store)	RMB 42.6/72 capsules	RMB 28.8/48 capsules; RMB 42/72 capsules	RMB 28/48 capsules; RMB 42.8/72 capsules	RMB 29.8/48 capsules; RMB 42/72 capsules
Yifeng Pharmacy (Damuzhi Store)	RMB 29.2/48 capsules	RMB 29.2/48 capsules	RMB 29.2/48 capsules	RMB 28.8/48 capsules

Shanghai No. 1 Pharmacy (Dingxiang Road Store)	RMB 21.9/36 capsules	RMB 21.9/36 capsules; RMB 29.5/48 capsules	RMB 21.9/36 capsules; RMB 29.5/48 capsules	RMB 21.9/36 capsules; RMB 29.5/48 capsules
Dingdang Health	RMB 28.8/48 capsules			

Table 5-6 Prices of Malingyong Diosmin Tablets (Prescription Drug)

	Store	Eleme	Meituan	JD Health
Nepstar Drugstore (Xujiahui Store)	-	RMB 57.5/36 tablets	RMB 54/36 tablets	RMB 49/36 tablets
Guoda Pharmacy (Taikang Store)	RMB 57.5/36 tablets	RMB 57.5/36 tablets	RMB 57.5/36 tablets	-
Guoda Pharmacy (Guangchang Store)	-	-	RMB 57.5/36 tablets	-
Nepstar Drugstore (Yingchun Road Store)	RMB 57.5/36 tablets	RMB 57.5/36 tablets	RMB 54/36 tablets	RMB 49/36 tablets
Yifeng Pharmacy (Damuzhi Store)	RMB 51.5/36 tablets	RMB 54.1/36 tablets	RMB 54.1/36 tablets	RMB 51.5/36 tablets
Shanghai No. 1 Pharmacy (Dingxiang Road Store)	-	-	-	-
Dingdang Health	RMB 57.5/36 tablets			

Table 5-7 Prices of By-Health Protein Powder 450 g (Food Supplement)

	Store	Eleme	Meituan	JD Health
Nepstar Drugstore (Xujiahui Store)	RMB 428/pack	RMB 428/pack; RMB 342/pack for promotion	RMB 390/pack; RMB 198/pack for promotion	RMB 398/pack
Guoda Pharmacy (Taikang Store)	RMB 428/pack	RMB 428/pack	RMB 398/pack; RMB 278.6/pack for promotion	-
Guoda Pharmacy (Guangchang Store)	RMB 428/pack	RMB 428/pack	RMB 428/pack	-
Nepstar Drugstore (Yingchun Road Store)	RMB 384/pack	RMB 428/pack	RMB 390/pack; RMB 258/pack for promotion	RMB 398/pack
Yifeng Pharmacy (Damuzhi Store)	RMB 428/pack; RMB 328/pack for promotion	RMB 428/pack	RMB 428/pack; RMB 192/pack for promotion	RMB 438/pack; RMB 368/pack for promotion
Shanghai No. 1 Pharmacy (Dingxiang Road Store)	RMB 428/pack; Buy 2 get 3	-	-	-
Dingdang Health	RMB 428/pack; RMB 229/pack for promotion			

Table 5-8 Delivery Charges of O2O Platforms

	Eleme	Meituan	JD Health
Nepstar Drugstore (Xujiahui Store)	RMB 7, free for orders of RMB 19 or more	RMB 5, free for orders of RMB 16 or more	RMB 4, free for orders of RMB 30 or more
Guoda Pharmacy (Taikang Store)	RMB 7, free for orders of RMB 20 or more	RMB 5, free for orders of RMB 20 or more	-
Guoda Pharmacy (Guangchang Store)	RMB 7, free for orders of RMB 20 or more	RMB 5, free for orders of RMB 20 or more	-
Nepstar Drugstore (Yingchun Road Store)	RMB 7, free for orders of RMB 20 or more	RMB 5, free for orders of RMB 20 or more	RMB 4, free for orders of RMB 34 or more
Yifeng Pharmacy (Damuzhi Store)	RMB 7, free for orders of RMB 20 or more	RMB 5, free for orders of RMB 20 or more	RMB 4, free for orders of RMB 40 or more
Shanghai No. 1 Pharmacy (Dingxiang Road Store)	RMB 7, free for orders of RMB 20 or more	RMB 5, free for orders of RMB 20 or more	RMB 4, free for orders of RMB 40 or more
Dingdang Health	Free for daytime orders and RMB 8 for nighttime orders, free for orders of RMB 28 or more		

From the above comparisons, it can be seen that drug prices on O2O platforms, including Dingdang Health, are lower, although not by much, than those of offline stores. In particular, the price difference of OTCs and prescription drugs between online and offline drug stores is small. In contrast, the prices of food supplements like protein powder vary notably across drug stores and O2O platforms, as the discounts offered are different.

With regard to the delivery charges of O2O platforms, Meituan and Eleme have more partner stores, their drug prices are less expensive, and their delivery charges are more attractive. Meituan's delivery policy shows that its delivery charge is RMB 5 per order and that the delivery is free during the promotion period. Eleme charges RMB 7 for each delivery but exempts such charges during promotional periods. JD Health, although charging less for delivery, has a higher threshold for free delivery than do Eleme and Meituan. Dingdang Health charges nothing for daytime delivery and as high as RMB 8 for each nighttime delivery but waves the delivery charge for orders of RMB 28 or more.

From the consumer perspective, the scale and network effects of the Internet may bring with them more convenient drug purchases and fuller product lineups. O2O platforms, breaking the limitation of space, offer another option to consumers who are unable to obtain their desired medicines from physical pharmacies due to a lack of availability. In addition, O2O platforms allow for more transparent prices, as consumers may choose to place orders with the online stores of the most preferential drug stores in the neighborhood. Although e-commerce platforms launched O2O medicine services fairly early, they are still at the market introduction stage due to limitations concerning the online purchase of prescription drugs and medical insurance coverage. These e-commerce platforms attract users with low thresholds for free delivery, low delivery charges and

even free delivery, and various discount coupons, among others. From the above comparison, it can be seen that at the capital input stage, online pharmacies price food supplements less expensive thanks to discounts and promotions and the free delivery of orders of a certain amount. At the middle and later stages, benefiting from the single-store traffic and sales increase with an expanded service radius as well as the controllable costs attributable to the online asset-light strategy, online pharmacies may still offer considerable discounts for the purpose of drug promotion.

5.3.3 Analysis of Online Diagnosis and Treatment

The emergence of online diagnosis and treatment, as a revolution of the traditional diagnosis and treatment method, has helped resolve some problems besetting patients, hospitals, and doctors.

First, online diagnosis and treatment, breaking the limitation by which patients have to go to hospitals for medical services, allows patients to consult doctors anytime and anywhere via the Internet, saves patients from long queues for on-site appointments, and facilitates easier access to medical reports after consultation. In summary, online diagnosis and treatment provide people with convenient medical services.

Second, online diagnosis and treatment help improve the current problem of the uneven distribution of medical resources. The network facilitates the coverage of high-quality medical resources across the country with ease and speed, enabling doctors to share their cases, exchange opinions, collaborate in medical operations, and seek self-improvement and granting those patients residing in remote areas access to high-quality medical services.

Third, online diagnosis and treatment enable doctors to utilize the fragment time in their lives and work to answer patients' questions, avoiding long wait times and insufficient consultation time.

A case study on Dingdang Health using its online health consultation data reveals that Dingdang Health is dedicated to providing users with an all-around solution that incorporates medical products and services and to assisting patients in chronic disease management, with a view of supplementing the service cycle. As of June 2021, Dingdang had established a medical team comprising 16 full-time physicians, 58 part-time physicians, over 800 external physicians seconded under cooperation with third-party medical institutions, and other medical professionals, including 397 pharmacists. From 2018 to 2020, the medical team offered 100,000, 2,200,000, and 4,400,000 online diagnoses and treatments, respectively, with a compound annual growth rate of 528.9%. This service has effectively improved the health business conversion rate. Over these three years, 51.4%, 69.9%, and 68.8% of the users who received prescriptions for online diagnosis and treatment directly placed orders for drugs and services with the platform, indicating the coordinated development of online diagnosis and treatment with the drug sales business.

Chapter 6: Conclusions and Recommendations

"Internet + X" is driving the restructuring of China's pharmaceutical industry. Internet-facilitated pharmaceutical transformation is an inevitable trend for traditional pharmaceutical manufacturers. There are problems with the current pharmaceutical services, either from the perspectives of traditional pharmacies and pharmaceutical companies or from that of users. These problems can be properly resolved by pharmaceutical e-commerce and mobile medical services that emerge from the tide of "Internet + X", thus forcing traditional pharmaceutical producers to conduct digital transformation.

Renhe Group is aiming to develop an integrated medical and pharmaceutical industrial structure, rather than focusing on one particular segment, in its acquisition of Dingdang Health. In terms of pharmaceutical resources, Dingdang Health has integrated the resources of pharmaceutical companies through the M2F model and formed procurement, industrial, and information alliances to reduce procurement costs and share information. For medicine distribution, Dingdang Health has connected products and distributors with the B2B model and established a medicine logistics and supply system that suits the development of modern pharmaceutical e-commence. To increase the number of its end users, Dingdang Health has promoted its presence across related industries through partnership with B2C platforms to effectively supplement other network-based platforms; with Dingdang Kuaiyao, Dingdang Health has also formed an integrated O2O service system that connects pharmacies and users to improve the availability of important drugs and user loyalty. With respect to product empowerment, Dingdang Health has developed a closed loop of medical consultation, drug sales, and health management by building a medical team and developing an online health consultation business. Concerning digital transformation, Dingdang Health has made continuous inputs to research and development and supported the digital empowerment of businesses through the application of big data, artificial intelligence, and other underlying technologies.

In reviewing the effect of digital transformation for traditional pharmaceutical companies, first, in terms of the operations capabilities of online pharmacies, smart pharmacies have better inventory turnover, average single-store profit, service radius, types of medical drugs, and delivery efficiency compared to traditional pharmacies. In the analysis of single-store profitability, this study finds that as online drug stores gain popularity, traditional pharmacies will feel shrinking profits and run behind their expenses, while online pharmacies, represented by Dingdang smart pharmacies, will improve their profitability. Second, financial data reveal that online pharmaceutical companies do not achieve higher profits than those of traditional pharmaceutical companies, as online drug stores have yet to gain popularity, and Dingdang Health has generated higher-than-expected sales expenses due to seizing the market and developing sales channels, in addition to a significant portion of fulfillment expenses. Third, regarding user experience, offline drug stores receive more negative reviews and complaints of poor in-store experience, incomplete categories of medical drugs, high pricing, limited opening hours, and bad service attitude of pharmacists compared to O2O drug stores. In O2O stores,

drug prices, although not by much, are lower than those in offline stores, and inexpensive or free delivery at the market introduction stage adds to their cost efficiency. In general, online drug stores have more advantages in terms of third-party reviews, ratings, drug prices, and online health consultations. However, the immediacy and professionalism of medical drug consumption largely decide the impossibility of replacing offline drug stores with online drug stores.

Currently, many obstacles and difficulties still stand in the way of the "Internet + X" transformation and upgrading of pharmaceutical companies, such as the inadequate integration of related industries, unclear policies, the underutilization of the bonus from reform, expected improvements in supporting service building, the desire for detailed measures aimed at bringing convenience and benefits to the people, and the desire for all-around professional talent. In the face of the current development trend, Renhe Group has proposed "Internet + Medicine" for its strategic transformation and upgrading policies, elaborating the strategic mission and development direction of "Internet + Medicine" in terms of China's pharmaceutical industry development and medical reform.

In the future, with the deep implementation of the "Internet + Medicine" industrial transformation, traditional pharmaceutical companies will have to build an Internet-enabled big health ecology that covers all related industries to complete their strategic transformation and upgrading. These pharmacies are just embarking on the journey of "Internet + X" transformation, and there will be a new round of reform in the pharmaceutical industry with the introduction of policy improvements. Other traditional pharmaceutical companies, drawing on the experience of Renhe Group from its acquisition of Dingdang Health for its digital transformation as well as their own actual conditions, should choose a suitable transformation route and model to achieve the "soft landing" of their traditional businesses in the tide of "Internet + X".

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Resume of the Author

Mr. Yang Wenlong (楊文龍), aged 60 years, is the Executive Director, Chairman of the Board and President of Dingdang Health Technology Group Ltd. Mr. Yang previously served as Chairman of the Board of Directors of Dingdang Medicine Express Technology from December 2017 to May 2021. Mr. Yang has been the Chairman of the Board of Directors and General Manager of Renhe (Group) Development Co., Ltd., since July 2001. Mr. Yang has also served as a Deputy Officer of the Central Population, Medicine and Health Committee of the China Democratic National Construction Association (CDNCA) since March 2013 and the Chairman of the Yichun Federation of Industry and Commerce since March 2013. Mr. Yang has consecutively served as a member of the eleventh, twelfth and thirteenth sessions of The National Committee of the Chinese People's Political Consultative Conference (CPPCC) since March 2008; as a member of the ninth, tenth and eleventh sessions of CDNCA since December 2007; as the Vice Chairman of the seventh, eighth and ninth sessions of Jiangxi Municipal Committee of CDNCA since June 2007; and Vice Chairman of Zhangshu Committee of the CPPCC since March 2007. Mr. Yang served as the Chairperson of the Board and General Manager of Jiangxi Kangmei Medical Health Care Products Co., Ltd. (江西康美醫藥保健品有限公司), a company engaged in medical and health business, from November 1998 to July 2001. Mr. Yang obtained an MBA from Renmin University in November 2004 in Beijing, PRC, and obtained a certificate upon completion of the fifth China CEO program of Cheung Kong Graduate School of Business in November 2010 in Beijing, PRC. Mr. Yang holds a certificate of senior economist issued by the Ministry of Personnel of Jiangxi Province, now known as Jiangxi Province Human Resources and Social Security Department, in January 2004 and a Chinese herbalist certificate issued by Zhangshu Title Reform Leading Group (樟樹市職稱改革領導小組) in October 1997.