Zacks Small-Cap Research

Sponsored – Impartial - Comprehensive

October 20, 2020

John D. Vandermosten, CFA
312-265-9588 / jvandermosten@zacks.com

scr.zacks.com

10 S. Riverside Plaza, Suite 1600, Chicago, IL 60606

AnPac Bio-Medical Science Co., Ltd. (ANPC - NASDAQ)

Next Gen Cancer Screening

Target price is based on a 20x multiple of 2028 EPS. The result is discounted to present at a 25% rate. Revenues represent contributions from physical checkup packages and cancer screening tests in China and the United States.

Current Price (10/19/2020)	$3.48
Valuation	**$7.00**

INITIATION

AnPac Bio is developing advanced cancer screening with its CDA technology that is able to detect the likelihood of 26 different cancers. The screening tool can serve as a valuable role in early detection and prevention of this common disease.

Revenues are solely generated in China from cancer screening and detection and physical checkup packages. Future growth will come from access to the Chinese hospital market and launch of testing services in the United States.

AnPac is focused on obtaining the license and authorization to provide services more broadly in China. The company is also working to launch testing services in the US having obtained a CLIA & CAP approved lab in California. Efforts to conduct clinical trials to validate the diagnostic platform and to seek FDA approval of its CDA testing platform is also underway.

Commercialization plans include obtaining certification to provide CDA testing services in hospitals in China and completing screening studies performed in the US. ANPC will initially sell the diagnostic as an LDT and later seek FDA approval for its tests, allowing for broader use.

SUMMARY DATA

52-Week High	**12.00**
52-Week Low	**3.15**
One-Year Return (%)	**N/A**
Beta	**N/A**
Average Daily Volume (sh)	**322,382**
Shares Outstanding (mil)	**11.93**
Market Capitalization ($mil)	**41.5**
Short Interest Ratio (days)	**0.0**
Institutional Ownership (%)	**0.0**
Insider Ownership (%)	**0.0**
Annual Cash Dividend	**$0.00**
Dividend Yield (%)	**0.00**
5-Yr. Historical Growth Rates	
Sales (%)	**N/A**
Earnings Per Share (%)	**N/A**
Dividend (%)	**N/A**
P/E using TTM EPS	**N/A**
P/E using 2020 Estimate	**N/A**
P/E using 2021 Estimate	**N/A**
Zacks Rank	**N/A**

Risk Level	**Above Average**
Type of Stock	**Small-Growth**
Industry	**Med-Biomed/Gene**

ZACKS ESTIMATES

Revenue
(In millions of US$)

	Q1 (Mar)	Q2 (Jun)	Q3 (Sep)	Q4 (Dec)	Year (Dec)
2019	$0.0 A	$0.0 A	$0.0 A	$1.6 A	$1.6 A
2020	$0.0 A	$0.6 A	$0.7 E	$0.7 E	$2.0 E
2021					$3.6 E
2022					$7.0 E

Earnings per Share

	Q1 (Mar)	Q2 (Jun)	Q3 (Sep)	Q4 (Dec)	Year (Dec)
2019	$0.00 A	$0.00 A	$0.00 A	-$1.62 A	-$1.62 A
2020	$0.00 A	-$0.72 A	-$0.18 E	-$0.13 E	-$1.03 E
2021					-$0.55 E
2022					-$0.36 E

© Copyright 2020, Zacks Investment Research. All Rights Reserved.

INITIATING COVERAGE

AnPac Bio-Medical Science Co., Ltd. (NASDAQ: ANPC) is a China-focused cancer screening company that designs and manufactures devices that analyze the biophysical properties of blood to determine an individual's risk of cancer. It is also building a presence using this same technology in the US. The company's founders spent many years combining the disciplines of medicine, physics and weak signal detection to decipher the biophysical information contained in cells suspended in blood for the purposes of cancer detection. In contrast to the traditional tests that have been used for screening which differ by type of cancer, AnPac's CDA technology uses a single test that can evaluate the risk of many cancers, including the most common ones such as breast, colorectal and lung. The approach provides earlier detection when compared to image-based screening and can be performed rapidly with a single sample of blood. For some cancers that can be addressed via CDA, such as esophageal and brain, no practical detection methods exist. The test is not only beneficial to patients, but is also valuable for the health management of large populations to help optimize costs and prompt early treatment. We see the target market for these services as managed care, large corporations, hospitals, single payer systems and other groups where it is critical to efficiently allocate scarce health resources where they will have the greatest impact.

The world of diagnostic testing has exploded over the last decade. As more treatments have become available for a wide variety of diseases, testing has become more important to identify those who will benefit from available therapies. Precision medicine, which considers an individual's genetics and physiology in the determination of treatment, has been enabled by the explosion in patient specific data, collected through a variety of methods including screening. When a person is diagnosed with cancer, the genetic signature of their disease is used to tailor the appropriate therapy. We anticipate that the signature of biophysical properties of cancer will also be able to efficiently and cost effectively monitor a patient's treatment. With the advent of genetic sequencing and blood-based biopsies, the ability to narrow down stage and type of cancer has improved markedly, allowing for ever more accurate diagnosis and precision therapy. AnPac's CDA technology is distinct from sequencing-based tests that generate large amounts of highly specific information but are costly and are challenged by signal to noise; instead, CDA is a tool that can effectively and quickly identify risk at a relatively low price.

The use of biophysical properties for cancer screening is not a mainstream approach. Modern science has tilted toward highly sophisticated, challenging and expensive sequencing without realizing the utility of information that is available at the elegantly simple level of biophysics. One catalyst that could shift interest towards this approach may be the resurgence of interest in machine learning; even the most elementary of machine learning models can leverage large amounts of data and produce actionable insights. There is a history of supportive research that finds an association between the physical properties of cells and cancer which only lacks clinical trials to support its use. Combining sensor design and fabrication, a vast blood-based cancer dataset and a trained algorithm is what AnPac founders, Drs. Herbert and Chris Yu, achieved when developing CDA technology. Leveraging these characteristics will provide an alternate and complementary approach to traditional screening.

The CDA technology builds on the correlation between biophysical properties and risk of cancer occurrence. Cancer cells are unlike healthy cells and can be differentiated through a variety of measurable properties. These properties include deformability, rigidity, acoustical, electrical, magnetic, nano-mechanical and optical properties. AnPac has conducted numerous retrospective studies that have identified biophysical properties related to the balance between normal cell growth and carcinogenesis. These insights informed an algorithm that was then shown retrospectively to be able to predict the likelihood of cancer. CDA can measure over time, especially in relation to treatment, tracking progression, response, and even resurgence of cancer, making CDA an invaluable tool in cancer management.

AnPac offers two main services: cancer screening and detection tests and physical checkup packages. AnPac's CDA technology is also capable of assisting diagnosis, monitoring recurrence and selection of therapy. We anticipate a broader penetration of the tests as the technology becomes more widely used and accepted. AnPac is in the early stages of growth and is generating minimal revenues in China. One of the primary hurdles to faster growth is clearance for a Class III medical device registration certificate from the Chinese National Medical Products Administration (NMPA). Securing this certificate will allow AnPac to place CDA diagnostic equipment in hospitals, the primary source of annual physical checkups for 100 million Chinese citizens every year. AnPac may obtain this authorization by late 2021. Recent successes, such as the new contract with Beijing Yuan Jian Health Management and the launch of new test products provide additional opportunities for revenue expansion.

While there are no revenues yet generated in the United States, AnPac plans to initiate a variety of studies that will validate the technology with leading academic centers. The company has active laboratories in California and Pennsylvania. These labs will initially be used to conduct further validation studies and later function as the bases for conducting CDA tests in the United States.

INVESTMENT THESIS

AnPac Bio is focused on two of the largest cancer markets in the world, China and the United States, geographies where the disease has been a leading cause of death since 2011. There are 18 million new cases of cancer around the globe annually with about 4.3 million in China and 1.8 million in the US. The number of cases is expected to grow as the incidence of cancer increases with age, and both of these regions are experiencing faster growth in the older population as a result of demographic trends.

Despite the high prevalence of cancer, there are few screening tests available that are easy to use, highly accurate, inexpensive and simultaneously test for the most common cancers. While there are a great number of screening tests available for different types of cancer, some cancers do not have a single reliable detection method, such as esophageal or brain cancer and tests that do exist provide low accuracy. This unmet need highlights the opportunity for a new approach that is able to demonstrate high levels of sensitivity and specificity for the types of cancer most difficult to detect.

While not in the cancer testing mainstream of genetic sequencing or circulating tumor DNA (ctDNA) detection, there is an expansive collection of research that supports the use of biophysical properties of blood and cells to detect the disease. Cancerous cells have distinct characteristics related to their structure and are larger, have greater density, lack surface adhesion molecules, and have greater stiffness among other attributes as compared to normal cells. These features allow for the use of acoustical, electrical, magnetic, nanomechanical and optical measurement devices to differentiate them from normal cells. These detection methods are simpler and cheaper to execute than current generation sequencing-based liquid-biopsies, making CDA more efficient for preliminary, routine screening.

AnPac's studies have demonstrated high levels of accuracy in 26 common cancers, providing a comprehensive solution for a disease that in many instances is not detectable until an advanced stage. Numerous retrospective studies have been conducted in conjunction with Chinese hospitals and research institutions. 25 research studies have been conducted and 15 of them have been published at ASCO meetings, other medical conferences or in medical journal supplements. AnPac will continue its research efforts in both China and the United States and conduct prospective studies that are expected to provide additional evidence of the CDA test's utility.

AnPac's initial revenue generation has been in cancer screening and physical checkup packages conducted in China. As the company advances through the regulatory process we expect it to obtain several clearances and approvals to fully market CDA in its two primary geographies. After receiving regulatory approval in China, AnPac will have access to the hospital market which should catalyze a leap in testing and revenue growth for the company. About 100 million Chinese citizens visit hospitals to conduct annual physical checkups every year. CDA is a natural, inexpensive addition to physical checkups, especially for those age 45 and older. The company is also pursuing laboratory certifications, device clearance and additional studies in the United States that will allow for commercialization of the CDA test in this region when achieved.

The market for screening and checkup packages is large; however, there are additional opportunities for growth as well. This includes assisting in cancer diagnosis, monitoring recurrence of cancer after therapy and guiding therapy selection. The CDA test may prove a useful and effective tool to improve cancer treatment and optimize its timing, improving outcomes.

Key reasons to own AnPac Bio shares:

- **Swiftly growing demand for cancer screening**
- **Rapid, inexpensive screening process for the most common cancers using a single blood sample**
- **High incidence and prevalence of cancer in primary markets of China and US**
- **Effective screening approach using biophysical properties**
  - **Substantial literature supportive of the approach**
  - **Prospective studies presented at ASCO demonstrate high accuracy**
- **Physical labs in place in China and the US**
- **Extensive history of research associating biophysical properties of blood with cancer**
- **Opportunity to expand suite of products to provide additional services**
  - **Therapy selection**
  - **Treatment monitoring**
  - **Genomic testing**
- **Development platform that can be applied to many genetic tests and cellular therapy applications**

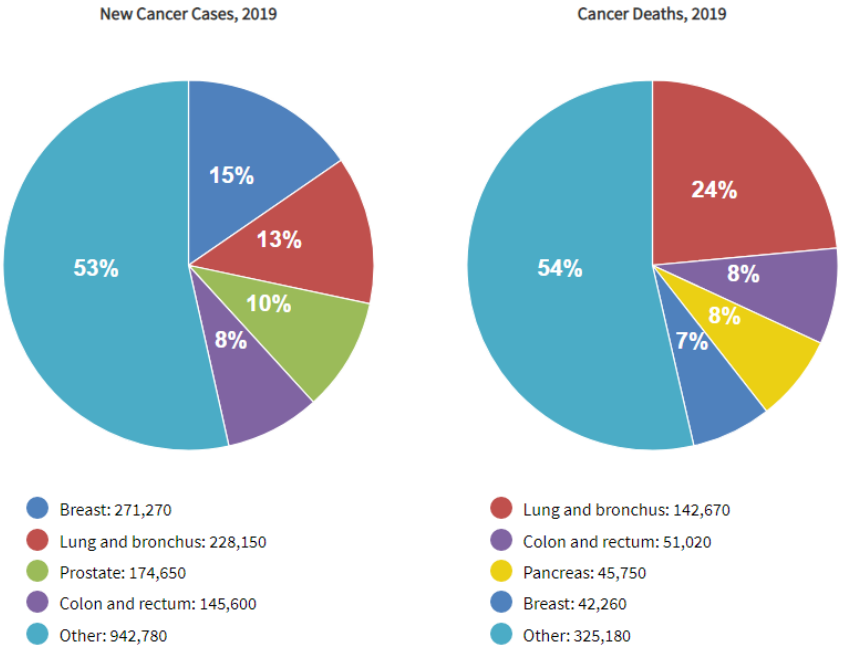
In this initiation report we discuss cancer incidence and the diagnostic testing space, providing detail on the current and upcoming approaches to cancer detection. We review research investigating the utility of using biophysical properties of cells to detect cancer, then detail AnPac's CDA technology and its proven performance. This is followed by a discussion of the regulatory environment that the company faces in both China and the United States, the company's strategy to grow screening services, discussion of risk and a review of peer companies. We conclude with a review of financial and operational highlights, as well as explain the rationale and methodology supporting our Valuation. The product of our work generates a target price of $7.00 per share.

Cancer: Incidence & Economic Burden

Global Cancer Incidence

Of the 18[1] million estimated global new cancer cases, the United States represents approximately 10% of this total, with 1.8 million cases and China at 24% of the total with 4.3 million cases according to the NIH and GLOBOCAN respectively. The most common types of cancer include lung, breast, colorectal and prostate.[2]

Exhibit I – US Cancer Cases & Deaths by Site[3]



Cancer is the second highest cause of death in the United States and the leading cause of death in China. In 2018, there were an estimated 610,000 cancer deaths in the US[4] and 2.9 million in China[5] highlighting the importance of improving diagnosis and treatment for this disease. Despite cancer being a leading cause of death in both of these countries, little progress has been made in diagnostic accuracy in the last decades. Cancer screening has a low rate of precision where, for example, 19% of breast cancers and 20-50% of prostate cancers are misdiagnosed.[6] Testing accuracy is even lower when performed during the early stages of the disease; however, the early stage is when a proactive response can provide the most impact at the least cost.

Age standardized cancer death rates are 130.1/100,000 in China compared with 91.0/100,000 in the United States.[7] This difference has been attributed to the prevalence of different types of cancer, substandard treatment and a low early detection rate.[8] Higher rates of gastrointestinal cancers in China, such as those of the liver, stomach and esophagus contribute to the difference. Higher rates of smoking in China have also driven an increasing prevalence of lung cancer, which is the most common type. Additionally, a lack of education, awareness and screening are also faulted for greater incidence and higher mortality.[9] A study conducted by a Chinese cancer organization found that the five-year all-cancer survival in China is 31% compared with 66% in the US.[10]

[1] Source: GLOBOCAN 2018, World Health Organization
[2] Global cancer incidence, World Cancer Research Fund / American Institute for Cancer Research. https://www.wcrf.org/dietandcancer/cancer-trends/worldwide-cancer-data
[3] National Cancer Institute, 2019 Cancer Statistics. https://seer.cancer.gov/statfacts/html/common.html
[4] Source: American Cancer Society, Cancer Facts and Figures 2018.
[5] Source: World Health Organization, GLOBOCAN 2018, China Data.
[6] NIH. Crunching Numbers: What Cancer Screening Statistics Really Tell Us. https://www.cancer.gov/about-cancer/screening/research/what-screening-statistics-mean
[7] Source: World Health Organization, GLOBOCAN 2018
[8] Feng, Rui-Mei; *et al.* Current cancer situation in China: good or bad news from the 2018 Global Cancer Statistics? Cancer Communications volume 39, Article number: 22 (2019).
[9] Wang, Y., *et al.* Comparison of Cancer Incidence between China and the USA. Cancer Biol Med. 2012 Jun; 9(2): 128–132.
[10] National Office for Cancer Prevention and Control and National Central Cancer Registry. Published in International Journal of Cancer. China's cancer survival rate less than half that of US, new study finds.

Early detection has a dramatic impact on survival. For example, the five-year survival rate for lung cancer is well over 50% for cases when the disease is localized in the lungs but only 5% in more advanced stages.[11] There are a broad variety of treatments for cancer; however, they become less effective when the disease has progressed to advanced stages. Early detection and diagnosis are critically important for efficiently and effectively treating this common malignancy. There are many screening tools available; however, they suffer from low levels of accuracy, high costs, inconvenience and discomfort and a need for multiple tests to cover the most common cancer types.

Healthcare Burden

According to a study by Frost and Sullivan, there are more than 175 million Chinese citizens over 65 years old. This age group suffers a higher incidence of cancer due to their age. The cohort is expected to increase to 306 million by 2030, dramatically increasing the number of individuals with the highest rates of disease. The global cost of cancer was estimated to be $1.4 trillion in 2019 and is expected to rise to $2.1 trillion by 2030, representing a 3.5% compound annual growth rate. In China, direct and indirect related medical costs for cancer in 2019 were $220 billion, and are anticipated to rise to $542 billion by 2030.[12] *In vitro* diagnostics are a large market growing at a rapid pace in China; in 2019, the estimated market size for this service was $12.3 billion,[13] a sum growing at almost 20% per annum.

Based on data provided by the World Health Organization, of the 18 million cases of cancer in 2018, five million cases could have been identified earlier and treated more effectively. Not only is survival improved with early detection, but in high-income countries, treatment cost is only a fraction (25-50%)[14] for early stage cancer compared to late stage. An article by Kakushadze *et al.* estimated a cost savings of 17% resulting from early diagnosis of cancer, ignoring the qualitative benefits of better health.[15] Cancer costs are substantially higher in the last year of life as compared with earlier stages. Another study examining mammography and colorectal screening identified cost effectiveness ratios of up to $22,000 and $40,000 respectively per life year.[16] There are numerous other studies that make a similar case. Screening and early detection are not only better for patient health but can also conserve individual and health system resources.

[11] American Cancer Society, Lung Cancer Survival Rates
[12] Using Frost and Sullivan data converted from RMB to US$ at a rate of 7.1:1
[13] Using Frost and Sullivan data converted from RMB to US$ at a rate of 7.1:1
[14] Early cancer diagnosis saves lives, cuts treatment costs. World Health Organization. https://www.who.int/news-room/detail/03-02-2017-early-cancer-diagnosis-saves-lives-cuts-treatment-costs
[15] Kakushadze, Zura; *et al.* Estimating Cost Savings from Early Cancer Diagnosis. Data 2017, 2, 30; doi:10.3390/data2030030
[16] Provenzale, D. Cost-effectiveness of screening the average-risk population for colorectal cancer. Gastrointest Endosc Clin N Am. 2002 Jan;12(1):93-109.

Screening & Diagnostics Overview

Cancer Screening

Due to the pressing medical and economic consequences of cancer, screening is crucial to informing patients early, and to manage public health. Cancer screening can differ from diagnosing in several ways. It can be less expensive, used more broadly, faster and easier to implement. It can be used to identify when more specific diagnostics are appropriate, which can be more invasive in return for a more detailed result.

The incidence of cancer has increased in China as the population has aged due to the association between age and cancer and other unhealthy activities such as smoking and diet.[17] A 2015 paper found that the cancer incidence rate in China was 174.0 per 100,000 and the fatality rate was 122.2 per 100,000. The research observed that breast cancer in Shanghai increased by 110% in 2008-2009 as compared to 1988-1992. Cancer has emerged as the leading cause of death since 2011.[18] With this backdrop, the importance of cancer screening and detection was critical to motivating Drs. Chris and Herbert Yu to develop the CDA technology.

The importance of effective cancer screening cannot be underestimated. In the United States, aggressive efforts made to fight the disease were able to reduce cancer rates by 26% over the 25-year period ending in 2015. This dramatic improvement was achieved in large part through early detection and treatment.[19] Cancer treatment is most effective when the malignancy is caught at an early stage.

Some of the most common screenings include mammograms, pap smears, colonoscopies, prostate-specific antigen (PSA) tests and ultrasounds among others. While these are helpful tools to identify cancer, tests can provide incorrect information, have a high cost, and result in complications. Invasive tests can cause side effects including pain, bleeding, infection, deformity and internal injury, while image detection requires the tumor being large enough to see. Accuracy can be a problem as well. A false negative can provide an unjustified sense of health while a false positive can send a patient on to unnecessary and expensive additional confirmatory testing. These limitations have led to demand for less invasive approaches such as liquid-based testing, including immunoassays and molecular testing that can be used to confirm and measure disease.

The advance of screening technology has enabled tests to be developed that are more sensitive than those of the past. The new generation of tests are increasingly blood-based and are able to avoid some of the shortcomings of previous approaches. Much of the focus so far is on identifying mutations that can help guide the optimal treatment that should be used.

Immunoassays are measurements of binding between antibodies and proteins. They have been used for decades to identify and assess the progression of disease. The antibodies used in the diagnostic are specific to unique antigens or analytes. Immunoassays are widely used to diagnose cancer including tests for PSA, cancer antigen 125 (CA125), and alpha-fetoprotein (AFP) used for the early detection of prostate, ovarian, and liver cancers, respectively.

Molecular testing is another approach to screen for cancer that primarily concerns the analysis of genetic material. The test examines tissue, blood or other body fluid samples and can facilitate the detection and characterization of a disease. Some examples of tests in this area include analyzing circulating tumor DNA (ctDNA) via genotyping, sequencing, target amplification (PCR) and other approaches. While molecular tests only require small sample volumes and have some ability to predict the probability of cancer occurrence in the future, they are complex, expensive, and not fully proven for early stage cancer screening.

Providers of recognized screening diagnostic tests include hospitals and physicians who use specialized imaging equipment and also take tissue samples to send to laboratories for further analysis. Manufacturers such as General Electric, Philips, Hologic, Steris, Olympus and many others provide this equipment. Large laboratories such as LabCorp and Quest Diagnostics also offer tissue diagnostic services. With the advance in detection of the components of blood with sequencing, blood-based diagnostics including PCR, BEAD (beam, emulsion, amplification and magnetics) and a variety of sequencing techniques have spawned the successors to less

[17] https://chinameddevice.com/seven-cancer-patient-diagnosed-every-minute-in-china/
[18] Yu, S. *et al.* Cancer Prevention Research in China. Cancer Prevention Research, August 2015.
[19] Byers, T. *et al.* The American Cancer Society challenge goal to reduce US cancer mortality by 50% between 1990 and 2015: Results and reflections. CA Cancer J Clin. 2016 Sep;66(5):359-69. doi: 10.3322/caac.21348. Epub 2016 May 13.

convenient and more invasive approaches. Some of the current larger companies that have liquid biopsy technologies on the market include Exact Sciences (NASDAQ: EXAS) and Guardant Health (NASDAQ:GH).

Cancer Diagnostics

There is a spectrum of diagnostic services that address the developmental stages of cancer. Molecular screening emerged in the last decades as an approach that was independent of a detectable tumor mass. It finds pre-symptomatic evidence of trace material or characteristics but can give a high false positive rate. Some of the profiling techniques include polymerase chain reaction (PCR), in situ hybridization (ISH), fluorescence in situ hybridization (FISH), genetic sequencing among others. There are several types of molecular biomarker screening categories. One example is carcinogenesis biomarkers, which detect abnormal molecular species generated by carcinogenesis such as mutated DNA and aberrantly methylated DNA. Another example is released biomarkers which are physiological molecules released in abnormal amounts due to the disruption of carcinogenesis including PSA or stool heme. The category also includes response biomarkers and risk biomarkers that find molecular species associated with cancer and include tests such as detecting antibodies and measurement of hormone levels.

Therapy selection is important for identifying the best treatment for a patient after an initial diagnosis of cancer. An individual's response to treatment in many cases depends on a tumor's genomic profile. Hundreds of gene profiles can be screened and determine whether a patient should pursue targeted therapy, immunotherapy or apply to join a clinical trial. Companies including Guardant Health and Foundation Medicine are dominant players in this segment.

After diagnosis and treatment of cancer, monitoring is an important part of ongoing care. Following treatment, patients and providers want to monitor the cancer to determine success, lack of response or resistance. Some cancers recur at an alarming rate such as bladder, with a 50% rate after cystectomy, breast at a 30% overall rate and ovarian at an 85% rate of recurrence.[20] This highlights the need for ongoing monitoring that is less invasive than biopsy and inexpensively performed. Companies provide tests for residual disease and recurrence in solid tumors using cell-free circulating tumor DNA (ctDNA), circulating tumor cells (CTCs) and other approaches

Sensitivity and Specificity

To evaluate the performance of cancer screening and diagnostic tests, sensitivity and specificity are measured. Sensitivity measures the proportion of actual positives that are correctly predicted and specificity measures the proportion of negatives that are correctly identified. Few tests are fully accurate, meaning that false positives and negatives will occur. The accuracy of a test, or the weighted sum of sensitivity and specificity is an important factor for determining the utility of a test and to avoid false positives and false negatives. Testing provides a mechanism to validate symptoms of a disease and also to anticipate a disease at a point when it can be more easily treated. Many of the gold standard tests that have high accuracy only provide their utility after the cancer has begun and are not intended for screening. While genomic tests do provide helpful information identifying mutations associated with cancer, they suffer from inaccuracy and are far more expensive. AnPac's tests provide a high degree of sensitivity and specificity, with many studies showing 90% or greater accuracy. Below we provide a subset of the 26 cancer types evaluated by AnPac's research arm in multi-center studies. We include the largest sample sizes in the group and pancreatic cancer, given this cancer's notorious elusiveness in detection.

Exhibit II – CDA Test Accuracy[21]

Cancer Type	Sample Size	Sensitivity	Specificity
Lung	2,277	82.4%	83.0%
Esophageal	2,253	85.8%	93.0%
Liver	804	92.3%	93.2%
Pancreatic	162	89.3%	90.6%
Gastric	1,438	88.7%	93.8%
Colon	884	89.4%	91.2%

New diagnostics are needed due to the lack of inexpensive, easy to use and accurate tests for screening. In a review, we examined research on a wide variety of diagnostic tests to assess their sensitivity and specificity. While it is not comprehensive it does give a sense of the ranges of accuracy for existing approaches.

[20] Cancer Recurrence Statistics. Andrea Blevins Primeau, PhD. November 30, 2018
[21] Source: AnPac Bio Form F-1 Corporate Filing, October 31, 2019

Exhibit III – Selected Accuracy Measures from Common Cancer Diagnostic Tests[22]

Cancer Type	Test Type	Sensitivity	Specificity
Lung	CT Scan	88.9%	92.6%
Lung	X-ray	78.3%	97.0%
Esophageal	CT Scan	59%-67%	56%-75%
Breast	Mammogram	75%-90%	90%-95%
Liver	Serum markers	50%-90%	63%-98%
Pancreatic	CA 19-9	67%-92%	68%-92%
Gastric	Endoscopy	88.6%	83.1%
Colon	FIT	79.0%	94.0%

Comparing AnPac's accuracy with common tests performed in similar cancers demonstrates favorable predictive ability. Not only does CDA screen for multiple cancers, its accuracy can exceed that of existing standard tests. As CDA uses a different approach to imaging, sequencing or identifying biomarkers for estimating cancer risk, it can serve as a complementary diagnostic to what is currently being used. There are numerous shortcomings in many of the most accurate tests. Even tests for diagnosis such as biopsy, which is considered the gold standard, may provide inaccurate and incomplete results. Shortcomings of a biopsy are that it is highly invasive, analyzes only one small part of the tissue and is unable to address the heterogeneity of tumors. Approaches in the field of radiology require that the tumor be large enough to appear in the imaging. High cost is another consideration, as PET, CT and MRI scans as well as 3-D mammograms are expensive and time-consuming despite favorable diagnostic ability. Serum tumor markers are extremely broad in their accuracy results despite their ease of collection.

[22] Source: Accumulated from various sources and compiled by the author.

Biophysical Properties of Blood and Cancer Overview

AnPac adopts a novel approach to screening and detecting cancer that we see as establishing a new paradigm in routine checkup screening and complementing both traditional and new cancer testing, including ctDNA and genetics. The use of biophysical properties to screen for cancer is not mainstream, yet there has been considerable research conducted in the field. Cancer cells are inherently different both metabolically and structurally compared with healthy cells and these differences are manifest in the cell's traits. While there are many types of cancer originating from different sites, the various cancer cells share similar attributes that allow them to be distinguished from normal cells. Thus, biophysical screening enables not only the rapid and cost-effective screening for a cancer, but the simultaneous screening for multiple cancers. Studies range from evaluating the transition time of normal and cancer cells through microfluidic channels, to using sound waves to identify the types of cells that pass through a narrow groove. Other investigations found that the electrical capacitance of normal and cancerous blood differs and that the properties of normal and cancerous cells are distinct when scanned with light in the near-infrared spectral range.

The push for new methods to detect cancer with a high degree of accuracy is justifiable. While there has been some progress with cancer diagnostics and early detection over the last decades, it has been slow. According to the National Cancer Institute (NCI), due to false positives, screening can not only be ineffective but also harmful when there is low selectivity and specificity. For women age 50 to 59, the NCI finds that more than 1,300 mammography screens are required to save one life. For some cancers, including pancreatic and ovarian, early detection is almost non-existent. Pancreatic cancer is difficult to detect early as the organ is deep in the body and disease is frequently asymptomatic until it has metastasized. There are no general screening tests for pancreatic cancer, but for high risk individuals, an endoscopic ultrasound or MRI may be run. Initial symptoms of ovarian cancer such as bloating, indigestion, pelvic pain and nausea can be attributed to a number of other causes besides cancer. Due to the lack of early detection tools, ovarian cancer frequently progresses to an advanced stage when it is no longer possible to surgically remove the entire tumor. According to the American Cancer Society, despite the existence of two tests[23] for ovarian cancer screening, neither of them provides a high degree of accuracy. These examples highlight the need for alternate approaches that are corroborated by extensive research. As we conducted our literature review to identify alternative approaches, we found a trove of research supporting the use of biophysical properties in identifying cancerous markers in blood.

In "A Brief Review of the Biophysical Hallmarks of Metastatic Cancer Cells,"[24] Zhang *et al.* found that there are abnormalities in the elastic properties of cells that are associated with disease and its progression. Cellular deformability is greater in metastatic cancer cells, which gives them the ability to invade the basal membrane and endothelial layer. In order to metastasize, tumor cells require a highly contorted cytoskeleton, a characteristic that serves as a biophysical marker for spreading cancer. In one instance, metastatic cancer cells isolated from pleural fluids of breast cancer patients were measured and found to be mechanically stiffer than benign cells. These studies used microfluidics to screen the cells, a process that records transition time and velocity of a cell passing through a microfluidic channel.

Another article titled "Biomechanics and Biophysics of Cancer Cells"[25] also focused on the structural abnormalities of cancer cells. Author Suresh noted that defects in the structure of the cytoskeleton influence disease, including cancer. The increased deformability of cancer cells allows them to leave the tumor and invade surrounding tissue. To achieve this, cancer cells must traverse fibers of the extracellular matrix and pass through micrometer-scale gaps or pores. The cell's reduced structural rigidity compared to non-metastatic cells allows them to more easily spread. This has prompted the development of biophysical probes to identify the mechanical properties of cancer cells including atomic force microscopy (AFM), magnetic twisting cytometry (MTC) and instrumented depth-sensing indentation methods.

Circulating tumor cells (CTCs) are frequently a target of cancer screening assays. These cells are the embodiment of metastasis, traveling through the blood to distant locations within the body, and have specific physical characteristics that are distinct from accompanying blood cells such as larger size and lower deformability. These characteristics allow for CTCs to be identified through processes that can measure these attributes such as

[23] The two screens for ovarian cancer are the transvaginal ultrasound (TVUS) which is unable to determine if a mass is cancer or benign and the CA-125 blood test; however, its association with ovarian cancer is weak.
[24] Zhang, W., *et al.* A Brief Review of the Biophysical Hallmarks of Metastatic Cancer Cells. Cancer Hallm. 2013 Aug-Dec; 1(2-3): 59–66.
[25] Suresh, Subra. Biomechanics and biophysics of cancer cells. Acta Biomater. 2007 Jul; 3(4): 413–438.

microfiltration.[26] In a review article published in BioMed Research International, CTCs show several distinctive characteristics relative to normal cells such as greater nuclear to cytoplasmic ratio, larger size, and distinct nuclear morphology.[27] Several approaches have been used to identify the biophysical state of CTCs including measure of hydrodynamic stretching, the use of an optofluidic laser for cell stretching, magnetic twisting cytometry, micropipette aspiration and atomic force microscopy.[28]

Acoustic properties of cells can indicate whether or not a cell is normal or cancerous. Researchers at Duke University, Lund University and MIT used an ultrasound technique on blood flow past a sensor. The scientists forced cell solutions through a micro-channel inside a chip. The acoustic field was then applied and able to separate the cells and identify the characteristics of the cells that passed through a channel. The group found that cancer cells cultured in the lab had different acoustic properties compared with healthy cells.[29] Other work has found that the electrical capacitance of normal and cancerous blood is different.[30,31] Blood samples that were tested in pediatric hematological cancers had higher values of capacitance when compared to normal samples. The optical properties of cancer cells have also been explored using visible and near-infrared spectrum in a skin cancer model. Light scatters differently when directed at cancerous compared to healthy tissue.[32] The small study conducted in Boston, Massachusetts provided many examples of a statistically significant difference in light scattering at specific wavelengths between healthy tissue and cancerous tissue. Researchers have also developed an optical probe that is able to detect precancerous and early cancer changes in cell rich epithelia[33] and optical spectroscopy has been used to diagnose cancer in patients undergoing endoscopy.[34]

This is but a brief sample of the research done in cancer biophysics. AnPac and its founding executives have realized the utility of this approach and are continuing to refine the platform to fill an unmet need for accurate, inexpensive and rapid cancer screening that can improve time to treatment and improve outcomes.

AnPac Bio-Medical Science

AnPac Bio was launched at the start of 2010 by founders Chris Yu, Ph.D. and Herbert Yu, Ph.D. who began conducting research and development around the creation of a new machine which could screen for and detect various cancer types based on biophysical properties. The company was founded upon the goal of improving the ability to accurately screen for cancer, which has become one of the most pervasive diseases in the world lacking an effective early detection approach. Despite an early desire to be a physician and coming from a family of doctors, Dr. Chris Yu earned a Ph.D. in physics and had worked for many years in the semiconductor industry for well-known companies such as Micron Technology and Motorola. Even though he advanced the leading edge of chemical mechanical processing in the semiconductor industry, Dr. Yu maintained his interest in using his knowledge to improve health. After a meeting with Dr. Herbert Yu, a professor at Yale's school of medicine, the two experts discussed the opportunities and shortcomings in early disease detection. Dr. Herbert Yu had been working to find a way to successfully detect cancer at its earliest stages, a problem that no one had been able to solve. Chris felt that he could use his background in physics and weak signal processing and detection to identify a solution. The duo teamed up and developed a new technology employing integrated circuits to fabricate highly sensitive transducers able to detect a biophysical signal in blood.

Early work by the two Ph.D.'s found that there was a statistically significant difference between cancer patients' blood and that of normal individuals. Their efforts expanded research into many different cancer types and found continued success at a much lower cost than other diagnostic approaches even in pre-cancer and prior to Stage I conditions. Retrospective studies were run and new employees were hired but instead of adding individuals from the health care space, the group added professionals from the semiconductor industry. Various approaches were tested against blood samples, including acoustical, optical and electrical properties.

[26] Zinggeler, M., Brandstetter, T. & Rühe, J. Biophysical Insights on the Enrichment of Cancer Cells from Whole Blood by (Affinity) Filtration. Sci Rep 9, 1246 (2019). https://doi.org/10.1038/s41598-018-37541-3
[27] Low, W.S., Abas, W., Benchtop Technologies for Circulating Tumor Cells Separation Based on Biophysical Properties. BioMed Research International, Volume 2015.
[28] Che, J., *et al.* Biophysical isolation and identification of circulating tumor cells. Lab Chip. 2017 Apr 11; 17(8): 1452–1461.
[29] Pham, Xuan. Acoustic Properties May Reveal Cancer Cell's Identity. May 18, 2016.
[30] Ghanbarzadeh-Daghian, A. *et al.* Quick, Single-Frequency Dielectric Characterization of Blood Samples of Pediatric Cancer Patients by a Cylindrical Capacitor: Pilot Study. Electronics 2020, 9(1), 95; https://doi.org/10.3390/electronics9010095
[31] Gascoyne, P., *et al.* Dielectrophoretic Separation of Cancer Cells from Blood. IEEE Trans Ind Appl. 1997; 33(3): 670–678. doi: 10.1109/28.585856
[32] Salomatina, E. *et al.* Optical properties of normal and cancerous human skin in the visible and near-infrared spectral range. Journal of Biomedical Optics 1.16, 064026 November/December 2006
[33] Vackman, V. *et al.* Detection of Preinvasive Cancer Cells. Early-Warning Changes in Precancerous Epithelial Cells Can Now be Spotted In Situ. Nature, 406, Pp. 35-36 (2000).
[34] Badizadegan, Kamran, *et al.* Spectroscopic Diagnosis and Imaging of Invisible Pre-Cancer. 2004;126:265-79; discussion 303-11. doi: 10.1039/b305410a.

Beginning in 2011 a number of R&D, manufacturing and marketing subsidiaries were created. By the end of 2015, AnPac had commercialized tests in China and created a subsidiary in the United States to conduct research and clinical studies in the US market. The research performed in the US and Chinese institutions would later be presented at the American Society of Clinical Oncology (ASCO) annual meetings and other conferences. Since 2015, more than 140,000 blood samples have been tested split between CDA testing and research studies.

CDA Device and Test

AnPac developed its Cancer Differentiation Analysis (CDA) technology in the first years after its foundation and performed the first commercial CDA test in China in 2015. The unit consists of a blood sample unit, a sample transport unit, a sample mixing chamber, a testing unit and a data storage unit. The machine employs a microfluidic device consisting of micro channels, micro sensors and measurement instruments with automated data recording capabilities. It is connected to a fluid delivery line inside the testing unit. When the sample enters the micro-channels of the microfluidic device, it is probed and analyzed to measure the desired parameters. Results are measured over discrete units of time and further analyzed by Anpac's proprietary algorithm.

Exhibit IV – CDA Device[35]



After the test has run, the CDA value is generated along with the protein tumor factor (PTF) and the cell tumor factor (CTF). These two outputs measure changes in protein and cell properties in the blood, respectively.

Validation

The CDA technology is a blood-based diagnostic that relies on biophysical properties of blood to determine cancer risk. Retrospective studies were conducted that were able to determine a correlation between biophysical properties and cancer occurrence. The change in biophysical properties over time is a potential symptom of the loss of immunity and increased likelihood of cancer. AnPac conducted a number of retrospective studies that examined the ability of the CDA technology to accurately determine the likelihood of cancer. There were 25 studies that were conducted with hospitals and medical institutes in China and over 180,000 blood samples were evaluated. Several of these studies have been presented at American Society of Clinical Oncology conferences including the breast cancer prognosis and lung cancer prognosis study.

AnPac's breast cancer study[36] evaluated 426 samples divided into a control and breast cancer group. Blood samples were taken and then measured using the CDA medical device. Output from the study generated a CDA

[35] Source: AnPac Corporate Presentation, November 2019

mean result of 34.03 with a standard deviation of 7.65 for control patients while the breast cancer group generated an output of 50.84 with a standard deviation of 9.69. The result indicated that breast cancer could be significantly distinguished from the control with a p-value of less than 0.001.

The non-small cell lung cancer (NSCLC) screening study evaluated 635 samples divided into three groups: a control group, a non-cancerous disease group and a NSCLC group. Whole blood was collected and analyzed by the CDA device generating output broken down by group. Test results were significantly distinguishable among each of the groups at better than the 5% level of significance. Sensitivity and specificity were calculated at 87.7% and 79.9% respectively.

Additional studies for hepatocellular carcinoma, esophageal cancer, breast cancer and others were conducted generating statistically significant results between the control and cancer group. AnPac has completed a number of studies regarding the accuracy of the CDA technology in partnership with Chinese hospitals and medical institutes. Results have been published at ASCO meetings and other medical conferences in China and the United States. There are an additional ten unpublished studies, the results of which are presented below along with the results for the published studies. Over 42,300 samples were used to generate the results. Below we provide a summary of studies that were conducted and include the calculated sensitivity and specificity for the tests.

Exhibit V – Research Studies[37]

Cancer Type	Sample Size	Sensitivity	Specificity	Publication/Presentation
Lung	2,277	82.4%	83.0%	ASCO
Cerebral	93	89.2%	89.9%	ASCO
Nasopharyngeal	188	86.6%	89.1%	
Oral	60	78.3%	90.8%	
Laryngeal	61	93.4%	88.0%	
Thyroid	39	100.0%	83.6%	
Esophageal	2,253	85.8%	93.0%	ASCO
Lymphoma	528	87.1%	92.4%	
Breast	493	74.6%	92.2%	San Antonio BC Symposium
Liver	804	92.3%	93.2%	ASCO
Bile Duct	26	87.5%	94.0%	
Gallbladder	28	100.0%	63.4%	
Pancreatic	162	89.3%	90.6%	
Gastric	1,438	88.7%	93.8%	
Kidney	55	88.9%	77.7%	
Bladder	29	72.4%	88.3%	
Colon	884	89.4%	91.2%	ASCO
Rectum	653	89.2%	88.0%	
Duodenal	32	84.4%	87.5%	
Prostatic	46	90.7%	93.2%	
Cervical	401	87.0%	90.2%	Shenzhen New Horizons
Ovarian	474	90.5%	90.1%	
Uterine	164	87.2%	92.3%	
Leukemia	196	77.6%	88.0%	
Bone	12	91.7%	91.0%	
Skin	18	88.9%	93.7%	

[36] Tao, H. *et al.* Investigations of Breast Cancer Screening Using a Novel in vitro Diagnostics Technology. J Clin Oncol 33, 2015 (suppl 28S; abstr 13)
[37] Source: AnPac corporate filings and author's work.

Diagnostic Test Regulation (US & China) and Marketing Strategy

AnPac is targeting both the Chinese and US markets, and the regulatory paths are unique in each market. In the US, AnPac will first pursue the Laboratory Diagnostic Test (LDT) designation for its CDA tests. The LDT designation, subject to FDA discretion, has been lightly regulated, making it a relatively unobstructed pathway to market for diagnostic tests. In China, medical devices, including diagnostic tests, are regulated by the China Food and Drug Administration. Though the FDA and CFDA share similarities, regulation of diagnostic tests in China, especially for serious conditions like cancer, is highly regulated. There are expedited pathways for devices deemed 'innovative' or 'priority,' though they maintain rigor in evaluation and approval.

Overview of US Diagnostic Test Regulation

Diagnostic testing apparatus are considered medical devices. Medical devices are regulated, in the US, by the FDA; within diagnostic tests there are two primary classifications: *In Vitro* Diagnostic (IVD) product and Lab Developed Test (LDT). The classification depends on how the tests are marketed. If the testing device was designed, made and used within a single laboratory, the device qualifies as an LDT. If the testing device, itself, is marketed to hospitals, clinics or the end user, it is considered an IVD. IVDs, like other medical devices, are assigned a class proportionate to their risk, and are subject to FDA requirements.[38] The Clinical Laboratory Improvement Amendments (CLIA) accredit the laboratories that use or conduct these diagnostic tests.

LDT

The LDT route to market is practically immediate, and does not require premarket approval. LDTs have been minimally regulated once on the market, though this could change. When they first emerged, LDTs were simple, standard tests ubiquitous in hospitals. As time has passed, LDTs have evolved in risk and complexity and the original intent of the designation is seen at odds with the present state of the industry. While the testing devices are regulated by the FDA, the laboratories that use them are regulated by the Centers for Medicare & Medicaid Services (CMS) under the CLIA. Labs that offer LDT-qualifying diagnostic tests must be CLIA certified.

CLIA

When the Medical Device Amendments Act was passed in 1976, many hospitals, which were already conducting routine in-house diagnostic tests, found the new oversight excessive.[39] In response, the CLIA were passed in 1988, refining regulatory standards.[40,41] Under the new standards, laboratories could apply for a CLIA license that would exempt their testing from IVD regulatory approval.[42] In August 2020, the Philadelphia lab received CLIA certification.

CAP

There may be instances when a lab may seek accreditation beyond CLIA. CAP, or the College of American Pathologists, has its own accreditation program that is internationally recognized and features a unique peer-based lab inspection. While this may seem counterintuitive, CAP hopes to establish a non-punitive, and mutually beneficial laboratory community, where best practices can rapidly exchange. Similar to CLIA, CAP inspections are biennial. The San Jose lab received CAP accreditation in March 2020.

FDA

The FDA, under the Food, Drug & Cosmetic Act, provides regulatory oversight for all medical devices in the US. LDTs, which are considered medical devices, are defined as diagnostic tests "designed, performed and used within a single laboratory."[43] The FDA has historically not enforced premarket review for LDTs, and oversight has been minimal.[44] As tests have grown more complex, more widespread and address life-threatening conditions, the risk profile has changed, and the FDA's minimal LDT oversight has recently come under scrutiny.[45] Furthermore, the FDA has identified dangerous tests that were inadequately supported with evidence, poor controls, or had falsified data. While in 2010, the FDA announced its intent to revisit its enforcement and in 2014 and 2017, published and revised draft guidance, nothing formal or enforceable has been issued.[46]

[38] https://www.fda.gov/medical-devices/ivd-regulatory-assistance/overview-ivd-regulation#2
[39] Mamuszka H. 2019. The Neverending LDT vs IVD Debate. *Journ of Prec. Med.* 43-46
[40] Mamuszka H. 2019. The Neverending LDT vs IVD Debate. *Journ of Prec. Med.* 43-46
[41] https://www.acponline.org/system/files/documents/running_practice/mle/clia-and-your-lab.pdf
[42] Mamuszka H. 2019. The Neverending LDT vs IVD Debate. *Journ of Prec. Med.* 43-46
[43] Mamuszka H. 2019. The Neverending LDT vs IVD Debate. *Journ of Prec. Med.* 43-46
[44] https://www.fda.gov/medical-devices/vitro-diagnostics/laboratory-developed-tests
[45] https://www.fda.gov/medical-devices/vitro-diagnostics/laboratory-developed-tests
[46] https://www.fda.gov/medical-devices/vitro-diagnostics/laboratory-developed-tests

If a diagnostic test, such as AnPac's CDA, fails to qualify as an LDT, it must undergo other, more stringent requirements before marketing rights are granted. AnPac expects to commercialize the CDA testing equipment itself to hospital laboratories across the nation, as demand grows for the CDA tests, which will require elevated regulatory approval.

Medical devices include everything from hip implants to bandages. There is a spectrum of risks across these devices, and the FDA has classified them in Class I, Class II, and Class III categories. Diagnostic test safety and class are evaluated in terms of the test's accuracy.

PMA

By far, the most stringent, lengthy and capital-intensive approval process for medical devices is the premarket approval[47] (PMA). If a device (typically Class III) is first-in-class, and there are no other devices that have preceded it that have already been granted marketing approval, then the device must substantiate its safety and efficacy. This often involves human trials, which are a considerable undertaking. *In Vitro* Diagnostic tests, without precedent also require clinical trials to demonstrate test accuracy. Devices not found substantially equivalent to Class I or Class II predicates were classified as Class III until 1997 when the FDA Modernization Act (FDAMA) established *de novo* classification. Under *de novo* classification, the device with no predicate will be assigned the appropriate class, rather than be automatically assigned to the highest risk class.[48] After the FDA Safety and Innovation Act (FDASIA) passed in 2012, devices could submit *de novo* requests without first filing a 510(k).[49] Not all devices require a PMA depending on the level of risk they pose, and Class I and Class II rarely require PMA.

510(k)

To avoid the time and expense associated with a PMA, most will apply for 510(k) market approval. The 510(k) permits an accelerated path to market that depends on whether the medical device under consideration is found to be substantially equivalent to one or more already legally marketed devices (predicate).[50] If a substantially equivalent predicate is not identified, the FDA will inform that a PMA is required.[51,52] Some devices are exempt under the Food, Drug and Cosmetic Act.[53]

To apply for 510(k) market approval, a premarket notification must be submitted at least 90 days before introduction of the device to the market. Certain device requirements may be less stringent and may be eligible for either a Special 510(k) or Abbreviated 510(k), which can include a breakthrough designation.[54] The notification is sent to the appropriate oversight entity which in the case of devices is the Center for Devices and Radiological Health.[55]

The FDA will review the premarket notification, and after review, will decide whether the device is substantially equivalent or will request additional information. The device is considered substantially equivalent if it is intended to be used in the same way, and shares the same underlying technology as its predicate. If there are any differences between the device under consideration and the predicate, the differences must not raise questions of safety and effectiveness. In cases where the differences are significant, the applicant may use 'reference devices', which differ from predicates and the device under consideration, but can still provide evidence for the safety and efficacy of the new device.[56] The predicate may have been legally marketed prior to May 28, 1976, classified down from Class III to Class II/I, or, itself, was found substantially equivalent through the 510(k) process.[57] The order, declaring the device substantially equivalent is marketing approval.[58]

AnPac will begin marketing the CDA tests in the US under the LDT designation which will allow AnPac to begin selling only in-house CDA tests from a central laboratory. Due to the direct path to market and low regulatory burden, the LDT designation would allow AnPac to grow into the US market with low risk and minimal upfront investment. This approach allows the company time to generate cashflow to support scaling efforts later via more stringent regulatory pathways. As market traction is gained, demand for tests grows beyond the capacity of in-house testing and with FDA approval the tests can be marketed more broadly.

[47] https://www.fda.gov/medical-devices/premarket-submissions/premarket-approval-pma
[48] https://www.fda.gov/files/about%20fda/published/CDRH-Learn---De-Novo-Program.pdf
[49] https://www.fda.gov/files/about%20fda/published/CDRH-Learn---De-Novo-Program.pdf
[50] https://www.fda.gov/medical-devices/premarket-submissions/premarket-notification-510k
[51] https://www.fda.gov/medical-devices/premarket-submissions/premarket-notification-510k
[52] https://www.fda.gov/files/about%20fda/published/CDRH-Learn---De-Novo-Program.pdf
[53] https://www.fda.gov/medical-devices/premarket-submissions/premarket-notification-510k
[54] https://www.fda.gov/medical-devices/premarket-notification-510k/510k-submission-programs
[55] https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=807&showFR=1&subpartNode=21:8.0.1.1.5.5
[56] https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=807&showFR=1&subpartNode=21:8.0.1.1.5.5
[57] https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=807&showFR=1&subpartNode=21:8.0.1.1.5.5
[58] https://www.fda.gov/medical-devices/premarket-notification-510k/510k-submission-process

Overview of China Diagnostic Test Regulation

China's medical device and IVD landscape continues to evolve and innovate. The National Medical Products Administration (NMPA) has made special accommodations to expedite the approval of "innovative" and "priority" medical devices. AnPac management is pursuing expedited approval in the Chinese market. Class III approval, expedited or not, would allow AnPac to place its CDA equipment in Chinese hospitals, where an estimated 100 million Chinese citizens go for their annual physical checkups every year.[59]

According to the NMPA, medical devices are defined as instruments, equipment, appliances, IVD, materials or other items that are used directly or indirectly on the human body, including software.[60]

Innovative Pathway
In February 2014, the Chinese government issued CFDA Order [2014] No. 13, defining special procedures for the special examination of "innovative" medical devices. Under these special procedures, certain medical devices would be eligible for prioritized evaluation and approval, expediting their path to market. In the US market, this process would be analogous to that outlined in the 510(k).

Qualification for the Green Channel begins with the possession of either a patent or license or the preliminary approval for a patent application for the innovative technology. The patent must be registered with the China Patent Office. The product must be technically advanced, and be the first of its kind in the Chinese market and must have significant clinical value, improve functionality or safety when compared to predicate devices and must be used in a manner consistent with the application scope defined in the patent. Qualification also includes stipulations related to production of the prototype and records of the design process.

The process begins with the preparation of the application, which can take from three to six months. The application includes a qualification certificate, statement of rights to intellectual property, overview of product research and design, technical documentation, certification of product innovation, risk management report and instructions for use. Product research and design overview detail manufacturing and efficacy of the product. Technical documentation includes manufacturing, performance specifications, and product clinical validation data. Certification of product innovation involves a self-search for predicates or comparable products, survey of the literature and substantiation of clinical value. The application is submitted to the CMDE Innovative Medical Device Review Office where they will be accepted, and subject to review by a panel of experts selected by the Office. Altogether, the technical review process can take approximately 45 days. The result is published on the CMDE website, subject to contest from the public for a 10-day period, after which, if there is no comment, the review result will be released to the applicant.

Priority Pathway
In August 2016, the CFDA proposed an updated priority review pathway for priority medical devices with breakthrough technologies that went into effect January 1, 2017.[61] The Priority Pathway differs from the Innovative Pathway in that the Priority Pathway explicitly prioritizes select therapeutic classes, such as those related to oncology, whereas the Innovative pathway incents first-in-class medical technology in general. Both are referred to as the Green Channel. The Priority Pathway was built upon the State Council's Opinion on Reform of the Drug and Medical Device Approval System released in August 2015. Class III medical devices are eligible to request priority review status if they are called in "Scientific and Technology Major Projects" and "Key Research & Development Plans," two lists that are a part of China's national science and technology initiative. If the technology targets oncology or rare diseases and offers a significant advantage over existing technologies, or answers an unmet clinical need for which no approved alternative exists, subject to CFDA discretion. Class II devices are eligible as well, but only for imported devices.

AnPac's CDA technology is both innovative and targets oncology, potentially qualifying it for either Innovative or Priority Pathways. If unapproved for either expedited pathway, AnPac will still need to apply for Class III approval, but the timeline may be significantly extended. Application and approval will still be through the CFDA, subject to CMDE evaluation, which can take around 12-18 months if CMDE review does not produce additional requirements. In contrast, an expedited pathway may take as little as five months. AnPac applied for CFDA Class III in 2019.

[59] https://www.chinadaily.com.cn/life/2012-11/14/content_15926380.htm
[60] https://globalregulatorypartners.com/countries/asia/china-national-national-medical-products-administration-nmpa/
[61] https://globalregulatorypartners.com/china-to-offer-priority-review-for-medical-devices-from-january-2017/

Facilities

AnPac maintains several facilities where CDA tests are conducted in China and the US. The first site opened was the biomedical clinical laboratory in Lishui, Zhejiang Province in China. This is the company's principal location and where the commercial CDA tests, combination tests and other immunological and biochemical tests are performed. The second laboratory in China is in Haikou, Hainan Province. This is a licensed genomics lab where sequencing is performed. The third Chinese location is the research and development center located in Shanghai. The next generation cancer screening and detection technology tests are created here. Other locations are in the United States. AnPac maintains a licensed clinical laboratory in San Jose, California which is equipped to conduct CDA and biochemical tests. In the near term the facilities will be used for prospective studies to obtain approval and validation for the CDA tests and for validating COVID-19 antibody tests using Roche's Cobas e411 machine. The lab has obtained a Certificate of Registration under the Clinical Laboratory Improvement Amendments (CLIA) and plans to enter into agreements with universities, academic medical centers, hospitals medical institutions and contract research organizations to conduct studies on CDA technology. The San Jose lab received CAP accreditation in March 2020. The newest clinical laboratory in Philadelphia, Pennsylvania was opened in the second quarter of 2020 and commenced operations in August, shortly after receiving CLIA lab certification. The lab is conducting COVID-19 antibody tests after receiving first phase equipment installation. It is awaiting the delivery of CDA machines and is partially staffed. The facility has applied for the Pennsylvania state lab permit and will seek CAP accreditation.

Exhibit VI - Summary of Laboratory Locations and Functions[62]

Laboratory	City	Function
Primary Lab	Lishui, China	CDA tests & device assembly
Secondary Lab	Haikou, China	Gene sequencing tests
R&D Center	Shanghai, China	R&D for new tests
US Lab, operating	San Jose, California	Research, CDA & Biochemical tests
US Lab, planned	Philadelphia, Pennsylvania	CDA tests / R&D

Current and Future Product Offerings

In addition to the current cancer screening offering, based on clinical studies, AnPac's CDA technology is also capable of assisting diagnosis, monitoring recurrence and guiding therapy selection, all of which can be offered by AnPac in the future and in different geographies. The CDA test can evaluate an individual's risk of cancer and also be used in conjunction with cancer treatment to monitor remission and the effectiveness of therapy.

Screening

CDA's foremost intended use is for screening the general population, especially for individuals who present risk factors for cancer. For the patient, a simple blood draw is required to conduct the test. It is a minimally invasive, side-effect free and automated procedure. After the sample is run through the CDA machine and the data analyzed, PTF, CTF and overall CDA numbers are generated. Certain cut off values have been determined to categorize the results as low risk (healthy), medium risk and high risk. The test does not determine the specific type of cancer that an individual may have. If patients present a medium or high risk from the screening, they are referred for follow up medical examinations. AnPac also offers combination tests that include other biomarker-based screening and detection tests from third parties. The CDA test provides the risk of cancer while the biomarkers identify the type of cancer. The results from the combination tests are evaluated by AnPac which can show which cancer types the patient may present.

AnPac offers seven standardized tests which can be combined with cancer positioning services. Generally, the more information a test can provide, the higher the price. The most popular test now offered in China evaluates for six different cancers including lung, liver, stomach and colon for both sexes and rectal and prostate for men and breast and ovarian for women.

Assisting Diagnosis, Prognosis and Recurrence

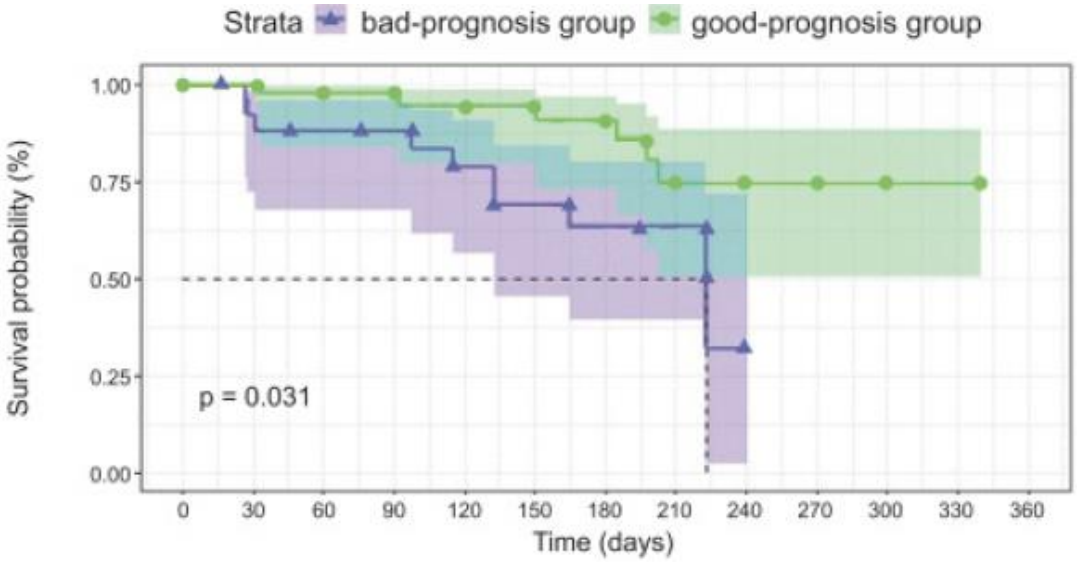
Another practical use for CDA technology is in diagnosing cancer. Current diagnosis involves inputs from the patient, from the doctor and from a variety of diagnostic tests, such as tissue biopsy, imaging or endoscopy. These

[62] Source: Company filings and author's own work.

procedures can be guided or augmented by blood-based biomarkers that provide complementary information. AnPac has developed this vertical by collaborating with third-party oncologists and hospitals, providing data that has been published and presented at ASCO meetings.

The utility of the CDA test also comes into play assessing a patient's response to cancer treatment. The test is an affordable and convenient approach to measure treatment progression, make adjustments to treatment in real time and monitor recurrence. AnPac has advanced research in this area as well, performing a breast cancer study that evaluated the progress of three patients. It was able to follow their post-operative status and identify the effectiveness of treatment. Another study evaluated lung cancer patients at the Shanghai Changhai Hospital and divided patients into good and bad prognosis groups. AnPac's group categorization was able to predict which group had the better survival rate in a statistically significant and meaningful manner.

Exhibit VII – Lung Cancer Progression Free Survival Predicted by CDA Technology[63]



Other studies have also been conducted to identify when a patient's remission ended and when cancer treatment was effective based on the overall CDA, PTF and CTF values.

Genetic Testing

AnPac is expanding its customer base in China by offering genomic testing in addition to the core CDA test. In November 2017, the company acquired Shiji Hainan along with its Haikou-based laboratory. The genetic tests that take place at this subsidiary are for targeted therapy selection and pharmacogenomics and genomics based testing. This vertical has the potential to customize treatment by tumor classification and can guide personalized medicine in surgery constrained situations.

Key Events

- IPO on NASDAQ – January 2020
- Addition of new insurance customers – February 2020
- San Jose lab CAP Accreditation – March 2020
- Philadelphia lab opening – 2Q:20
- Philadelphia lab CLIA Lab Certification – August 2020
- New contract with Beijing Yuan Jian Health Management – June 2020
- Filing of various patent applications in the US - 2020
- Launch of prospective studies in the US – 2020
- Class III Medical Device Registration Certificate – December 2021

[63] AnPac Form F-1, October 31, 2019.

RISKS

AnPac faces many risks including regulatory, country, political, and financial among others. Obtaining the proper clearances, certifications and qualifications for medical devices and laboratories is an extended process and not guaranteed to result in approval. Legal frameworks and government actions can raise barriers and tariffs that can delay projects and increase costs. High development costs and multi-year periods before anticipated profitability place a company at the mercy of capital which may dilute early shareholders.

In China it can take up to three years to receive a required Class III medical device registration certificate from the authorities so that commercial tests can be conducted in Chinese hospitals. In the United States, a lab developed test may be marketed only after certification of the laboratory under CLIA. There are also state-based accreditation requirements that are required for tests to be conducted in that region.

FDA or other governmental regulatory approvals are required for most devices before they can be legally marketed. Substantial expense is required to advance a device through the PMA or 510(k) submission process which can take from months to years to accomplish depending on the complexity of the requirements. Companies that have had previous success with the FDA or other regulatory agencies are in a more favorable position than those that may be new to the process.

Assuming devices and tests are cleared by the necessary agencies, commercialization is another rough sea that requires navigational skill. Hiring a sales force is expensive and costs are upfront. Success relies on distributors and sales representatives, many of which are outside the control of the company. AnPac must additionally develop confidence in the accuracy and validity of its screening tool.

Even under a scenario of growing revenues, emerging companies need to invest in many areas to continue their trajectory. This requires funding which may be difficult to secure. Access to financing comes and goes in cycles. During periods of improving confidence, capital may be easy to access; however, during a liquidity crisis or a period of heightened risk perception, even companies with bright prospects may be in trouble if they are dependent on the financial markets to fund their growth. If capital is needed to sustain the company and it is not readily available, it may be forced to suspend operations, sell equity at a substantial discount to previous valuations and dilute earlier shareholders. A lack of funding may leave potentially promising products without a viable route to move forward or force a company to accept onerous terms.

AnPac differs from its competitors by measuring the biophysical properties of cells in the blood rather than identifying analytes. While it is a new and differentiated approach to cancer detection and results have been confirmed experimentally, it is still unproven in the marketplace. The versatility of biophysical sensing provides tremendous utility and the approach is simpler, faster and cheaper compared to sequencing. Despite CDA's advantages, it is difficult to predict if the technology will achieve mainstream acceptance.

AnPac has only generated revenues in China from the sale of blood tests performed in AnPac's own laboratories. Soon, it hopes to obtain Class III medical device registration so services may be available in Chinese hospitals. However, even if the registration is granted, hospitals and patients may not demand these services. All hospitals in China are controlled by the government which introduces a political element to success. AnPac also hopes to validate and commercialize its CDA tests in the United States which is a new market where it has little experience.

The most recent threat to Anpac's operations has been the coronavirus outbreak. A rapidly slowing economy, restricted face-to-face interaction, delays in conducting new clinical trials and heightened risk-aversion from investors will likely have a negative impact on revenue growth.

AnPac has experienced a deceleration in topline revenues as a result of delays in routine cancer screenings and annual wellness checks. The lack of revenue expansion, continued cash-burn, and uncertainty in capital markets may threaten AnPac's liquidity. Additionally, AnPac's ability to collect blood samples in China was interrupted when the Chinese government closed collection points across the country. AnPac relies on these samples to conduct its analysis and continue to strengthen and prove its CDA platform. As of July 2020, it appears that China has largely resumed normal day-to-day activities after locking down; the risk still remains that there could be a resurgence of coronavirus in China.

AnPac must collect sufficient data and provide strong enough results to establish a reputation with the US medical community and gain LDT approval. The blood samples that provide the basis for AnPac's data require in-person,

face-to-face contact with a phlebotomist to collect, which may be limited due to the coronavirus. Most US hospitals have prioritized their intensive care in response to the pandemic, even at the expense of many revenue-generating non-emergency operations. We anticipate a slow start to the blood sample collection effort in 1H:20.

Aside from the immediate threat from the pandemic, AnPac also faces risks related to its operations in China. AnPac is currently unable to market its tests to its largest target market: hospitals. AnPac has applied for an NMPA Class III medical device registration certificate which would allow entry into Chinese hospitals. Though management is actively pursuing China's expedited regulatory approval pathways, it expects the award of the certificate to take at least three years and there is still risk that the certificate is not granted. Following the receipt of the certificate, AnPac still must successfully market the devices to hospitals.

Operating in China is subject to regulation, not only regarding the CDA device, but the company itself. AnPac is required to keep up-to-date on its licenses from the National Health Commission in order to continue operations. AnPac is an off-shore holding company incorporated in the British Virgin Islands. China currently has, to varying degrees of enforcement, laws associated with Foreign Investment (FIL), taxation (EIT), and foreign exchange (SAFE) that could affect AnPac's ability to manage capital and earnings.

The primary risks AnPac faces in the US relate to the acquisition of clinical data, establishing a favorable reputation in the US medical community, and pursuit of the LDT designation. As AnPac builds its US market credibility, its success will depend on demonstrating the accuracy of the CDA technology and successfully marketing the product to health plans, providers and other payors. The impact of the pandemic has disrupted AnPac's efforts to conduct the studies, acquire clinical trial samples and remain on-track to commercialize its tests in the United States.

Historically, the FDA has not actively enforced its regulatory requirements for LDT tests. However, as a result of the increasing risk of some diagnostic tests, in 2014, the FDA announced its intent to revise its oversight of LDTs. Since then, the FDA has not yet finalized its revision. However, the FDA may update regulations, requiring AnPac to expend considerable resources to comply. Even without revision, LDT oversight is subject to FDA discretion, which means they can decide that the CDA tests are not LDTs and require additional steps for approval.

The current geopolitical climate presents significant risks. Tensions between US and China have increased in recent years leading to trade and capital flow disruptions. These tensions persist and are even exacerbated by the pandemic. There has also been an increase in government action against business executives which may reduce or halt travel between the countries. Tariffs have been placed on Chinese goods and may impact the cost of CDA machines shipped to the United States.

While we have discussed a broad variety of risks above, we believe that our forecast parameters, discount rates, success probabilities and valuation metrics address these eventualities and our target price reflects an assumption of these risks faced by AnPac and others in the diagnostics industry.

PEERS AND COMPETITORS

The cancer screening and diagnostic market is large and growing with an estimated $144 billion in 2018 global sales.[64] The space is composed of a variety of testing subtypes including laboratory tests, genetic tests, imaging, endoscopy, biopsy and others. The market is moving from clinical testing towards more advanced approaches such as molecular diagnostics and point of care testing that provide results with greater speed and accuracy. The goal is to continue to improve the speed and accuracy and provide local, inexpensive, and minimally-invasive cancer blood-diagnostics that can help providers target their treatments.

Many public and private companies, often emerging from academic research groups, have joined the effort and include blood (or other fluid) diagnostics for cancer. These liquid biopsies generally involve the ultra-sensitive, albeit highly-noisy, detection of analytes in blood. These analytes can include cancer cells such as circulating tumor cells (CTCs) or unique biomarkers including proteins, exosomes, genetic material and epigenetic modification. Each analyte requires a specific technique to detect. For example, some techniques may leverage the analytes' spectroscopic properties, while genetic material may be amplified and sequenced.

There are several categories of cancer detection and diagnosis from molecular screening for early cancer detection, to therapy selection and treatment monitoring/relapse management. Companies such as GRAIL and AnPac Bio are focused on the early cancer detection market, while Guardant Health and Foundation Medicine target therapy selection. Natera pursues treatment monitoring and relapse management, a category which may be a future market for AnPac. 2020 has been a busy year for cancer diagnostics. AnPac held its IPO in January followed by ArcherDx, Burning Rock Bio and Genetron, with the latter two also headquartered in China.

AnPac's primary competition is in China, where BGI is a dominant player. Grail, Guardant Health and Exact Sciences target CTCs or genomics such as ctDNA, cfDNA & cfRNA in contrast to biophysical properties of CDA technology, which may make them strong complements given their different approaches. Some of the factors that give an advantage in the space include maturity of technology, market adoption rates, broader test menus, larger test databases and brand recognition. We list a variety of competitors in the diagnostic testing space in both the public and private realm.

Exhibit VIII – Peer and Competing Companies, Private[65]

Company	Therapeutic Area
Accugenomics	NGS and dPCR for ctDNA
Accuragen	Blood tests tracking proteins, circulating DNA, miRNA, etc.
Apostle	cfDNA liquid biopsy
Biodesix	Blood-based lung cancer diagnostics
Biofluidica	Liquid biopsy (CTC, cfDNA) for Acute Myeloid Leukemia
Bluestar Genomics	Epigenomic liquid biopsy
Cadex Genomics	qPCR tracking of patient therapy response
Cellmax Life	Blood test for colorectal cancer
Celsee (Bio-Rad)	CTC isolation and analysis via microfluidics and microwells
Conquerx	Biosensing of DNA, miRNA and proteins, analyzed by AI
Creatv Microtech	Microfilters for enrichment of CTC
Cytogen	CTC based liquid biopsy
Datar Cancer Genetics	CTC and cfDNA liquid biopsy
Elypta	Metabolism-based liquid biopsy
Eutropics Pharmaceuticals	Cancer treatment diagnostics
Exosomics	Tumor exosome based liquid biopsy
Foundation Medicine	Genomic profiling tests for biomarkers & genomic alterations for cancer
Freenome	Multi-analyte liquid biopsy + AI
Genomill Health	NGS and AI for liquid biopsies
GRAIL	Early cancer detection, NGS using cfNA, DNA & RNA

[64] Market Analysis Report, 2018. Grand View Research.
[65] Source analyst work, company reports.

Exhibit VIII (continued) – Peer and Competing Companies, Private[66]

Company	Therapeutic Area
Archer Dx	Molecular products for genomic testing, PCR Chemistry
Inivata	Genomic liquid biopsy.
Lexent Bio	Liquid biopsy theranostics.
Lunglife AI	Lung cancer liquid biopsy and AI.
Massive Genomics	Pan-cancer NGS liquid biopsy.
Menarini Silicon Biosystems	CTC recovery and identification.
Metamark	Urology-centric cancer diagnostics.
mIR Scientific	Liquid biopsy/molecular diag & therapy optimization for urological cancers
NovellusDX	Live-cell based assay to monitor signaling pathways.
nRichDX	High-yield cfDNA, ctDNA and exosomes liquid biopsy.
Nucleix	Epigenetic cancer detection in liquid biopsy.
Oncore Pharma	mRNA based liquid biopsy for breast and colorectal cancer.
Predicine	Genomic based liquid biopsy.
Rarecyte	Cytefinder: Fluorescence microscopy to detect cancer cells
Sysmex Diagnostics	Optics based diagnostic devices.

Exhibit IX – Peer and Competing Companies, Public[67,68]

Ticker	Company	Price	MktCap (MM)	EV	Therapeutic Area
300685.SZ	Amoy Diagnostics	CNY85.20	CNY18,909	CNY18,320	Molecular diagnostic kits for oncology precision medicine.
603658.SS	Autobio Diagnostics	CNY167.86	CNY72,830	CNY73,850	Markets in vitro diagnostic reagents and instruments to medical labs
ADPT	Adaptive Biotech	$49.70	$6,749	$6,179	Offers immunosequencing services to research and clinical customers
AGL.L	ANGLE plc	GBP49.01	GBP84,687	GBP73,330	Circulating tumor cell harvesting technology to researchers
AROC.ST	AroCell AB (publ)	SEK3.31	SEK250	SEK233	Blood-based Thymidine Kinase 1 monitoring in patients with cancer
BD1.AX	BARD1 Life Sci	AUD0.0260	AUD62.3	AUD54.9	Noninvasive diagnostic tests for early detection of cancer.
BIOC	Biocept, Inc.	$4.68	$63	$40	CTC and ctDNA assays utilizing a standard blood sample.
BIOVIC	Biovica International	SEK36.10	SEK1,021	SEK1,020	Blood-based biomarker assays for cancer monitoring
BNR	Burning Rock Bio	$27.49	$2,798	$2,470	NGS cancer detection in China for precision treatment
EPGNF	Epigenomics AG	$0.87	$32	$23	Blood-based DNA methylation test for colorectal cancer detection
EXAS	Exact Sciences	$107.14	$16,089	$16,424	Cancer screening & diagnostics. Cologuard
GH	Guardant Health	$102.74	$10,215	$9,277	Liquid biopsy tests for advanced stage cancer
GTH	Genetron	$11.33	$1,001	$737	Precision oncology for cancer screening, diagnosis & monitoring
IDXG	Interpace Biosci	$3.99	$16	$4	Molecular analysis for early diagnosis and treatment of cancer
MYGN	Myriad Genetics	$13.01	$978	$985	Molecular diagnostics. Sequencing, riskScore, prenatal
NVTA	Invitae Corp	$48.39	$6,377	$6,273	Genetic testing for cancer, cardiology, neurology & other
NTRA	Natera, Inc.	$72.55	$5,796	$5,422	Fertility testing
PRPO	Precipio, Inc.	$2.36	$39	$39	Clinical diagnostic services in hematopoietic or blood-related cancers
PSNL	Personalis, Inc.	$27.84	$888	$782	Sequencing & data analysis services for cancer R&D
RHY.AX	Rhythm Biosciences	AUD0.22	AUD44.3	AUD45.55	Tests for early detection of colorectal cancer.
SZLS.TO	StageZero Life Sci	CAD0.85	CAD41.6	CAD41.1	Molecular diagnostic for early detection of diseases including cancer
TOMDF	Todos Medical Ltd.	$0.06	$12	$17	Infrared based liquid biopsy
VCYT	Veracyte, Inc.	$41.56	$2,102	$1,956	Cancer genomic sequencing
VNRX	VolitionRx Limited	$3.52	$169	$150	Epigenetics-based blood tests for cancer diagnostics
AWH	Aspira Health	$3.68	$383	$373	Blood test for ovarian cancer biomarkers.
ANPC	**AnPac Bio**	**$3.48**	**$42**	**$41**	**Biophysical property cancer screening in China & US**

[66] Source: analyst work, company reports.
[67] Source: analyst work, company reports.
[68] Price and market capitalization data is as of October 19, 2020

MANAGEMENT PROFILES

Dr. Chris Chang Yu, Co-founder, Chairman of the Board and Chief Executive Officer

Dr. Yu has served in his current role since the company's inception in 2010. As the first or principal inventor of more than 300 patent applications spanning semiconductor, materials and life science, he has innovated leading technologies and products during his long and successful career since the 1990s. Dr. Yu developed the CDA technology for cancer screening and detection. He is a member of the ASCO. Prior to founding AnPac, he co-founded Anji Microelectronics (Shanghai) in 2004 which recently IPOed. Dr. Yu served as a technical director at Semiconductor Manufacturing International Corporation (NYSE: SMI and SEHK: 981) from 2002 to 2004. Dr. Yu served as a vice president of the research and development team of Cabot Microelectronics Corporation from 1996 to 2002. While working at Cabot, Dr. Yu took a multi-disciplinary approach to developing a new mechanism for a key integrated circuit material. Dr. Yu also worked at three U.S. Fortune 500 companies, including serving as a group leader in the research and development division at Rockwell Co. from 1994 to 1995, engineer at Motorola Co. from 1992 to 1994, and senior engineer at Micron Technology Co. from 1989 to 1992. He has also authored more than 80 papers, including ones relevant to cancer detection. Dr. Yu received his bachelor's and master's degrees in physics from the University of Missouri Kansas-City Campus in 1983 and 1984, respectively. He received his Ph.D. in physics from the Pennsylvania State University in 1990. His master's and doctoral dissertations both addressed innovative detection techniques.

Dr. He Yu, Co-founder and Chief Medical Officer

Dr. Yu has served as Chief Medical Officer since the company's inception in 2010. Dr. Yu has served as a professor and program director of cancer epidemiology at the University of Hawaii Cancer Center and an adjunct professor at Yale School of Public Health since 2012. He was a faculty member, from assistant professor to professor, at Yale University, School of Medicine from 2001 to 2011. Trained in medicine, epidemiology and clinical biochemistry, Dr. Yu conducts various laboratory-based clinical and epidemiologic investigations and has extensive experience in cancer research. He has designed and been involved in many clinical research projects that assess the molecular and genetic features of tumor specimens in relation to cancer characteristics and survival outcomes of patients with various kinds of cancers. As a principal investigator and coinvestigator, Dr. Yu has developed and participated in several large, population-based epidemiologic studies that investigate gene-environment interactions in breast, endometrial, liver and pancreatic cancers. Biomarkers under his investigation include genetic polymorphisms in DNA repair genes, DNA methylation and methylator phenotype in tumor suppressor genes and detoxification genes, protein markers, peptide growth factors and various non-coding transcripts. Dr. Yu received his bachelor's degree in medicine from Shanghai First Medical College in 1983. He also received a Master of Science degree in epidemiology and a Ph.D. in clinical biochemistry from University of Toronto in 1990 and 1996, respectively.

Mr. Jinqiu (Edwards) Tang, Chief Financial Officer

Mr. Tang has served as AnPac Bio's Corporate Controller since October 2019. Prior to joining AnPac Bio, Mr. Tang served as a global internal auditor at Natuzzi S.p.A (Italy) from 2016 to 2019. Previously, he worked for Beijing Dongshen CPAs from 2013 to 2016 and Shanghai De'an CPAs from 2011 to 2013 where he provided external audit, finance and tax advisory services across different industries and sectors. He has been a Certified Public Accountant in Australia since 2019. Mr. Tang received his bachelor's degree in accounting in 2007 and MBA in 2009 from Charles Sturt University in Australia and his bachelor's degree in law in 2017 from Southwest University of Science and Technology in China.

Mr. Weidong Dai, President, China

Mr. Dai has served in his role as President since April 2015. Prior to joining AnPac, Mr. Dai served as general partner at Stirrfir Investment Management Co. Ltd. from 2008 to 2015, chairman of RTS Management (Shanghai) Co., Ltd. from 2004 to 2013, managing director at Hong Kong Pro-Health Technology Co. and Shanghai Pro-Health Medical Devices Co., Ltd. from 1998 to 2004, and as chief scientific officer at Wex International Inc. (a subsidiary of a U.S. listed company) from 1994 to 1998. He has served as an adjunct professor at Anhui College of Traditional Chinese Medicine since 2004 and an executive director at the Hainan Branch of China Science Tsing Research Institute of Science and Technology since 2018. Mr. Dai has published a number of medical research papers and scientific articles in professional journals. A medical device for which he led the research and development was awarded the Hong Kong Industrial Award in 1999. Mr. Dai received his bachelor's degree in medicine from Anhui Medical University in 1982, master's degree in medicine from Sun Yat-sen University of Medicine in 1985, and an Advanced Certificate of the EMBA CEO Program from Fudan University, School of Economics in 2002.

Financial and Operational Results

In January 2020, AnPac announced the pricing of its initial public offering of 1,333,360 shares at $12.00 per share on the NASDAQ. Through this offering, AnPac raised approximately $16 million. February saw the acquisition of two insurance customers, Bohai Life Insurance Co, Ltd. and the Qingdao Branch of PKU Founder Life Insurance Co., Ltd. Under these agreements, AnPac will provide multi-cancer, standardized CDA tests to assess customer cancer risk. In late February, AnPac announced that it had filed for a coronavirus detection patent, an innovative application of CDA technology that could add value in the future.

In March, AnPac was granted patent protection in the US for an integrated and decomposable micro apparatus for site-specific drug delivery. On March 27, AnPac announced that it received CAP accreditation for its San Jose, CA laboratory. AnPac was granted another two patents in May: one for a novel medical device for disease detection utilizing integrated circuit technology and another for improved disease detection bringing the total number of US patents to 19. AnPac filed its Form 20-F on May 15, 2020 for the twelve-month period ending December 31, 2019.

June began with the appointment of AnPac's new CFO, Mr. Jinqiu (Edwards) Tang, who has extensive audit, accounting and finance experience, replacing Ms. Yu (Rain) Zhang. This was followed by the signing of a $3 million, three-year contract for cancer screening with Beijing Yuan Jian Health Management. Mid-June, AnPac launched a new immunology test product line consisting of multiple immunology related tests that rely on AnPac's novel multi-factor proprietary algorithms.

In August and September AnPac provided two updates for studies the company had been conducting in several cancers. The first press release discussed the statistical significance of the CDA test in over 190 cancer cases, over 900 pre-cancer cases, and 700 disease cases. The second press release marked the completion of a multi-year study evaluating prognosis and recurrence for 1,000 confirmed lung cancer patients. Conclusions from the study find that CDA value is a good indicator for prognosis and that there is a relationship between CDA value and survival. We expect the referenced studies to appear in journal articles at conferences in the near future.

In September and October, AnPac announced an expansion of an existing testing contract, a capital raise and new grants that are expected to expand revenues and provide additional financing to fund the company's drive towards positive earnings. In mid-August, AnPac extended its relationship with Beijing Yuan Jian Health Management Co., Ltd. in China and will provide the company's new immunology test, AnPac Defense Medical Examination (ADME). The 14 month contract will provide 20,000 ADME tests in multiple locations. AnPac provided further details regarding its $7 million capital raise with details included in an October 14 amendment to an F-1 filing. Keystone Capital Partners will manage the preferred stock issuance. Non-dilutive capital is expected from local authorities in China that will provide up to $8 million in grants and a rental award. The non-dilutive capital is expected to be received over the next few years beginning this quarter and will support research and development and new product commercialization.

AnPac Bio filed its full year 2019 financial statements, Form 20-F on May 15, 2020 for the twelve-month period ending December 31, 2019. The company reported revenues of $1.6 million, which consisted of $1.5 million from the Cancer Screening & Detection Test segment and $0.1 million from the Physical Checkup Packages segment. This represented a 2.6% increase over the prior year. Operating expenses rose 89% to $13.5 million generating a net loss of ($14.5) million or ($1.62) per share. This compares with an operating loss of ($6.5) million in 2018.

On September 10, 2020 AnPac submitted first half 2020 results in a press release on the website and a 6-K filed with the SEC. Revenues were $573 for the first six month period, rising 3.4% in local currency aided by a 114% increase in test average selling price. Gross margin as a percentage of total revenues was 45.4% in 1H:20 up from 41.4% during 1H:19. Total costs rose by 82% with increases in research and development and general and administrative slightly offset by lower selling and marketing expenses. Costs related to the initial public offering non-cash share based compensation contributed to the increase in expenses.

Cash on the balance sheet was $1.4 million as of June 30, 2020 and operating burn was ($7.8) million or ($1.3) million per month. We believe AnPac has successfully accessed bridge financing and grant funds as they prepare to close the recently announced $7 million capital raise.

VALUATION

AnPac Bio has launched its cancer screening tests in China and established a beachhead in the United States with two active laboratories. While cancer is one of the leading diseases around the globe, there has been little progress made over the last decades to identify the disease early when it can be most effectively treated. Drs. Chris and Herbert Yu recognized this void and applied their knowledge of signal processing, biophysics and medicine to design a process that can identify cancer cells by their biophysical properties.

In our valuation approach we forecast growth of cancer screening and detection tests in China and the US and physical checkup packages. The primary drivers for our revenue estimates are number of tests and revenue per test. We anticipate test growth of almost 20% for 2020, and revenue per test growth of 32% overcoming weakness in the first part of the year. Trends provided in the July 13 1H:20 earnings release support a strong second half. We see the implied contracted price of $39 per test from the Beijing Yuan Jian Health Management deal as a good basis for future pricing in the Chinese market. The model grows revenue/test by a 3% compound annual growth rate (CAGR) over the forecast period. We see test growth in China accelerating in 2H:20 and in 2021 as the drag from the coronavirus dissipates. Consistently strong test unit growth is forecast in subsequent years. We expect AnPac to receive its Class III registration clearance at the end of 2021 and our forecasts reflect an acceleration in growth as hospitals begin using the test.

Exhibit X – Test, Revenue/Test & Sales Estimates[69]

AnPac Biomedical Science Co.	2019 A	2020 E	2021 E	2022 E	2023 E	2024 E	2025 E	2026 E	2027 E	2028 E
Total Revenues ($USD)	**$1,558**	**$1,984**	**$3,628**	**$7,000**	**$12,024**	**$19,631**	**$31,343**	**$49,170**	**$74,046**	**$106,551**
Revenue Growth	2.6%	27.3%	82.9%	92.9%	71.8%	63.3%	59.7%	56.9%	50.6%	43.9%
Commercial tests (China)	52,428	56,700	83,202	126,830	196,586	283,084	390,655	527,385	696,148	884,108
Revenue/Test (China)	$28.44	$34.33	$39.00	$40.00	$41.00	$42.25	$43.75	$45.00	$46.50	$48.00
Commercial tests (US)			1,250	8,200	17,056	32,748	59,928	104,874	167,798	251,697
Revenue/Test (US)			$210.00	$210.00	$216.30	$222.79	$229.47	$236.36	$243.45	$250.75

First launch of paid tests in the United States is forecast for 2021. Test volume is initially anticipated to grow quickly, reaching over 250,000 tests by 2028, representing a CAGR of 77% from 2022 to 2028. Revenue per test is expected to initially be $210 inflating at around 3% per year.

We also forecast a small contribution from Physical Checkup Packages. This segment generated $67,000 in 2019 and we anticipate $1 million in revenues by 2028, representing a CAGR of 35%.

We use a multiple of future earnings to determine our valuation. Our valuation employs a 20x multiple of future earnings per share as our primary valuation metric. The value is then discounted to present using a 25% rate. When we apply our 20x multiple to EPS of $2.17, we generate a 2028 target price of $43.39. Discounting this to present generates a valuation of approximately $7.00. The valuation approach is sensitive to assumptions regarding revenue growth, net margins, earnings multiples and discount rates. A one percentage point change in margin would have a 2% impact on target price. Delaying 2028 earnings by one year would have a 20% negative impact on our valuation while a one-year advance of AnPac's recognition of earnings would increase the target price by 25%. Below is a sensitivity table that shows present value of 2024 price to earnings (P/E) based valuation.

Exhibit XI – Sensitivity Table[70]

P/E Multiple: 2028 EPS	Discount Rate				
	20.0%	22.5%	25.0%	27.5%	30.0%
15.0	$7.57	$6.42	$5.46	$4.66	$3.99
17.5	$8.83	$7.49	$6.37	$5.44	$4.65
20.0	$10.09	$8.56	$7.28	$6.21	$5.32
22.5	$11.35	$9.63	$8.19	$6.99	$5.98
25.0	$12.61	$10.69	$9.10	$7.77	$6.65

Based on the assumptions identified in our financial model, we generate a current valuation of $7.00 per share.

[69] Source analyst work, company reports, market data.
[70] Source analyst work, company reports, market data.

CONCLUSION

AnPac is approaching diagnostic cancer screening from a new direction that identifies the biophysical properties of blood to identify cancer risk. Not only is this approach uncorrelated with other testing approaches that use DNA sequencing but it is also much less costly with simpler detection mechanisms. The company is in an attractive market as there are an estimated 18 million cases of cancer a year, and as the likelihood of the disease increases with age, there is also a demographic tailwind to anticipated demand as the older population is expected to increase at a faster rate than the population overall. Research has shown that catching cancer early can have a dramatic impact on survival and on the total cost of treatment, which can make a strong economic case to employers and health plans who want to keep their people on the job and reduce spending on preventable disease. Current screening approaches are poor and present accuracy levels that create an undue burden on the health care system and on the patients who use them, either through unnecessary worry and procedures for a false positive, or failure to catch the disease for a false negative.

Studies have been conducted for decades on the biophysical differences of cancer cells compared to healthy ones. We have conducted an abbreviated literature review that finds research identifying measurable differences in metabolic and structural differences of diseased cells. Studies ranged from the evaluation of cell deformability, to the refraction of sound and light waves off of cells. Other research determined that the electrical capacitance of normal and cancerous blood differs and that the properties of normal and cancerous cells are distinct when scanned with light in the near-infrared spectral range.

AnPac's CDA test has much improved levels of sensitivity and specificity, in many cases exceeding 90% in contrast to other screening approaches that generate accuracy 10 to 20 percentage points lower. The accuracy of the CDA test has been demonstrated in 25 retrospective studies in 26 different cancers using a sample size of over 42,000. Several of the studies have been presented at ASCO and other conferences. The CDA machine is an automated diagnostic device that generates quantitative results from a blood sample that places a patient in one of three categories: low, medium and high risk. If they are high risk, further testing is conducted to locate and identify the cancer. The regulatory pathway to allow for the tests to be given is long in both China and the US; however, much progress has been made obtaining certifications. Beyond the cancer screening tests in China and the US, physical checkup packages are also offered. We also anticipate that AnPac will offer other screening and monitoring services in the areas of assisting diagnosis, prognosis and recurrence and genetic testing.

Key reasons to own AnPac Bio shares:

- **Swiftly growing demand for cancer screening**
- **Rapid, inexpensive screening process for the most common cancers using a single blood sample**
- **High incidence and prevalence of cancer in primary markets of China and US**
- **Effective screening approach using biophysical properties**
    - **Substantial literature supportive of the approach**
    - **Prospective studies presented at ASCO demonstrate high accuracy**
- **Physical labs in place in China and the US**
- **Extensive history of research associating biophysical properties of blood with cancer**
- **Opportunity to expand suite of products to provide additional services**
    - **Therapy selection**
    - **Treatment monitoring**
    - **Genomic testing**
- **Development platform that can be applied to many genetic tests and cellular therapy applications**

We see a long runway of growth for this technology given its simplicity, low cost and high rate of accuracy. Following additional studies in the United States and diagnostic test and device clearance in the US and China, we anticipate high double digit growth and penetration into employer and health plan markets over the next several years. Based on our forecasts and valuation assumptions, we generate a target price of $7.00.

PROJECTED FINANCIALS

AnPac Bio-Medical Science Co., Ltd. - Income Statement

AnPac Biomedical Science Co.	2018 A	2019 A	1H A	Q3 E	Q4 E	2020 E	2021 E	2022 E	2023 E	2024 E
Total Revenues ($USD)	**$1,519**	**$1,558**	**$573**	**$669**	**$742**	**$1,984**	**$3,628**	**$7,000**	**$12,024**	**$19,631**
Revenue Growth	80.3%	2.6%	3.3%	15.2%	75.4%	27.3%	82.9%	92.9%	71.8%	63.3%
Cost of Goods Sold	$840	$869	$313	$334	$371	$1,018	$1,603	$2,940	$4,689	$7,460
Gross Margin	44.7%	44.2%	45.4%	50.0%	50.0%	48.7%	55.8%	58.0%	61.0%	62.0%
Gross Profit	**$678**	**$689**	**$260**	**$334**	**$371**	**$965**	**$2,026**	**$4,060**	**$7,335**	**$12,171**
Selling & Marketing	$1,456	$1,958	$661	$522	$525	$1,708	$2,240	$2,417	$2,750	$2,900
Research & Development	$1,497	$1,413	$1,052	$320	$350	$1,722	$1,400	$1,540	$1,500	$1,500
General & Administrative	$4,274	$10,167	$7,175	$1,500	$1,300	$9,975	$6,460	$6,718	$6,987	$7,267
Other Income	($88)	($54)	($7)	$0	$0	($7)	$0	$0	$0	$0
Operating Income	($6,461)	($12,795)	($8,621)	($2,008)	($1,804)	($12,433)	($8,074)	($6,615)	($3,902)	$505
Operating Margin	*-425.5%*	*-821.2%*	*-1504.5%*	*-300.3%*	*-243.1%*	*-626.8%*	*-222.5%*	*-94.5%*	*-32.5%*	*2.6%*
Interest Income (Expense)	($137)	($375)	($73)	($90)	($90)	($253)	($360)	($360)	($360)	($360)
Total Other Income	$302	($1,457)	$753	$0	$0	$753	$0	$0	$0	$0
Pre-Tax Income	($6,261)	($14,546)	($7,938)	($2,085)	($1,883)	($11,906)	($8,383)	($6,934)	($4,238)	$141
Income Tax	$29	$31	$5	$6	$6	$17	$25	$21	$13	($0)
Tax Rate	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
Net Income	($6,232)	($14,515)	($7,933)	($2,079)	($1,877)	($11,889)	($8,358)	($6,913)	($4,225)	$141
Reported EPS	**($0.73)**	**($1.62)**	**($0.72)**	**($0.18)**	**($0.13)**	**($1.03)**	**($0.55)**	**($0.36)**	**($0.18)**	**$0.01**
YOY Growth		122.2%				*-36.3%*	*-47.2%*	*-33.4%*	*-49.5%*	*-103.3%*
Shares Outstanding	8,524	8,938	10,952	11,500	14,000	11,500	15,300	19,000	23,000	23,250

Source: Company Filing // Zacks Investment Research, Inc. Estimates

© Copyright 2020, Zacks Investment Research. All Rights Reserved.

HISTORICAL STOCK PRICE

AnPac Bio-Medical Science Co., Ltd. – Share Price Chart[71]



[71] Source: Zacks Research System

DISCLOSURES

The following disclosures relate to relationships between Zacks Small-Cap Research ("Zacks SCR"), a division of Zacks Investment Research ("ZIR"), and the issuers covered by the Zacks SCR Analysts in the Small-Cap Universe.

ANALYST DISCLOSURES

I, John Vandermosten, hereby certify that the view expressed in this research report accurately reflects my personal views about the subject securities and issuers. I also certify that no part of my compensation was, is, or will be, directly or indirectly, related to the recommendations or views expressed in this research report. I believe the information used for the creation of this report has been obtained from sources I considered to be reliable, but I can neither guarantee nor represent the completeness or accuracy of the information herewith. Such information and the opinions expressed are subject to change without notice.

INVESTMENT BANKING AND FEES FOR SERVICES

Zacks SCR does not provide investment banking services nor has it received compensation for investment banking services from the issuers of the securities covered in this report or article.
Zacks SCR has received compensation from the issuer directly or from an investor relations consulting firm engaged by the issuer for providing non-investment banking services to this issuer and expects to receive additional compensation for such non-investment banking services provided to this issuer. The non-investment banking services provided to the issuer includes the preparation of this report, investor relations services, investment software, financial database analysis, organization of non-deal road shows, and attendance fees for conferences sponsored or co-sponsored by Zacks SCR. The fees for these services vary on a per-client basis and are subject to the number and types of services contracted. Fees typically range between ten thousand and fifty thousand dollars per annum. Details of fees paid by this issuer are available upon request.

POLICY DISCLOSURES

This report provides an objective valuation of the issuer today and expected valuations of the issuer at various future dates based on applying standard investment valuation methodologies to the revenue and EPS forecasts made by the SCR Analyst of the issuer's business.
SCR Analysts are restricted from holding or trading securities in the issuers that they cover. ZIR and Zacks SCR do not make a market in any security followed by SCR nor do they act as dealers in these securities. Each Zacks SCR Analyst has full discretion over the valuation of the issuer included in this report based on his or her own due diligence. SCR Analysts are paid based on the number of companies they cover. SCR Analyst compensation is not, was not, nor will be, directly or indirectly, related to the specific valuations or views expressed in any report or article.

ADDITIONAL INFORMATION

Additional information is available upon request. Zacks SCR reports and articles are based on data obtained from sources that it believes to be reliable, but are not guaranteed to be accurate nor do they purport to be complete. Because of individual financial or investment objectives and/or financial circumstances, this report or article should not be construed as advice designed to meet the particular investment needs of any investor. Investing involves risk. Any opinions expressed by Zacks SCR Analysts are subject to change without notice. Reports or articles or tweets are not to be construed as an offer or solicitation of an offer to buy or sell the securities herein mentioned.

© Copyright 2020, Zacks Investment Research. All Rights Reserved.