



**TRADE & INDUSTRIAL POLICY STRATEGIES**

# **THE JOHANNESBURG HEALTH CLUSTER**

**July 2018**

**Report compiled by  
Trade & Industrial Policy Strategies**

---

## CONTENTS

EXECUTIVE SUMMARY.....	3
INTRODUCTION.....	5
SECTION ONE: CLUSTER ANALYSIS.....	7
Definition.....	9
Clusters and Productivity .....	10
Clusters and Innovation .....	12
Clusters and New Business Formation .....	13
Cluster Policies .....	13
Does everyone buy into the cluster approach? .....	16
SECTION TWO: THE HEALTHCARE CLUSTER IN JOHANNESBURG.....	17
Hospitals and ambulatory care facilities.....	20
Medical practitioners.....	22
Allied medical practitioners.....	24
Specialist input services.....	27
Pharmaceuticals and medical product inputs.....	32
Pharmaceuticals.....	33
Pharmacies.....	36
Facilitating and supporting cluster participants.....	40
Government.....	40
Universities and research institutions.....	42
Institutions and associations.....	46
Medical schemes.....	48
Summary of the Johannesburg healthcare sector.....	51
SECTION THREE: A MEDICAL DEVICE CLUSTER FOR JOHANNESBURG.....	56
The medical device industry status quo.....	57
Key constraints.....	63
National government medical device sector support policies and strategies.....	64
Government intervention to support the growth of the industry.....	65
Growing the Medical Device Cluster in the City of Johannesburg .....	66
CONCLUSION.....	71
REFERENCES.....	74
ABBREVIATIONS.....	76
ANNEXURE: OVERVIEW OF DATA ANALYSIS PROCESS AND FINDINGS.....	77

## EXECUTIVE SUMMARY

Healthcare is most often thought of as a social issue pertaining to a citizen's access to efficient, effective healthcare and the considerable challenges of sustainably financing a public healthcare system (in whatever form it takes).

It is less common for the healthcare system to be thought of as an economic sector even though it is a R326 billion a year industry, accounting for just over 9% of national gross domestic product (GDP). With the South African healthcare sector poised to grow substantially through a series of medical, economic and policy drivers, interest at all three spheres of government is increasing as to how such future growth can be supported and leveraged.

This research report is focused on the healthcare sector in the City of Johannesburg (CoJ). Healthcare is a multifaceted, highly complex set of complementary and interrelated services and inputs. It was decided that the best theoretical approach to use in populating the city's healthcare activities and understanding the size, scale and operations of such activities at an economic level was to use cluster theory. Cluster theory is a superior construct to an industry or sector approach as it allows all linkages (backwards, forwards and sideways) and all inputs required to deliver a final service to be consistently accounted for.

The participants and structures of healthcare activity were found to be sizable. Direct patient care is offered either through hospitals or ambulatory care facilities (such as clinics and doctors' rooms). These interfaces with the patient require the services of medical practitioners (doctors and dentists), allied medical practitioners (such as physiotherapists and dieticians) and specialised input service providers such as imaging and laboratory specialists. This direct patient care is dependent on inputs from two key industrial sectors: the pharmaceutical sector which provides medicines and drugs; and the medical devices sector which provides instruments, consumables, implants, machinery and diagnostic devices. Finally, all this activity related to patient care occurs within a supportive or associative environment made up of medical schemes, government, universities, and trade and professional associations.

Each of these services and inputs were populated and plotted on city maps. Three findings emerged. First, that the City of Johannesburg has a massive and robust range of healthcare facilities and participants which are well dispersed across the city, suggesting that in general there is good patient access to healthcare services. The second finding was that, despite this good coverage, the mapping process clearly showed three strong clusters where co-location of similar and associated practitioners and service providers have agglomerated. The areas are the Parktown/Parktown North/Rosebank area; Sandton; and Midrand.

The third finding of the research is that, while direct patient care activity in the cluster is strong and robust with few (if any) visible gaps, the input sector to the cluster is a source of weakness and vulnerability: 65% of pharmaceuticals and 90% of medical devices are imported, showing a gaping hole in the local healthcare cluster.

---

***The City of Johannesburg has all the building blocks to grow, expand and develop current medical devices activity within its robust broader healthcare cluster. The cluster offers opportunities for increased city-based GDP and value-added growth, increased employment opportunities, substantial export opportunities and the opportunity to support the national government's drive towards import substitution in a rapidly growing market segment.***

---

This research report focuses on the medical devices sector and delves deeper to understand the problems faced by the sector and what would be required to leverage the sector for domestic growth and import substitution. It appears that the national government is committed to growing the medical device sector and that any initiatives undertaken by the city would thus be in line with and support national industrial policy thinking. This is important as many of the constraints facing the sector can only be mitigated at a national level.

At a city level a clear role exists for CoJ to initiate, resource and facilitate the creation of a formal medical devices cluster institution, which should be formalised within a not-for-profit company with a Board and Chief Executive Officer (CEO). The ultimate aim of the institution (special purpose vehicle or SPV) is to facilitate and support the collaboration and joint activity of the industry, government and academic stakeholders who represent the core of the industry. The research shows a possible configuration for the activities such an SPV might undertake and these functions are specific to the nature of the firms which dominate the sector (start-ups and small and medium businesses).

It is argued that even though progress on standards, certification and designation needs to be forthcoming from the national government, the CoJ can begin to undertake immediately a number of interventions, and that if the city fails to react proactively to these opportunities there is every chance that such opportunities will be relocated to the Western Cape, which is already active in the sector.

CoJ has all the building blocks to grow, expand and develop current medical devices activity within its robust broader healthcare cluster.

The cluster offers opportunities for increased city-based GDP and value-added growth, increased employment opportunities, substantial export opportunities and the opportunity to support the national government's drive towards import substitution in a rapidly growing market segment. This is an opportunity the city does not want to miss out on.

## INTRODUCTION

Healthcare at a government level is understood first and foremost as a social issue pertaining to a citizen's access to efficient and effective healthcare and the considerable challenges of sustainably financing a public healthcare system (in whatever form it takes). Health economics on the other hand, (because of the multiple types of public and mixed healthcare systems and issues of access and affordability) focuses on evaluating and analysing the costs, charges and expenditures inherent in different types and configurations of healthcare systems.

Less well researched and understood is the idea of the healthcare system as an economic cluster comprised of interrelated goods and services providers who collectively make a substantial contribution to employment and GDP. In South Africa the private and public healthcare sectors are jointly valued at R326 billion – a contribution of 9% of total GDP (Madubuld, et al, 2014). Estimates are that in Gauteng there are 70 000 healthcare employees in the public sector (Gauteng Department of Health, 2015) and most likely more than an equivalent number in the private sector. In Johannesburg alone there are 17 000 doctors officially registered.

With the substantial value and employment in the existing sector, and a host of variables that suggest the demand for healthcare will increase substantially in the future, it becomes appealing for policymakers in economic and related fields at all three spheres of government to: i) understand the scope, extent and depth of the health cluster; ii) the operationalisation and interconnections between players in the cluster; and iii) any emergent opportunities which exist to leverage additional economic growth and employment from the cluster.

---

*The research shows that the City of Johannesburg could put in place a series of cluster and cluster-related initiatives in the field of medical consumables and devices which would leverage the healthcare sector and result in higher GDP and employment outcomes for the city.*

---

In this paper the health cluster is considered as it exists in the City of Johannesburg. Despite the narrowness of the geographic boundary, the research shows that Johannesburg is home to a broad, deep, extensive and robust healthcare cluster that has grown organically. The research also shows that, while some interrelations between cluster participants is vibrant and improves productivity and lowers costs, gaps remain where improved relationship building could offer growth and output benefits. Two key emergent growth opportunities present themselves: mass production opportunities at the lower end of the medical consumables market (import substitution); and high-end, high-value new product development (for local and export markets) in the medical devices market. The research shows that the City of Johannesburg could put in place a series of cluster and cluster-related initiatives in the field of medical consumables and devices which would leverage the healthcare sector and result in higher GDP and employment outcomes for the city.

Section one of the paper introduces the broad theoretical concept underpinning the approach of the paper – cluster analysis. Although cluster analysis has many detractors and critics, the section shows why the approach is particularly useful in describing activities where multiple industry and sector players need to co-ordinate across Standard Industrialisation Classification (SIC) codes to deliver on customer needs. It also explains why cluster analysis is a particularly useful approach for regional and metropolitan authorities to use, in that it gives them policy space independent of national industrial policies. Cluster theory and its application is explained in terms of how it was used to assess the Johannesburg health care cluster; how clustering generates firm and regional level growth and productivity gains; and how and where sub-national government spheres can conceptualise interventions which will improve regional growth outcomes. It will be shown that while clustering in the healthcare sector may not always lead to reduced input prices and productivity improvements – and while evidence is unclear as to whether clustering will always result in improved patient outcomes – the evidence is unanimous that new medical devices, pharmaceuticals and other medical input production only flourish as industrial manufacturing activities when they take place within a dynamic and strongly networked cluster.

Section 2 details the City of Johannesburg healthcare cluster. Public and private databases were consulted, not only to ascertain the categories and number of participants in healthcare service or goods provision and the city's underlying healthcare infrastructure base, but to ascertain where within the City of Johannesburg specific agglomerations of healthcare activities are accumulated. The section provides an overview of the participants in the City of Johannesburg's healthcare sector (public and private), the relative scale of different populations, and Geographic Information Systems (GIS) maps identifying where in the city agglomerations occur. The methodological details and technicalities related to the GIS mapping are in Annexure A.

Section 3 follows on from the finding of Section 2 that the biggest gap in the South African and Johannesburg healthcare cluster is the local production of pharmaceuticals and medical devices. Given the high import content of active ingredients in pharmaceutical products which compels pharmaceutical producers to locate near the coast, developing the pharmaceutical manufacturing sector in Johannesburg is seen as not particularly viable. Rather the section argues that, given the status of the cluster and particularly the resources available through the University of the Witwatersrand (Wits) and the University of Johannesburg (UJ), the presence of medical scheme head offices, and the presence of 60% of all medical device manufacturers near the city, the City of Johannesburg should perhaps focus on the medical devices sector and its growth opportunities. The section builds on the cluster theory of Section 1 and suggests possible intervention approaches that would fill the gap in the citywide cluster.

## SECTION ONE: CLUSTER ANALYSIS

There is no single accepted definition of the “territorial dimension of interrelatedness between enterprises and players” (OECD, 2010), which are sometimes termed industrial districts, flexible specialisation, local nodes, networking, local systems of production or clusters. All the ideas do, however, share a common lineage and can be traced back to some or all the concepts of Alfred Marshall’s work on economies of urbanisation and economies of localisation.

In his seminal *Principles of Economics* (1890), Marshall sought to unpack and understand the concentration (agglomeration) of firms in geographic areas and how firms made locational decisions. He identified what he called urbanisation effects, which described the general urban advantages (externalities) that accrued to any firm in any sector operating in an urban environment as opposed to a firm operating in isolation in a rural area for example. Advantages included predominantly concentration issues such as access to good transport infrastructure and access to large consumer markets. Of greater interest to Marshall was what he termed economies of localisation. In economies of localisation, Marshall and later Alfred Weber (1929) were interested in understanding where externalities arose from similar or connected firms being proximate to one another. In other words, were there advantages to firms locating close to other firms in what was then called an industrial district and is now usually called a cluster? Marshall found that locational agglomeration economies did exist and that the benefits to firms arose from three sources.

### THREE BENEFITS OF CONCENTRATION

#### First benefit

**Access to a large skilled pool of labour** with the right mix of skills, known as labour pooling. The argument was that because lots of similar or related firms gather in one location they provide a consistent and reliable source of employment for appropriately skilled workers. The attraction of workers by the cluster decreases the risk to firms of not finding the required skills they seek and improves the quality of the match between the firms and employees.

#### Second benefit

The second benefit to co-locations is known as **input sharing**. In this argument, Marshall maintained that firms operating in a similar field will benefit from co-location because such co-location may assist in the development of common infrastructure, it will lead to reduced transport costs between various suppliers and consumers of final and intermediate goods, and it will allow for specialisation and diversification.

#### Third benefit

The third benefit is known as the **knowledge spillover benefit** which included the heightened diffusion of industry-specific knowledge and information.

Marshall believed these three agglomeration economies collectively would allow firms to lower the cost of production inputs and increase a firm's productivity so it became more competitive. This competitive advantage would underpin the growth of firms and hence the growth of cities and regions. He understood these benefits (externalities) were not only economic phenomena but that behind them lay social, political, cultural and institutional factors and behavioural dimensions of interdependence. At the time, however, he did not pursue these avenues of investigation. For many years his pure approach to economies of agglomeration remained the cornerstone of understanding regional and metropolitan economic performance and hence impacted and directed sub-national economic policy thinking.

With increased globalisation, liberalised world trade, improvements in technology and the rise of global value chains towards the end of the 20th century, it appeared the location of firms was becoming a variable of diminishing economic importance. This changed in the 1990s when sociologists, management consultants, corporate strategists and institutional economists started considering other sources of externalities. This gave rise to what Wolman and Hincapie (2010) term "the social network model" of co-location. In this approach, informal networks of individuals across firms and across other related institutions (for example trade associations, unions, universities) facilitate the transmission of knowledge that leads to innovations, and the adoption of advanced and improved techniques related to production processes, marketing, research and other activities. In this model, networks are based on interpersonal relations and trust and embody the social capital embedded in them. Gordon and McCann (2000) note that there is nothing inherently spatial about the social network model although it has explicit spatial applications. This is because such networks are created through a combination of social history, on-going collective action and shared interests. They argue that these conditions are most likely to arise when economic relations have historically been more localised and/or that there is a distinctive local economic base and cultural or personal links among key players.

The most cited and well-known conceptualisation of clusters in the modern era is put forward by Michael Porter in his 1990 book *The Competitive Advantage of Nations* and in his later work *Clusters and The New Economics of Competition* (1998). His approach includes both the pure economics of agglomeration explained by Marshall and the so-called social network model of co-location. His approach also directly and centrally deals with the changes to the global economy since Marshall penned his thoughts in 1890.

He argues that companies in the modern era can source capital, goods, information and technology from anywhere around the world, often with the click of a mouse. This suggested to him that, in theory, more open global markets and faster transportation and communication should diminish the role of location in competition. He argues that anything that can be sourced from a distance through global markets and corporate networks is available to any company anywhere in the world and therefore is essentially nullified as a source of competitive advantage (Porter, 1998). This theoretical view was not, however, matched by what Porter saw on the ground. What he witnessed were critical masses in one place which were unusually competitively successful in a particular field. In his first musing on the topic he used Hollywood, Wall Street, Silicon Valley and the Japanese electronics industry as prime examples. His point of departure was that location remains fundamental to the competitiveness of firms and their ability to grow but that the role of location differs vastly from two generations ago.



---

*Clusters “are geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include for example, suppliers of specialised inputs such as components, machinery and services, and providers of specialised infrastructure. Clusters also often extend downstream to channels and customers and laterally to manufacturers of complementary products and to companies in industries related by skills, technologies, or common inputs. Many clusters include governmental and other institutions – such as universities, standard-setting agencies, think tanks, vocational training providers, and trade associations – that provide specialised training, education, information, research and technical support.” – Michael Porter*

---

## Definition

Clusters according to Porter (1998) are “geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include for example, suppliers of specialised inputs such as components, machinery and services, and providers of specialised infrastructure. Clusters also often extend downstream to channels and customers and laterally to manufacturers of complementary products and to companies in industries related by skills, technologies, or common inputs. Finally, many clusters include governmental and other institutions – such as universities, standard setting agencies, think tanks, vocational training providers, and trade associations – that provide specialised training, education, information, research and technical support.”

Porter suggests three qualifying characteristics of clusters defined in this way.

- First – he asserts that a cluster’s boundaries are defined by the linkages and complementarities across industries and institutions and not by political boundaries such as city or provincial limits. He uses as an example the chemical cluster in Germany which spills over into German-speaking Switzerland.
- Second – he notes that clusters rarely conform to SIC systems and that often the standard industrial classification system actually obscures significant clusters. Interestingly, to illustrate this characteristic Porter uses medical devices as a cluster, which remained unrecognised using the SIC system because it was obscured by the larger SIC contributors of electronic equipment and plastic products.
- Third – he emphasises that a characteristic of this definition of a cluster is that it promotes both competition and co-operation. He argues that rival firms in a cluster will compete intensely to win consumers and market share but that there is simultaneously co-operation, especially vertically among companies in related industries and local institutions. As such Porter sees clusters as representing a new kind of spatial organisational form which sits between anonymous, arm’s length market transactions on the one hand and vertically integrated hierarchies on the other.

Porter's actual theory is based on three arguments:

- Clusters and productivity
- Clusters and innovation
- Clusters and new business formation.

These arguments are highly reminiscent of Marshall's agglomeration economies. This similarity and the questions it poses about cluster theory are examined in the following sections.

## Clusters and productivity

In this aspect of Porter's argument, a firm's productivity can be enhanced within a cluster through four channels.

The first channel is that a firm operating in a cluster will have better access to appropriately skilled employees and suppliers than a firm operating in geographic isolation. Labour market advantages are created because the existence of a cluster sends a signal to potential employees that in this location job opportunities abound and that competition for such skills will result in competitive salaries. This attraction of appropriately skilled and experienced workers affords firms in the cluster access to a ready labour pool at reduced search and transaction costs. For example, Silicon Valley is a prime locational magnet for job seekers in the information and communication technology (ICT) field; while Hollywood is a prime locational magnet for aspiring actors and actresses.

A well-developed cluster equally affords firms easier access to other inputs used in the delivery of a firm's goods or services. In this second channel the benefit to a firm in a cluster arises because co-location creates a business environment in which specialised input suppliers are readily available. This ability to source necessary inputs locally decreases transport costs, search costs and transaction costs as well as reduces the need to hold inventory. Proximity to input suppliers also allows for easier ancillary support to be offered by suppliers for example installation, repairs, on-going maintenance and debugging. Porter raises three additional points related to the advantages of having local and proximate suppliers. The first is that having such specialised input suppliers creates space for upstream purchasers of inputs to diversify and specialise more readily. He also points out that in a cluster it is less risky to outsource activities to proximate companies and input suppliers than it would be if outsourcing had to be done over a considerable distance. This again affords firms the ability to specialise and focus on core activities and productivity gains. Finally he argues that proximity allows for more flexible contracting than distance and that increased flexibility in input contracts allows firms to remain nimble, responsive and competitive.

The second channel through which Porter argues that firms in a cluster benefit from co-location is complementarities (Porter, 1998). He argues that a host of linkages between cluster members results in a whole which is greater than the sum of its parts. The example he uses the tourism sector to illustrate this. He shows that in a typical tourism cluster the quality of a visitor's experience will depend not only on the appeal of the primary attraction but on the quality and efficiency of complementary businesses such as hotels, restaurants, shopping centres and transport facilities.

---

*A host of linkages between cluster members results in a whole which is greater than the sum of its parts. In a typical tourism cluster, the quality of a visitor's experience will depend not only on the appeal of the primary attraction but on the quality and efficiency of complementary businesses such as hotels, restaurants, shopping centres and transport facilities.*

---

Complementarities arise in four ways. The first is when firms' products complement each others to meet consumer needs, as in the tourism example. Another is when firms co-ordinate their activities to optimise their collective productivity (for example a saw mill increasing the quality of the wood it processes so as to support a furniture maker who wants to produce higher value-added products).

A third complementarity arises in marketing. The argument is that a cluster frequently enhances the reputation of a location in a particular field. This makes it more likely for consumers to look for service providers or producers of goods based in that area. Beyond reputation, complementarities offer benefits in the form that a cluster attracts new customers as they can see multiple vendors in a single trip. As will be shown in this report, complementarities are extremely important in the healthcare cluster in Johannesburg.

Access to institutions and public goods is the third channel through which Porter argues firms in a cluster can enjoy productivity gains. The argument is that investment made by government or other public institutions can enhance a company's productivity by providing access to specialised infrastructure or specialised educational programming. Porter also lists quasi-public goods, such as a cluster's information and technology pools and its reputation, which also improve the productivity of individual firms. Contentiously Porter does not limit his analysis of public goods to investments by the government. He also argues that investments by other private sector firms in a cluster can be seen as public goods for co-locational firms. The examples he cites of such investments include: investments in training programmes, quality centres, and testing and standards laboratories. Access to such resources obviously improves individual firm productivity.

Porter's final channel between cluster involvement and individual firm productivity gains is based on a strategic management concept of better motivation and measurement as variables which support better productivity performance. The argument is simple – it suggests that local rivalry is highly motivating and that because of proximity and co-location there is better information available about competitors' products, costings and profitability, and that the ability to more easily measure this instils a greater sense of competitive rivalry.

It is obvious that Porter's four channels through which clustering supports increased firm level productivity is very similar to Marshall's labour pooling and input sharing arguments.

---

*A firm in a cluster benefits not only from preferential access to understanding breakthrough consumer demands and trends but also to new and evolving technology, component and machinery availability, new services and innovative marketing concepts.*

---

## Clusters and innovation

Porter believes that in addition to enhancing a firm's productivity, clustering is essential in promoting a company's ability to innovate. The first aspect of driving innovation derives from the ability of a cluster to make innovation opportunities more visible. Because of the way Porter defines a cluster, a firm operating within a cluster will have access to sophisticated buyers who provide a priceless window to firms of current and future market demands. By way of example he again uses the Silicon Valley, arguing that firms in the valley "plug into customer needs and trends with a speed difficult to match by companies located elsewhere" (Porter, 1998). When other institutions (universities, trade associations) are added to the picture, a firm in a cluster benefits not only from preferential access to understanding breakthrough consumer demands and trends but also to new and evolving technology, component and machinery availability, new services and innovative marketing concepts. Porter argues that such learning is facilitated by making site visits and frequent face-to-face contact which is only feasible with geographic proximity.

Over and above increased visibility of innovation opportunities, Porter argues that clusters support the capacity and flexibility of firms to respond to such innovative opportunities. This capacity and flexibility arises due to the presence of specialist input providers that can meet the demand for new components or services – or will be willing to work alongside a cluster member firm to innovate the necessary inputs. This decreases the risk of innovating and lowers the cost of innovating.

The existence of other institutions in a cluster also strongly supports innovation at a firm level. Firms can co-ordinate with training facilities, universities and other research institutions on required skills sets and other required inputs necessary to support firm-level innovation. This provides a firm in a cluster with a clear advantage over a firm trying to innovate in an isolated geographic location with no complementary service providers around.

Finally, Porter again raises the issue of inter-firm competition within a cluster as a benefit to increased innovativeness. The argument is not particularly pithy but states that "reinforcing the other advantages for innovation is the sheer pressure – competitive pressure, peer pressure, constant comparison – that occurs in a cluster" (Porter, 1998). Executives vie with one another to set their companies apart and maintain or expand market share and this allows clusters to remain on-going centres of innovation for decades.

## Clusters and new business formation

Porter's third and final benefit of clustering is that new companies will proliferate in a cluster more readily than in isolated areas. He argues that clusters are conducive to new business formation for a variety of reasons. First individuals working within a cluster are argued to be more likely to perceive a gap in the market around which they can launch a new venture. Second it is argued that the barriers to entry within an existing cluster are lower than elsewhere. This is because existing skills are readily available, input suppliers and component manufacturers and complimentary services are close at hand and a strong and vibrant market exists. These realities all decrease the risk of starting a new venture and are likely to therefore improve the likelihood of raising funding for the new venture. Porter characterises the formation of new businesses within a cluster as part of a positive feedback loop, with the net result that companies in a cluster advance relative to rivals at other locations.

Porter uses these three benefits of clustering as a rationale for cluster-based economic development policies. He argues that clusters involve externalities across firms in a location, and associated public goods. In the presence of these positive externalities, market failure will lead to underinvestment in key areas such as specialised skills, scientific knowledge and specialised infrastructure. This provides a strong rationale for public policies which should capture these externalities and thereby improve productivity, and with it job, wage and innovation growth.

Once a cluster has been identified (a role to be undertaken by the government according to Porter) four potential market failures arise which public policy should focus on: 1) creating co-operative networks and encouraging dialogue between firms and other institutions; 2) collective marketing of the region's cluster specialities; 3) provision to firms of services such as access to finance, commercialisation support and design; and 4) identification of weaknesses in existing cluster value chains and attracting investors and businesses to fill these gaps (Wolman and Hincapie 2010).

---

*Cluster theory is vocal on what the government can and should do  
but rather quieter on how it should achieve desired outcomes.*

---

## Cluster policies

There is general agreement that it is difficult or nearly impossible for public policy to intentionally create clusters where they do not already exist (Rosenfeld, 2010; Cotright, 2006; Wolman and Hincapie 2010). The literature and arguments show clearly that clusters develop naturally through market processes (agglomeration economies) and individual actions of firms, workers, consumers and employees of associated institutions. The question is whether it is possible for direct intentional human intervention to address market failures and improve cluster operations and, if so, through what kinds of policies or practices.

Again there is consensus that, while cluster theory does not provide much detailed or specific guidance in the development and construction of cluster strategies and interventions, there are

benefits to be gained from supporting clusters which already exist, clusters for which the region has a competitive advantage relative to other regions or clusters whose impacts or externalities particularly serve public purposes (Rosenfeld, 2000; Cotright, 2006; Wolman and Hincapie, 2010; Newlands, 2003; Duranton, 2005).

Cluster theory is vocal on what the government can and should do but rather quieter on how it should achieve desired outcomes. Certainly in the literature reviewed, theory on the role and activities of that would constitute public policy in pursuit of improved clustering is sorely lacking. What is not lacking are examples, anecdotal findings and lessons learned from thousands of cluster programmes undertaken globally at a regional and metropolitan level over the past two decades. This is not surprising as most cluster studies take the form of qualitative case studies based on observation and interviews with participants.

At a general level Porter (2000) claims that successful cluster initiatives share various commonalities:

- A shared understanding of what is competitiveness and what drives it.
- A focus on removing obstacles and easing constraints.
- Appropriate cluster boundaries which are based on interconnectedness and not industry definitions.
- Wide involvement of all cluster participants including the public sector, private sector companies, educational institutions, research and development (R&D) and testing institutions, trade associations and unions.
- Private sector leadership and a public private partnership approach to the cluster initiative.
- Close attention to personal relationships and the building of trust and common purpose
- A bias towards action.
- Institutionalisation of the overall cluster and specific interconnectedness relationships.

More specifically Rosenfeld (2010) argues that essentially three types of economic development policies flow from Porter's cluster theory (and more generalised and updated versions of the theory). The first is associational encouragement which includes efforts to encourage information exchange and knowledge spillovers. The second is the provision of specialised services to an identified cluster such as access to a particular type of funding or testing facility. Third is targeted investments including R&D, foreign direct investment (FDI) attraction and recruitment.

Feser (2008) provides a more detailed list of cluster-building interventions, especially those aimed at increasing innovations and technology related activities. On the supply side he suggests:

- Creating a cluster industry association to serve as a catalyst for cluster interests. This fits with Porter's success criteria of institutionalising a cluster, and best practice suggests government should fund the establishment and running costs of the body.
- Location incentives for, and recruitment of, firms that would fill important gaps in the cluster supply chain. This can be achieved using special economic zones, incentives on utilities and rates at a municipal level, using the government's FDI attraction infrastructure to attract key catalysing firms and marketing to attract related firms. The question of subsidising individual firms to attract them to a cluster is generally frowned on as uncompetitive.

- Establishing business networks to encourage information-sharing and joint problem-solving. This may include the institutionalisation of trade and business associations, entrepreneur networks and networking events, standard-setting agencies and technology networks. Importantly, case studies focus on the need for cluster participants to perceive themselves as part of a joint endeavour. This necessitates not only that networks and associations are established but that cluster institutions interact with each other and are connected.
- Investing in university research competencies related to the cluster. Fester (2008) and Porter (1998) both focus on increasing university R&D but a study by the Massachusetts Institute of Technology (MIT, 2005) in the US argues that universities have a broader role to play in supporting a local cluster. The MIT study argues that universities contribute to local innovation in several direct and indirect ways. First university staff often seek to exploit their laboratory discoveries by patenting and licensing their intellectual property to local firms. Universities likewise can help local firms adapt knowledge originating elsewhere to local circumstances. Universities can also be helpful in assisting to integrate previously separate areas of technology activity and help in multi-disciplinary product, process and service development. They can also assist in unlocking and redirecting knowledge that is already present in the cluster but which is not being put to productive use while also providing a space for a public conversation about the future direction of technologies and markets. Over and above these activities, MIT argues that the role and importance of the university in providing relevant and appropriate education and a university's role in attracting new human knowledge (and potentially financial resources) from external areas should never be underestimated. Overall in all the literature surveyed, the role of universities is highlighted, particularly in clusters which depend on technology advancement and innovativeness.
- Business incubators to provide services to cluster members. This may be especially necessary when new firms are created to meet an existing gap in a cluster or value chain.
- Regulatory assistance that would provide guidance to firms on regulatory compliance.
- Providing technical and business development advice and services to smaller firms through an industrial extension service analogous to agricultural extension services.
- Skill upgrading of workers in identified clusters and specialised training institutions, programming and curriculum development to meet the skills requirements of the cluster.
- Making available risk-based financing through the creation of appropriate vehicles such as venture capital funds.
- Establishing joint investments into shared services such as testing facilities or maintenance capabilities.

On the demand side Fester (2008) cites three key interventions:

- Targeting public sector procurement to local firms in the cluster,
- Fostering purchasing links among members of the cluster in product or value chains through supplier fairs and assistance to suppliers.
- Supporting cluster exports.

Although little in the literature focuses on the demand side of cluster support, as will become apparent in the research in relation to the South African health cluster and the growth of medical device manufacturers – demand side interventions are likely to be crucial.



### Does everyone buy into the cluster approach?

The popularity of clusters as an idea is met with ambivalence in academia. Martin and Sunley (2003) describe clusters as a chaotic concept that conflates quite different types, processes and spatial scales of economic localisation under a single, all embracing, universalistic notion. Feser (2008) is concerned that if clusters are everything (nodes, networks, industrial districts, collaborations) then maybe they are nothing. Legendikj and Cornford (2000) believe that cluster work is too broad to be dealt with by a single theory and should be viewed as a black box in which a range of evolving academic and policy threads have been placed together. None of these descriptions are overly supportive of the theoretical value of cluster analysis – yet among all the critiques and concerns two strong positives continuously emerge from the debate.

The first is that it is perfectly alright to have competing views on clusters, and authors such as Benneworth and Henry (2004) believe that such diverse views strengthen overall analysis and policymaking. Despite the criticisms of cluster theory there is close to universal acceptance that the idea promotes a multi-perspectival approach, by which writers mean that cluster theory encompasses: theory from regional economics (economies of agglomeration), theory from business and management studies (supply chain co-ordination and firm strategy) and theory from sociology and geography (embeddedness and institutional thickness). Each theory and aspect has a different disciplinary background, different rules of evidence and different proof and causality implications – in other words different points of entry into a construct – the cluster. What proponents of cluster theory (and begrudgingly critics of cluster theory) admit is that the value add of clusters is precisely that they allow multiple explanations that can interact conceptually to provide a richer understanding of a situation than could be achieved by a monistic approach.

The second point of consensus among proponents and critics alike is that clusters are an appealing concept for sub-national tiers of government (provincial or municipal). Martin and Sunley (2003) and Benneworth and Henry (2004) argue that it is hard for sub-national tiers of government to develop and implement regional economic growth programmes under the influence of a national industrial policy. They see clusters as a means for sub-national governments to demonstrate their opposition to, and independence from, national and federal policies without challenging the overall political legitimacy of the national developmental state. This allows local politicians to meet their own technical and political needs without incurring the wrath of the central government.



## SECTION TWO: THE HEALTHCARE CLUSTER IN JOHANNESBURG

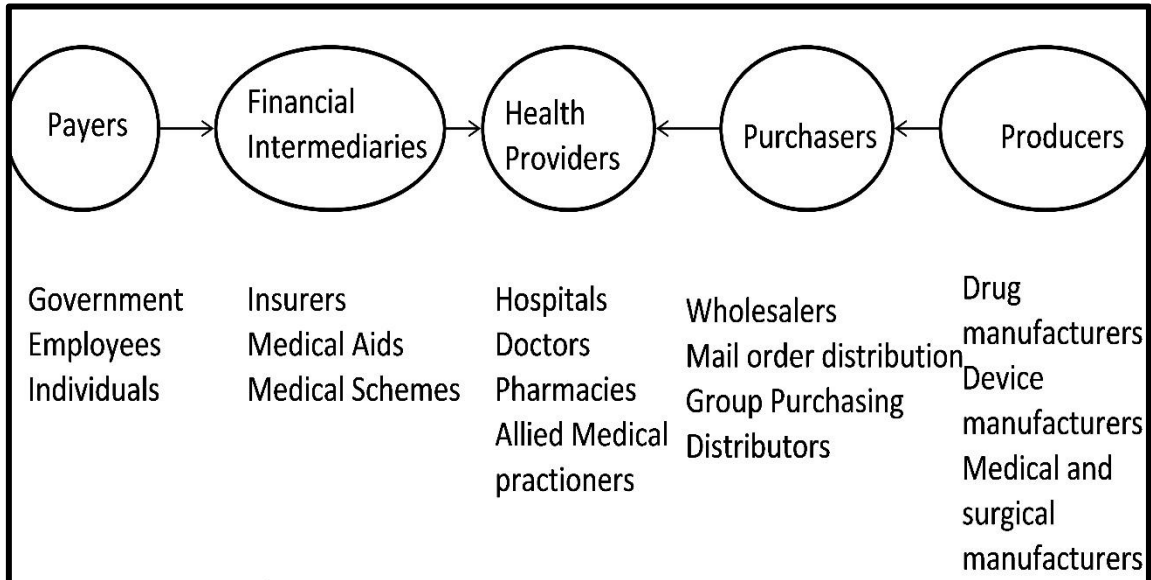
Methodologically, clusters can be conceptualised according to a variety of characteristics.

In this research project the chosen methodology is to create a cluster based on category of membership which the literature (Wolman and Hincapie, 2010; Porter, 2000; Gordon and McCaan, 2000) suggests will involve some combination of:

- A goods or service-producing industry.
- Suppliers or consumers of an industry.
- Business or professional services related to these industries.
- Other industries producing similar products or utilising similar processes.
- Trade associations consisting of firms in an industry or related industries.
- Workers with specialised skills or occupations utilised by these industries.
- Workforce development institutions that provide training and skills.
- Research institutions (R&D facilities and research universities).
- Government as regulator, facilitator, organiser, provider of incentives, investments.

At its most basic, the healthcare industry can be depicted as a simple value chain, as shown in Diagram 1.

**Diagram 1: Health industry value chain**

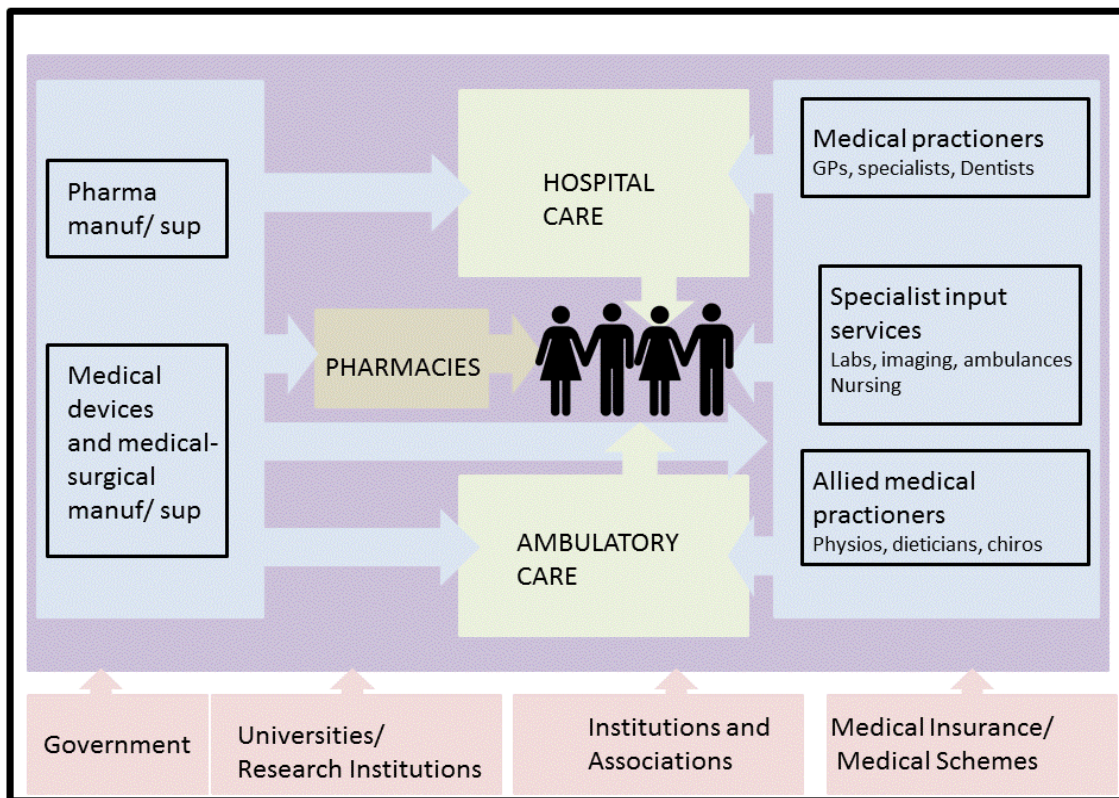


Source: Compiled by S Lowitt, TIPS

The value chain is in cluster terminology reductionist and one dimensional as it fails to capture the interconnectedness of upstream, downstream, side stream, supportive, allied, associated and complementary players.

A broader depiction of the moving parts of a healthcare cluster are shown in Diagram 2.

**Diagram 2: The Healthcare Cluster**



Source: Compiled by S Lowitt, TIPS

The boundary of the cluster is the outer black box and everything inside of the black box is defined as the healthcare cluster. All activities in the inner purple space denote core cluster activities aimed at providing medical care to patients. The four pink boxes which lie within the cluster boundary, but outside core patient activities, are denoted as facilitating activities<sup>1</sup> but are nevertheless crucial for the functioning of the cluster. Although each cluster category of participants will be explained, it is important to explain upfront some unique features of the cluster which determine its operations, and which will impact developmental policies considered potentially appropriate for the growth of the cluster in Johannesburg.

The unique feature of the healthcare cluster is the dominance of third party agents and gatekeepers. When a patient visits a doctor, allied medical worker or a hospital it is natural to assume the patient is the consumer. However, the doctor or clinician decides what tests to run, what surgeries to perform and what pharmaceuticals to prescribe even though the doctor or clinician is not responsible for the payment of the good or service. This means that members of the medical fraternity in the healthcare cluster become third party agents making medical decisions for their patients. As such the medical community becomes the de facto consumers of medical inputs and services even though they are not paying for them.

<sup>1</sup> The inclusion of government as a facilitating activity relates to all government activities over and above those related to the administration of government-funded and run hospitals and clinics which are included in the core activities of the clusters in the form of the green boxes: hospitals and ambulatory care. Government facilitating actions are viewed as including: drafting of legislation and regulations, policy development and support, procurement approaches, support in market and export development.

---

*The existence of third party agents and gatekeepers has a marked impact on overall cluster performance and growth prospects and has significant implications for how successful certain future government interventions may prove to be.*

---

To add to this complexity many patients do not actually pay for the services and products prescribed to them by the medical fraternity. In the case of the indigent, the state usually pays depending on the type of healthcare system in place. In the private sector, most patients rely on a medical scheme to meet healthcare costs. In this private healthcare scenario a funder pays the ultimate healthcare provider (a hospital or a doctor). This places funders in the position of gatekeepers as they can accept or refuse costs delegated to them by third party agents (doctors and hospitals)<sup>2</sup>.

With these distinguishing features an economic understanding of the healthcare cluster is difficult to establish as the basic building blocks of orthodox supply and demand analysis are absent – as is the traditional relationship between price and production and consumption. The existence of third party agents and gatekeepers has a marked impact on overall cluster performance and growth prospects and has significant implications for how successful certain future government interventions may prove to be.

Returning to the healthcare cluster and its component parts: as a general descriptor, healthcare refers to the maintenance or improvement of health via prevention, diagnosis and treatment of disease, illness, injury and other physical and mental impairments in human beings. A healthcare cluster (black box, diagram 2) comprises direct activities related to patient care (purple box) and activities which facilitate and enable direct patient care (pink boxes) to take place. Traditionally, healthcare delivery is described as primary secondary and tertiary. Primary healthcare is the first point of consultation with a patient in need and is most commonly provided by a generalist who deals with a wide range of health and wellbeing problems. Primary healthcare providers are usually community-based clinics or general practitioners. Primary healthcare predominantly deals with accidents, chronic non-communicable diseases (such as diabetes, asthma, back pain and high blood pressure), once-off sicknesses (such as flu or gastroenteritis) and sexually transmitted infections and contraception.

Secondary healthcare is provided by specialists. Patients usually enter the secondary healthcare system through a referral from their primary healthcare provider. Secondary healthcare specialists treat specific diseases and complaints that cannot be dealt with at a general level (such as acute conditions, cancer, kidney failure, blocked arteries or pregnancy complications). Finally, patients may be referred to the tertiary healthcare system which is known as specialised consultative healthcare and includes in-patient care and treatment in a hospital.

---

<sup>2</sup> A medical scheme's ability to accept or refuse costs is regulated by the Medical Schemes Act No. 131 of 1998 which is explained in more detail in the following section. In the public healthcare system codified treatments and approved schedules work in a similar fashion.

The primary, secondary and tertiary descriptions of healthcare delivery are patient-centric and commonly applied by healthcare practitioners and policymakers. Looking at healthcare from an economic cluster perspective, however, requires that businesses, institutions and the intermediate and final suppliers of goods and services be placed as delivery building blocks. This allows for economic linkages to be understood and examined, which ultimately allows the research to identify gaps and growth opportunities in the operations of the cluster.

## Hospitals and ambulatory care facilities

A patient may access medical care through two channels: the ambulatory care system (primary and secondary care where the patient is mobile) or the hospital system (tertiary care where the patient stays at the health facility). The hospital system specifically caters for in-patient treatment and is differentiated by the existence of beds in which patients stay at the institution under 24-hour care. Although most hospitals offer some out-patient (ambulatory) services – the distinguishing feature of a hospital (as opposed to a clinic for example) is that the facility caters for patients staying overnight and requiring round-the-clock treatment. Ambulatory care on the other hand includes all institutions and service providers which offer medical services on a walk-in, out-patient basis. The ambulatory care channel includes: clinics, medical centres, day clinics, doctors' and dentists' consultation rooms and the consulting rooms of allied medical practitioners.

Hospitals include state-run hospitals funded through the fiscus and private sector hospitals which operate on a for-profit basis. Johannesburg is well serviced with 19 public hospitals and 37 private hospitals, servicing a population of just over five million.

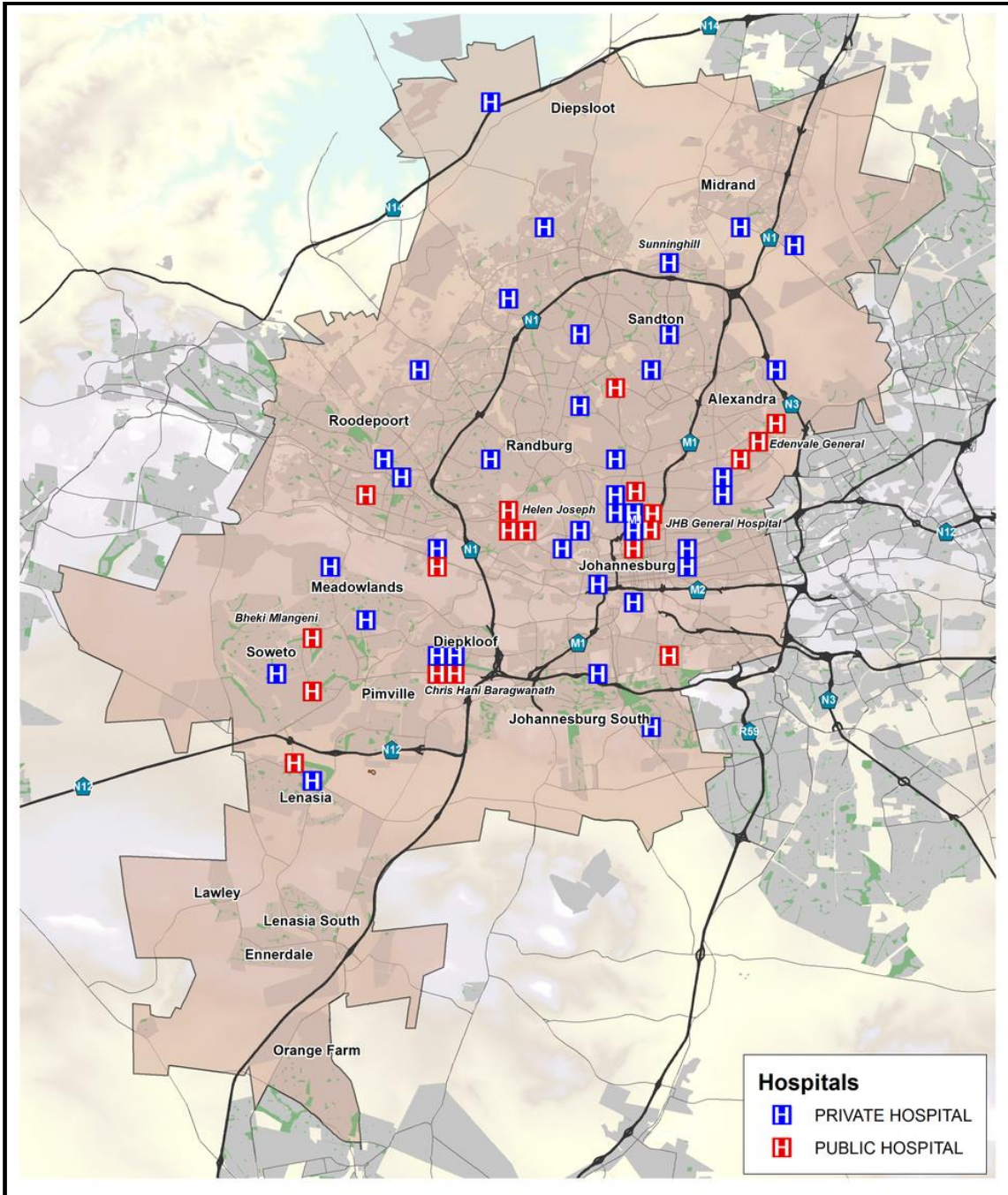
Map 1 shows public hospitals located near strong population densities and relatively well dispersed in support of universal access across the City. Private hospitals are also well dispersed but there is a central sub-cluster around the Auckland Park, Parktown, Rosebank area and then North in the Sandton area

Private hospital ownership in South Africa has become increasingly concentrated since 1994 with three major hospitals groups: Life Healthcare Group Ltd, Netcare Limited and Mediclinic dominating market share together with a handful of independently owned private hospitals. As will be explained later one of the drivers of high level of market concentration in the private hospital sector is the need for hospitals to amass collective power when negotiating with medical schemes. This is achieved partly by mergers and acquisitions and dominant market positions and partly by co-operative behaviour across hospital groups that negotiate as a bloc.

Ambulatory care covers the provision of medical services on an out-patient basis. It is far more extensive than hospital-based care. Out-patient services are available through a myriad of channels including: state or private community clinics, day clinics, medical centres, doctors and allied medical practitioners' consultation rooms. Ambulatory healthcare providers far outnumber hospital providers. There are 95 public and 157 private clinics in Johannesburg without taking into account the number of consulting rooms of medical practitioners and allied medical practitioners. Public sector clinics are operated by both the Gauteng Provincial Government's Department of Health and the City of Johannesburg.



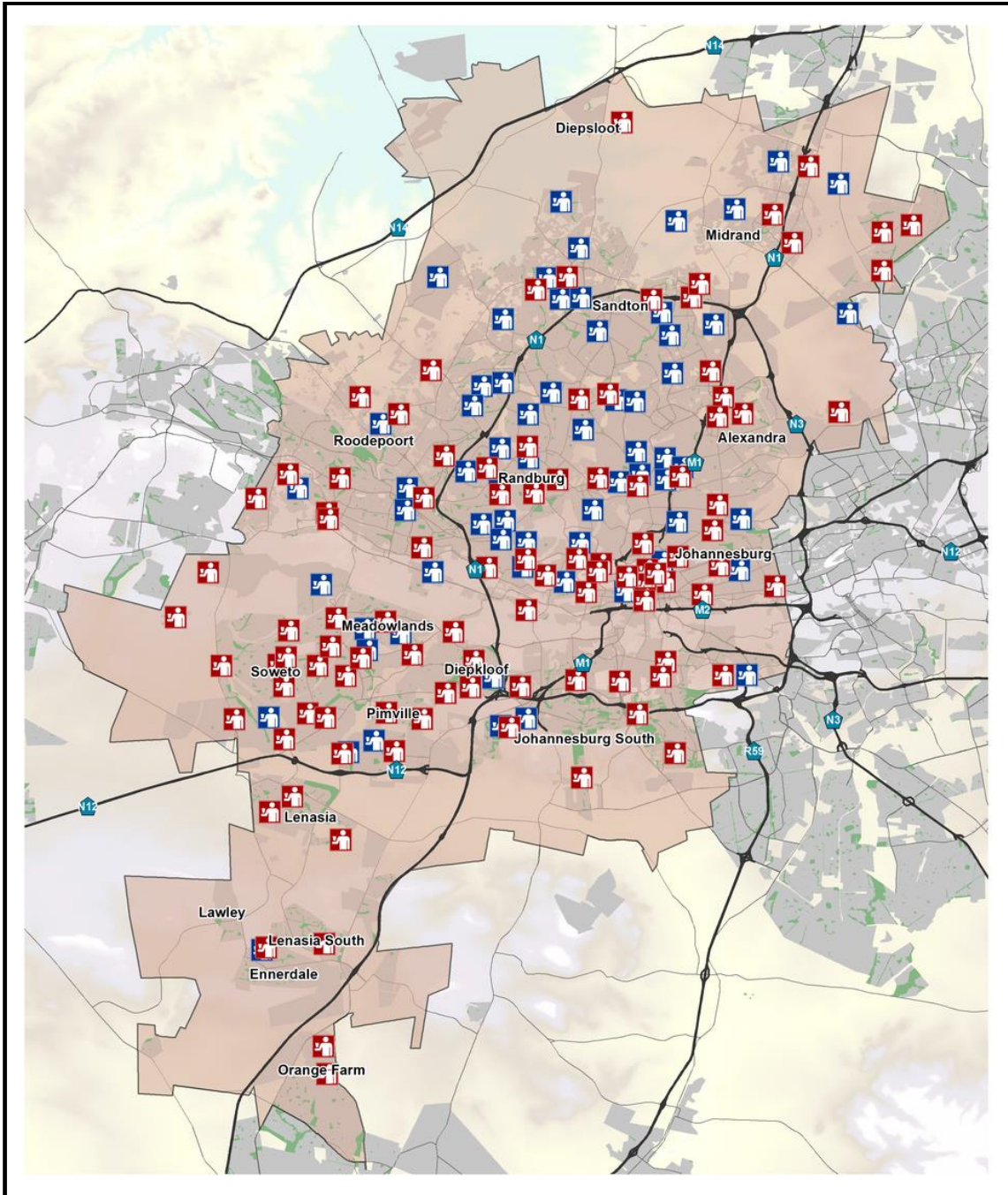
**Map1: State and private hospitals**



As shown in Map 2, public sector clinics (red) are located close to low-income and impoverished communities while private sector clinics (blue) are clustered around high concentrations of populations, especially in more affluent areas.

As is evident in the maps in this section, the city's hospitals and clinics (especially those in the private sector) create a pull around which other cluster participants congregate due to the economic advantages of physical proximity.

**Map 2: Clinics**



The most numerous category of healthcare service providers in the cluster belong to the categories of medical practitioners, specialist input service providers and allied medical practitioners. Each is considered in turn.

### **Medical practitioners**

While ambulatory care and hospital facilities are the two interfaces through which patients receive healthcare services – both the interfaces rely on three core inputs to deliver services: medical practitioners; allied medical practitioners; and specialist input providers. The differentiation between medical practitioners and allied (or para) medical practitioners is



legislation and registration. In South Africa it is illegal to work as a medical practitioner unless you have passed the Medical Board Examination and registered with the Health Professional Council of South Africa (HPCSA) as per the Health Professionals Act No. 56 of 1974. A similar rule applies to dentists, who need to pass the Dental Practitioners Examination and register with the HPCSA. Dentists and doctors with the necessary qualifications and duly registered with the Medical and Dental Board are categorised as medical practitioners. Medical practitioners is thus a narrow category of service provider covering only doctors and dentists. Medical practitioners can be generalists such as family doctors, GPs and physicians or they may specialise in a particular field such as oncologists, dermatologists or pulmonologists. Table 1 lists the main specialities taught and registered in South Africa.

**Table 1: Medical practitioners – Key fields of specialisation**

<b>*Anaesthetists</b>	<b>* Obstetricians and gynaecologists</b>	<b>*Public health practitioners</b>
<b>*Cardio thoracic surgeons</b>	<b>*Ophthalmologists</b>	<b>*Radiation oncologists</b>
<b>*Clinical pharmacologists</b>	<b>*Orthopaedic surgeons</b>	<b>*Radiologists</b>
<b>*Dentists</b>	<b>*Otorhinolaryngologists (ear, nose and throat specialists - ENTS)</b>	<b>*General surgeons</b>
<b>*Dermatologists</b>	<b>*Paediatric surgeons</b>	<b>*Urologists</b>
<b>* Emergency medicine practitioners</b>	<b>*Paediatricians</b>	
<b>* Family physicians</b>	<b>*Pathologists</b>	
<b>* Maxillofacial and oral surgeons</b>	<b>*Physicians</b>	
<b>*Neurologists</b>	<b>*Plastic surgeons</b>	
<b>*Neuro surgeons</b>	<b>*Psychiatrists</b>	

Source: [www.wits.org.za](http://www.wits.org.za)

Medical practitioners operate using one of three business models. First, they can operate as sole proprietors running their own enterprise (known as a practice) with private consulting rooms in a residence, business park or other building. Second, they can form a partnership or company operating as a larger medical practice where several individual medical practitioners in similar or complementary fields set up a joint enterprise. Third, a medical practitioner can operate out of a hospital. Hospital-based medical practitioners can either deal only with in-patients who have been admitted to a hospital ward; or they may operate a dual business model where they treat both private, ambulatory patients and in-care, hospital patients.

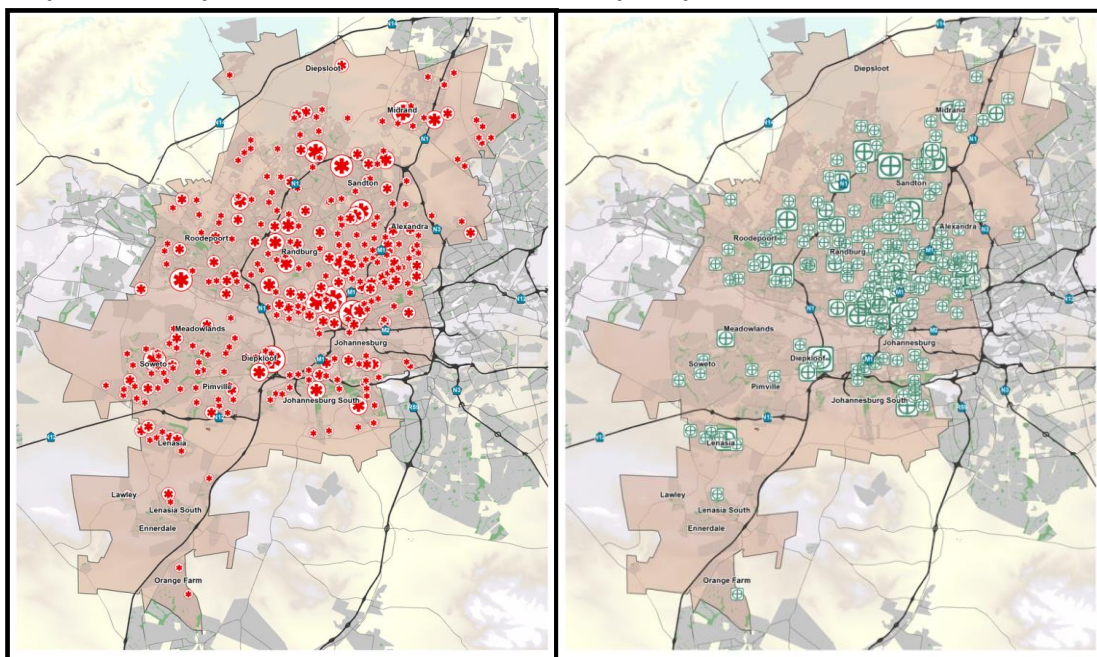
In the private sector, medical practitioners render a service directly to their patients and seek payment either by invoicing the patient directly or invoicing the patient's medical scheme. Legally the patient who has received such private treatment is ultimately liable for payment. It is estimated that there are just over 23 000 doctors and dentists in South Africa with seven out of 10 doctors and nine out of 10 dentists working in the private sector (Gauteng Department of Health Overview, 2017). Using desktop research and interviews, the researchers were able to identify and map 4 019 private sector doctors and 827 private sector dentists operating as sole proprietors or in larger medical practices in the Johannesburg area. The researchers were unable to establish the number of doctors and dentists operating out of private sector hospitals and clinics but calculate this number to be approximately an additional 3 500 medical and

dental practitioners. This suggests that there are close to 8 000 medical practitioners in the private sector in City of Johannesburg. Estimations based on health department statistics at a national and provincial level suggest that there are approximately 1 600 fully qualified medical practitioners in the public sector in Johannesburg and a further 2 000 student medical practitioners in the city. As a grand total it is estimated that there are over 11 000 medical practitioners servicing the population of Johannesburg.

Maps 3 and 4 indicate the location of general practitioners and specialists across the country. GPs are well-dispersed servicing all communities and large areas of the population, while specialists distinctly seem to cluster around private hospitals and clinics. This leads to a strong central cluster running from Auckland Park/Parktown and Rosebank up into the Sandton/Fourways/Bryanston area.

**Map 3: General practitioners**

**Map 4: Specialists**



### Allied medical practitioners

Allied medical practitioners is a large composite category of healthcare cluster service providers. The category is divided into three sub categories: allied practitioners involved in patient care and registered with the appropriate HPCSA Board; allied practitioners who work behind the scenes and do not regularly interface with patients but are registered with the appropriate HPCSA Board; and alternative practitioners who are not registered.

The first category South of allied medical practitioners includes people working in ancillary medical fields, who are registered with one of the 11 Boards of the HPCSA – but are not medical practitioners as defined by the HPCSA. Examples of allied medical practitioners are: physiotherapists, oral hygienists, speech therapists, psychologists and dieticians. A complete list of all recognised allied medical practitioners as per the HPCSA is shown in Table 2.



**Table 2: Allied medical practitioners registered with the HPCSA**

<b>DENTAL ASSISTING, DENTAL THERAPY AND HYGIENE BOARD</b>	<b>PHYSIOTHERAPY, PODIATRY AND BIOKINETICS BOARD</b>
Oral hygienist	Physiotherapists
Dental assistant	Physiotherapist assistants
Dental Therapist	Physiotherapist technicians
<b>DIETETICS AND NUTRITION BOARD</b>	Remedial gymnasts
Dieticians	Masseurs
Nutritionists	Podiatrists
<b>MEDICAL TECHNOLOGY BOARD</b>	Biokineticists
Medical laboratory scientist	<b>PSYCHOLOGY BOARD</b>
Medical technologist	Psychologists
Medical technicians	Registered counsellors
Laboratory assistants	Psychometrists
<b>OCCUPATIONAL THERAPY, MEDICAL ORTHOTICS, PROSTHETICS BOARD</b>	Psycho technicians
Occupational therapist	<b>RADIOGRAPHY AND CLINICAL TECHNOLOGY BOARD</b>
Occupational therapy technicians	Clinical technologist
Medical orthotics and prosthetics	Radiographers
Orthopaedic footwear technicians	Electro encephalographic technicians
Orthopaedic technical assistants	Radiation laboratory technologist
Assistant medical orthotics and prosthetics Art therapists (drama, music, art)	
	<b>SPEECH LANGUAGE AND HEARING PROFESSIONALS BOARD</b>
<b>OPTOMETRY AND DISPENSING OPTICIANS BOARD SPEECH LANGUAGE AND HEARING PROFESSIONALS BOARD</b>	Hearing aid acoustician
Dispensing opticians	Audiometrician
Optometrists	Speech hearing and correctionist
Orthoptists	Community speech and hearing worker
	Speech therapist assistant

Source: [www.hpcsa.co.za](http://www.hpcsa.co.za)

Allied medical services are often seen as complementary to medical practitioners' services. For example, an orthopaedic surgeon who replaces a patient's knee will send the patient to a physiotherapist to achieve healing, strength and mobility after surgery. Likewise a cardiologist may send an at-risk patient to a dietician. Although patients usually visit allied medical practitioners on the referral or suggestion of a medical practitioners, some patients self-diagnose and visit an allied medical service provider without first consulting a medical practitioner. Allied medical practitioners can operate in this manner using the same business models as medical practitioners. They can run a private practice, a joint practice, or operate out of a hospital seeing either in or outpatients or a combination of the two. Legally it is permissible to operate a practice in some allied medical fields (dietician, art therapist, counsellor) without being registered with the appropriate HPCSA Board but such practices and practitioners will not be recognised by medical practitioners, hospitals or, importantly, medical schemes.

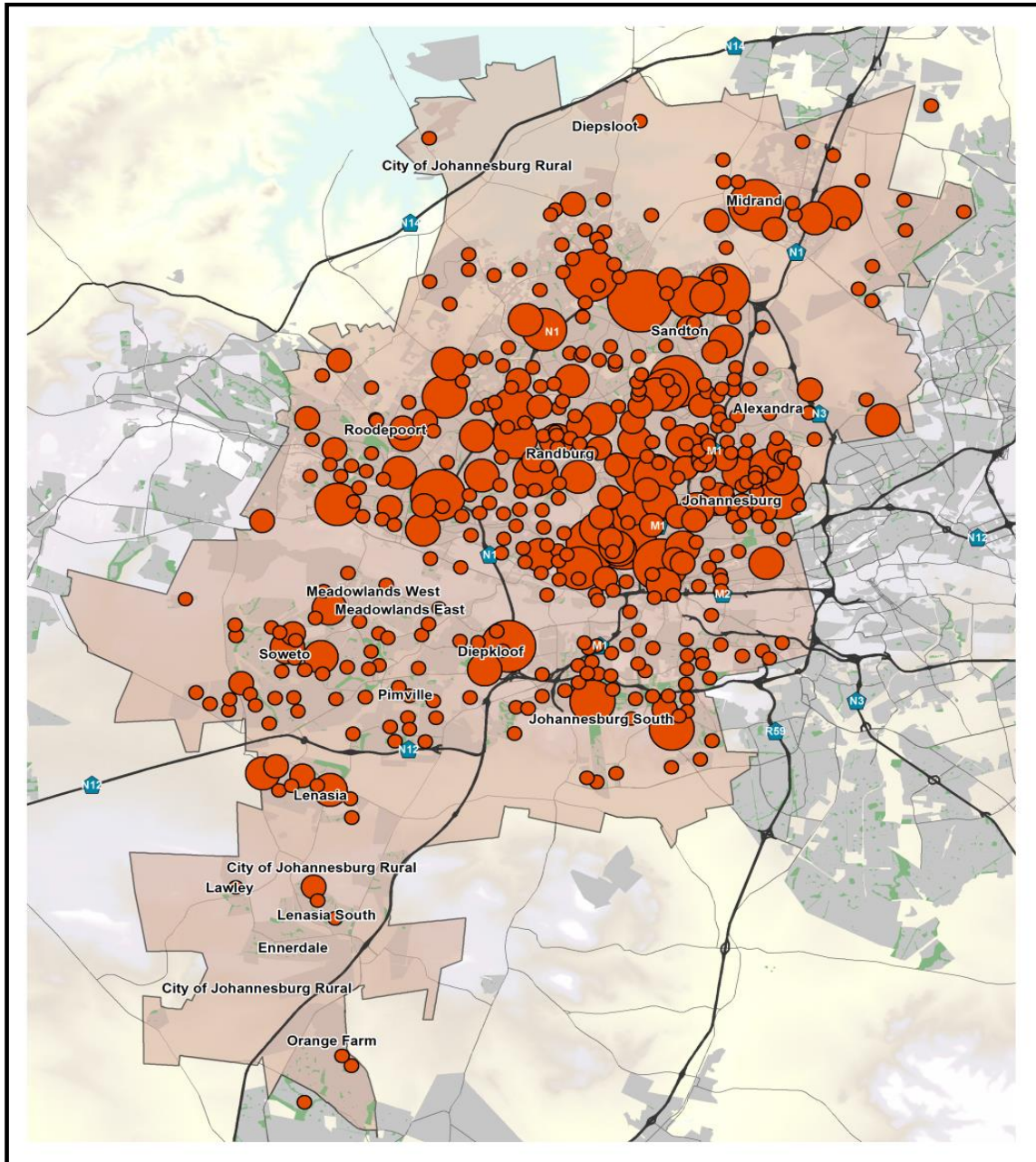
Given the highly complementary relationship between medical treatment and the need for allied medical treatments it is unsurprising to see in Map 2 that in Johannesburg allied medical practitioners exhibit a strong clustering around medical practitioners, hospitals and clinics. The map also reveals several outliers of allied medical practitioners operating in what appears to be isolation from the strong existing cluster core. This is explained mainly by allied practitioners who see patients not referred by doctors and who often set up practices close to shopping centres, gyms, other clusters of highly concentrated populations, or people who work from home.

The second sub-category of allied medical practitioners includes behind-the-scenes personnel who often do not interface directly with patients but who facilitate and allow medical, allied medical practitioners and specialist input providers to offer their services. This category can be thought of as intermediate service input providers to final service providers. It includes all technicians, laboratory workers and medical technologists (who perform and interpret test results such as blood tests, bacterial cultures and tissue biopsies). General and specialised technicians (as opposed to medical technologists) are involved in maintaining or assisting with the physical equipment and devices used by medical and allied practitioners. For example, an orthopaedist will have technicians who make castings of patient's feet and create orthotics based on the mould, while a radiographer will employ a clinical technologist to take the X-ray which the radiographer, who is a medical practitioner, will then analyse and use to assist with a patient's diagnosis. For certain categories of behind-the-scenes technical and laboratory staff, registration with the appropriate HPCSA Board is required. This is especially true in formal situations such as state and private hospital chains. In some private practices a medical practitioner or allied medical practitioners may be prepared to forgo having an HPCSA-registered technician but this leaves the practitioners open to law suits and non-payment by medical schemes. As will be shown, there is an overlap between this sub-category of allied medical practitioners and specialised input providers covered in the next section. This overlap arises due to the complexity and interconnectedness of the healthcare cluster.

The final category of allied medical practitioners is known as alternative practitioners and these are service providers in an allied medical field who are not eligible for registration under any of the HPCSA's Boards and are not covered by the Health Professions Act No. 56 of 1974. They include Ayurveda, Chinese Medicine and Acupuncture, Chiropractic, Homeopathy, Naturopathy, Osteopathy, Phytotherapy, Therapeutic Aromatherapy, Therapeutic Massage Therapy, Therapeutic Reflexology and Unani-Tibb.

Given the breadth of services covered in the category of allied medical practitioners, it is hard to land on a strong estimate of how many practitioners currently operate within the City of Johannesburg. Using official and commercial sources of data and interviews the researchers were able to identify and map almost 7 000 allied medical practitioners in the private sector. If it is assumed that the public sector-private sector ratios for this category is similar to that among medical and dental practitioners, it would suggest that including the public sector there are probably close to 9 000 allied medical practitioners in the City of Johannesburg. It has been suggested in interviews that this number may be an underestimation of up to 20%.

**Map 5: Allied medical practitioners**



Map 5 shows the substantial number of allied medical practitioners operating in the city. Although well dispersed, there is a strong sub-cluster in the central area of the city map stretching from Auckland Park up to Sandton in the North. The densest population and concentration of providers exists around hospitals and clinics, showing the strong complementary relationship between the two.

### **Specialist input services**

Along with medical and allied medical services the third key input required to offer healthcare services to patients (through either the hospital or ambulatory interface) is specialist input services. There is an overlap between these specialised input services and allied medical practitioners but they have been separated out because of the different business models by

which services are rendered, different investment decisions and different clustering behaviour. The three main specialist inputs are: laboratory services, imaging, and emergency care. Nursing has been added as a fourth specialist input service.

In South Africa laboratory services are usually referred to as pathology services. Medical practitioners and some allied medical practitioners use pathology tests to assist in diagnosing a patient's condition or ailment. In this procedure a specimen (blood, urine, tissue) is collected from the patient. The laboratory is then responsible for the management of the specimen (storage, transport, safety and ultimately disposal); the testing of the sample; providing the result of the testing; and finally the interpretation of that result. Laboratory testing is a crucial input to modern medical care and is a tool all medical practitioners and a number of allied medical practitioners rely on to perform their jobs.

The key departments or specialisations in medical laboratories are: analytical chemistry, chemistry, coagulation, cytogenetics, cytology, haematology, microbiology, molecular biology and virology. Domestically there is also specialisation in tuberculosis and HIV/Aids testing due to high incidence levels.

Laboratories use advanced, sophisticated equipment, which is usually imported and extremely expensive. In addition, laboratory services must be accredited through the South African National Accreditation System (SANAS) and comply with International Organization for Standardization (ISO) 15189 for main laboratories and ISO 9001 for all support departments. This makes the barriers to entry into this sector extremely high and, as expected, the domestic market is highly concentrated.

There are two dominant players in the laboratory space: the National Health Laboratory Services (NHLS), which is responsible for all laboratory testing in the public sector and Lancet Laboratories, the dominant private sector provider. There are a handful of smaller independent laboratories but their service offering is limited. Laboratories are run by certified technicians and medical technicians who are captured under allied medical practitioners, as explained above. Pathologists are medical practitioners registered with the Medical Board of the HPCSA.

NHLS laboratories are found only in state-run hospitals and health facilities. Lancet and other private sector laboratory providers are found in multiple locations including large facilities within private hospitals and standalone offices near clusters of medical practitioners.

In the private sector, laboratory services are billed to clients separately from invoices from medical and allied medical practitioners. As is shown below laboratory services are clustered around medical practitioners and ambulatory and hospital clusters. This is not only to offer convenience to patients but to ensure economies of scale, given the upfront investment of expensive equipment required to perform the range of diagnostic tests required by medical and allied medical practitioners.

The NHLS runs 260 laboratories countrywide of which at least 40 are in Johannesburg. Lancet operate more than 400 laboratories with 86 in Johannesburg.

The second specialist input into direct patient care in the healthcare cluster is imaging services. Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues (physiology). Medical imaging seeks to reveal internal structures hidden by the skin and bones, and to diagnose and treat disease. Like laboratory services, imaging is a form of diagnostic tool used by medical and allied medical practitioners to assist with patient diagnosis and care.

Technology development in medical imaging has made this input one of the fastest growing branches of medicine. Current imaging technology includes: X-ray radiography, magnetic resonance imaging, medical ultrasonography, ultrasound, endoscopy, elastography, tactile imaging, thermography, medical photography and nuclear medicine functional imaging techniques such as positron emission tomography (PET) and single-photon emission computed tomography (SPECT). Imaging departments are run by radiographers and related technical support staff, all of whom are registered under the Radiography and Clinical Technology Board of the HPCSA. To an even greater extent than laboratory services, the initial investment in capital equipment necessary for imaging is enormous with magnetic resonance imaging (MRI) machines costing from US\$150 000 for an entry-level scanner to US\$1.2 million for a state-of-the-art scanner. With such large and lumpy investments, the provision of imaging in the healthcare cluster is dominated by the need to ensure economies of scale by using machinery at as near to full capacity as possible. For this reason, 90% of imaging technology exists in hospitals, where high volume usage is assured. Imaging equipment is in most cases owned outright by the hospital although many hospitals outsource the actual day-to-day operation and billing of their imaging services to third parties. As with laboratory testing, patients are ultimately responsible for the final cost of imaging services consumed in the private sector. In the public sector, imaging costs are covered by the Department of Health.

The remaining 10% of imaging services not sited in hospitals exists in the form of specialist radiography practices most often located close to clusters of medical practitioners. Most of these standalone practices use less expensive technology such as traditional X-rays and ultrasounds only. Recently some niche imaging boutique practices have surfaced most especially in the PET scan market where patients (without referral from a medical practitioners) seek scans to rule out any potential underlying diseases as part of a wellness and proactive approach to individual health.

As will be shown, the creation of imaging technology and R&D is an area of strength for South Africa.

The third specialist input service in the healthcare system is emergency care services – specifically ambulance services. Emergency services are dedicated to providing out-of-hospital acute medical care, transport to definitive care, and other medical transport to patients with illnesses and injuries which prevent the patient from transporting themselves. Emergency services use the skills of paramedics, ambulance drivers and assistants and emergency care technicians and practitioners. In the case of air ambulances, pilots and flight medical staff are also used.



In South Africa there is a public sector emergency service system with ambulance services provided by municipal and provincial governments but funded from the national fiscus; and a private sector emergency care system with ambulance services provided by private sector companies, non-governmental organisations (NGOs) and charitable and community-based organisations. The largest private sector emergency care providers are profitmaking companies such as Netcare911 (a wholly-owned subsidiary of the Netcare hospital group) and Emergency24.

The dominant providers in the local industry offer a complete range of emergency assistance including rapid response and rescue and extrication services. For example, the Netcare911 fleet alone includes: 200 emergency vehicles, 60 rapid response vehicles, 135 ambulances, four dedicated mobile intensive care unit (ICU) transporters, three extraction and rescue vehicles as well as helicopter and fixed-wing aero-medical services. A large number of smaller operators also offer narrower transport services. In the public system, 790 ambulances currently service the Gauteng population. In the public sector, rescue services are performed by the fire brigade not the ambulance service although often both services are required.

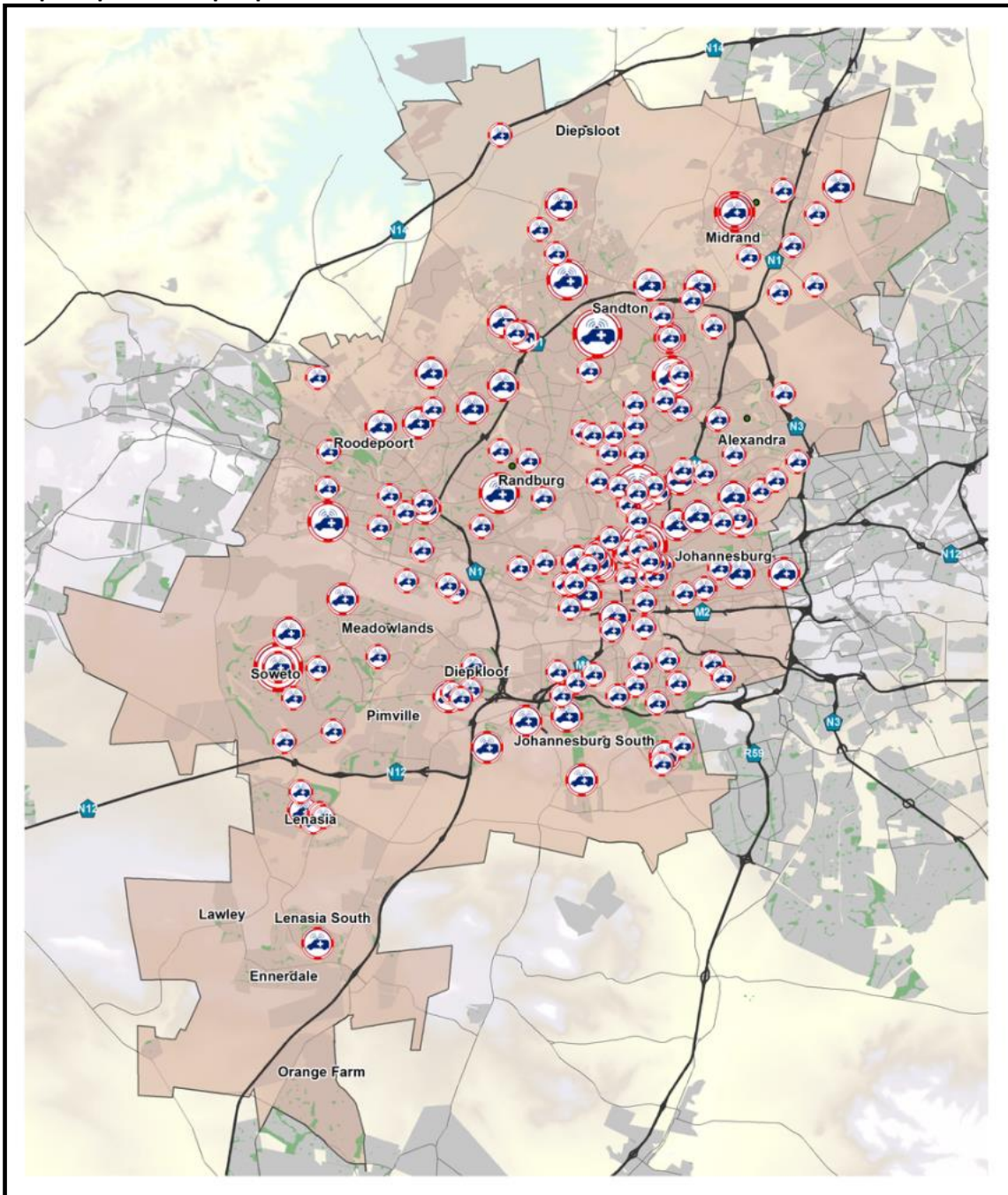
The emergency care service sector is often overlooked in the overall healthcare cluster but is not only vital in terms of patient care but is economically a large sector with substantial capital investment and employment.

The final specialised input into direct patient care is nursing. Nurses in South Africa must be registered with the South African Nursing Council (SANC) in terms of the Nursing Act No. 33 of 2005. Nurses can be registered based on different qualifications related to different categories and limitation of what care they may offer. Some nurses who provide the most basic welfare (non-clinical) care to patients have a higher certificate in nursing; while nurses allowed to offer clinical care to patients usually have a three-year Bachelor's Degree in Nursing. Nurses with a tertiary degree are also able to specialise and obtain certification, as for example an orthopaedic nurse specialist or paediatric nurse specialist. Nurses are used in virtually every medical setting to assist medical practitioners care for and treat patients. They are most densely concentrated in hospitals where they assist in procedures, administer medication, monitor and care for patients. They are also often found in private consulting rooms of medical practitioners especially where small outpatient procedures are undertaken. Interestingly, costs associated with nursing care are never billed to patients directly and are rather viewed as overhead costs borne by the hospital, clinic or individual medical practitioners.

Nurses are by far the most numerous of all the categories of healthcare cluster participants. Of the 287 000 nationally registered nurses, 75 000 are employed in Gauteng. Johannesburg is home to Wits and UJ, both of which offer bachelor and post graduate degrees in nursing, and there are three nursing colleges which offer certificate and diploma courses. Nurses registration is based on home addresses of duly registered members and not based on place of employment. As it was not possible to contact each private and public hospital in Johannesburg to determine staffing numbers, no mapping of these cluster participants is included. Nevertheless it is obvious by definition that most nursing participation will take place where hospitals and medical practitioners concentrations are identified.

Collectively the specialised service providers of laboratory services, imaging services, emergency care and nursing support the medical and economic activity taking place through the channels of ambulatory care and hospital care. The services support direct patient care and are crucial to the activities of medical and allied medical practitioners. The depth and interconnectedness of the relationship is evident in the close physical proximity between such specialised inputs and concentrations of hospitals and sub-clusters of medical practitioners. This makes sense not only for patient care and convenience but more importantly economically in terms of very high service complementarity and the underlying need to achieve economies of scale to drive down costs.

**Map 6: Specialist input providers**



The pattern of population density around private hospitals and less around public hospitals seen in Map 6 can probably be explained by a phenomenon noted in an analysis of hospital clustering in America. It was found that very large hospitals enjoyed internal economies of scales, but that they attracted fewer associated service providers to the area because most services are offered in-house. This would explain the lack of a strong expanded cluster of specialist input providers around Chris Hani Baragwaneth Hospital for example. On the other hand where smaller hospitals appeared in proximity to each other, additional services crowd into the area due to outsourcing behaviour. The economies of scale made available by multiple hospitals outsourcing activities such as laboratory testing, imaging or allied medical services allows smaller hospitals to enjoy similar cost reductions as those in large (usually public) institutions.

### **Pharmaceuticals and medical product inputs**

In Diagram 2 (page 18) the blue box on the right-hand side of the purple direct patient care box in the overall healthcare cluster is made up of medical practitioners, allied medical practitioners and specialist input services, as explained.

From a cluster perspective, these participants are viewed as the core service providers that interface with their market (patients) through either the hospital or ambulatory care interface. As explained earlier, the boundaries of a cluster do not comply with traditional industrial or sectoral classifications but allow for a broader analysis of associated and complementary activities that underpin all aspects of the final product offering – in this case offering healthcare to patients. As such it is insufficient in the healthcare cluster to only consider the services offered to patients directly by medical, allied and specialist input service providers. It is also necessary to follow back to source all the inputs which are used by these service providers and to look at the value chains behind these intermediate and final inputs. For example, a pathology laboratory technician will use a syringe, tubing, cotton wool and a plaster during the completion of a simple blood test and then chemicals, diagnostic strips and capital equipment and consumables to complete the diagnostic testing. Similarly, a cardiac surgeon will use a heart lung bypass machine, scalpels, sutures, cardiac catheters and electrocardiogram (EKG) monitor and anaesthetics during heart surgery and a host of pharmaceutical drugs after surgery; while a physiotherapist will use gels, creams and rubs, disposable paper bed protectors, heat lamps and muscle relaxants to treat a back spasm. These items can be thought of as indirect inputs to the healthcare supply chain but – within the parameters of a cluster study – they are vitally important inputs of the same importance as the direct inputs on the right of the cluster diagram. Essentially, modern medical care could not be provided in the absence of these inputs and as such they are a key determinant in the overall activities of the healthcare cluster.

Within the healthcare cluster a differentiation is made between two key categories of inputs which support medical, allied medical and testing services: pharmaceutical inputs and medical device inputs. Together the two input industries are estimated at ex-factory prices of R55 billion (the dti, 2014), which make them a significant industrial input sector.



---

*The defining characteristic of the South African pharmaceutical market is that out of the R36 billion of sales only 35% of pharmaceuticals are produced locally with a substantial 65% of all South African pharmaceuticals being imported.*

---

## Pharmaceuticals

Pharmaceutical firms discover, develop, produce and market drugs or pharmaceutical drugs which are then dispensed to patients (customers) either through a script issued by a medical practitioner or over the counter at a retail pharmacy. The Medicines Control Council applies standards laid down by the Medicines and Related Substances Act No. 101 of 1965, which governs the manufacture, distribution, sale, and marketing of medicines. The prescribing and dispensing of medicines is controlled through the determination of schedules for various medicines and substances. The council, in considering whether a medicine is suitable for use for its intended purpose, assesses its relative risk against the benefits. The Medicines and Related Substances Act No. 101 of 1965 defines a medicine as “any substance or mixtures of substances used or purporting to be suitable for use or manufacture or sold for use in:

- a. the diagnosis, treatment, mitigation, modification, or prevention of a disease, abnormal physical or mental state, or the symptoms thereof in humans, or
- b. restoring, correcting, or modifying any somatic or psychic or organic function in humans, and includes any veterinary medicine.”

The pharmaceutical market in South Africa is valued at R36 billion annually of which R23.5 billion is spent by the private sector and R12.5 billion by the public sector. The difference in value between the private and public sectors’ spend relates not only to the volume of medicines used but the fact that the public sector traditionally uses generic medicines (80% of all purchases) which are cheaper per unit than medicines still under patent, which are more commonly found prescribed in the private sector (37% of purchases).

The defining characteristic of the South African pharmaceutical market is that out of the R36 billion of sales only 35% of pharmaceuticals are produced locally with a substantial 65% of all South African pharmaceuticals being imported. This makes pharmaceutical imports the fifth biggest contributor to the national deficit. This was not always the case. The South African pharmaceutical industry was relatively robust until the decimation of the industry between 1998 and 2005, predominantly due to a new global trend of consolidation, mergers and acquisitions. In this period of seven years the local industry lost 37 manufacturing plants and over 6 000 jobs. Starting in 2003, the dti began a pharmaceutical industry revival programme based on the idea of import substitutions with (by its own admission) mixed results (the dti, 2014). Currently there are four large local producers: Aspen, Adcock Ingram, Cipla and Sanofi. Their production is bottom heavy, with mixing and final tablet and capsule production taking the place of more sophisticated formulation capacities.

Pharmaceuticals comprise active pharmaceutical ingredients (APIs) and non-active ingredients (binding materials, flavourings and dyes). In almost all cases in South Africa all APIs are imported, thus even though there is local production of final tablets and capsules, supply in the local market is still dependant on a core imported component. In addition, domestic manufacture of vaccines has ceased completely since 2000 and the manufacture of biological medicines is struggling to attract investment despite attempts by the government to support both niche markets. The government continues to take an active role in the industry, especially in the production of antiretroviral (ARV) drugs, given that the country has the largest ARV programme in the world servicing 2.2 million people in the public sector and 150 000 people in the private sector.

Of the top four pharmaceutical producers in the country, two manufacturing factories are located in Johannesburg – Adcock Ingram's recently updated plant in Wadeville and Sanofi's state-of-the-art facility in Midrand. The two facilities stand out as they are the only inland factories, with other producers preferring to be near to sea ports through which their APIs are imported.

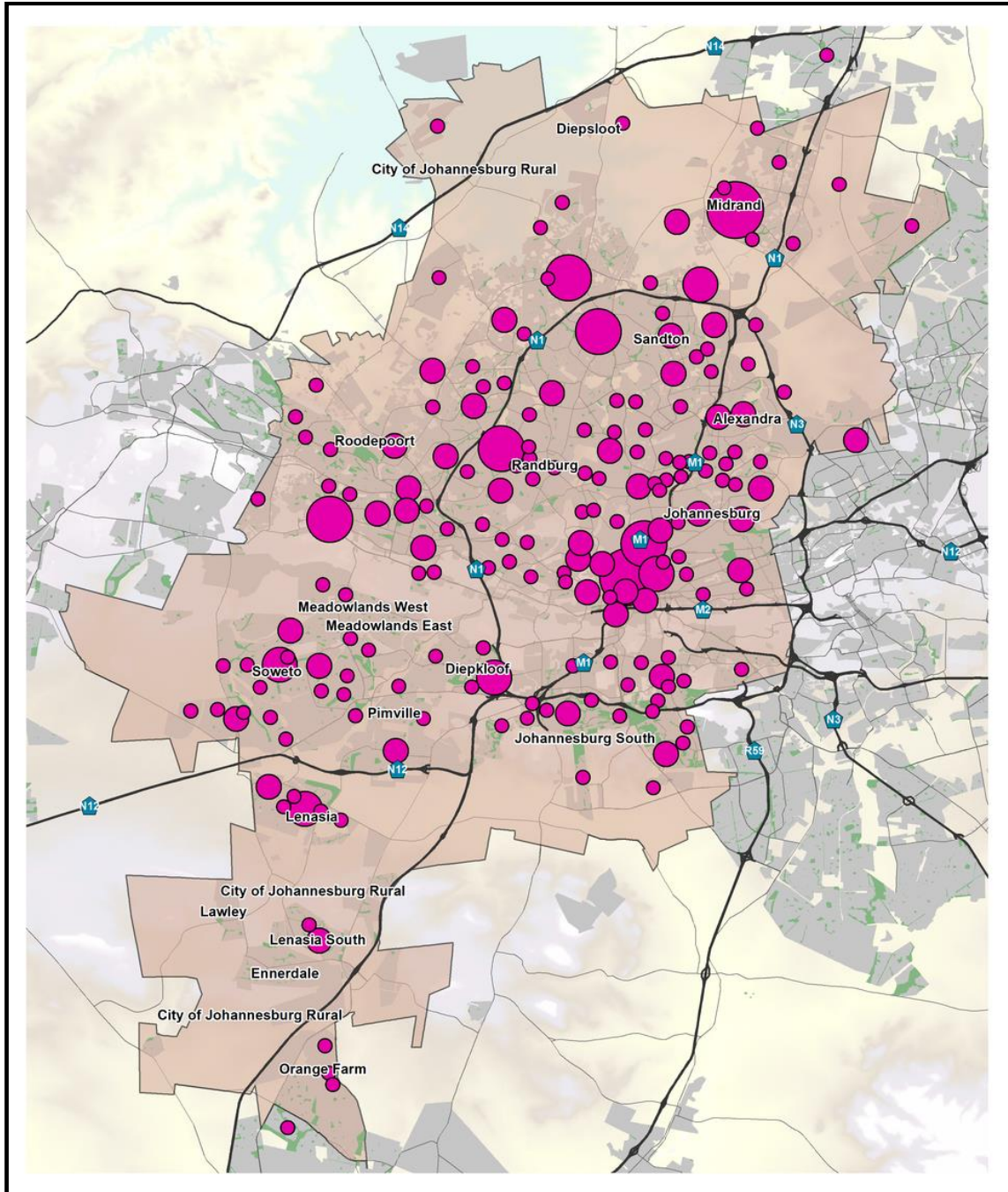
## Pharmacies

Final pharmaceutical products are categorised according to a schedule system set out by the Medicines Control Council (MCC). Scheduling is affected by toxicity, how safe a medication is to use, the illness it treats, the need for professional diagnosis, the potential for dependency or abuse, global practices, and patients' need for access to the medicine. The scheduling system runs from 0 to 8. Schedule 0, 1 and 2 drugs are defined as being safe to use *without* the need to consult a medical professional as the symptoms for its use are easily recognised by the patient. This means that these products can be purchased over the counter. Examples include: aspirin, some cough mixtures, low dosages of paracetamol, and vitamins. Schedules 3 to 6 drugs are only available with a prescription, which means a medical practitioner must approve the use of the drug for the patient for a given period. Prescribed medicines can only be dispensed by an accredited pharmacist registered with the South African Pharmacy Council (SAPC). The dispensing of drugs takes place through in-house hospital dispensaries and in the retail sector. Retail pharmacies include those operating through chain stores (for example Medirite, Clicks and Dischem) and a large number of local and community pharmacies known as independents. Pharmacies sell both over-the-counter drugs (schedules 0, 1 and 2) and prescription drugs (schedules 3 to 6).

Recently, because of limits on dispensing fees and single exit prices for pharmaceuticals, the business model of most retail pharmacies has changed to incorporate cross-selling and associated merchandise to assist in maintaining profitability now that dispensing revenue and profits on pharmaceuticals has been capped. Pharmacies now sell soaps, bath products, vitamins, cosmetics and even sweets and toys in an attempt to stay in business. SAPC estimates that for independent pharmacies, 80% of revenue is still earned from the dispensing and sale of medication while 20% is earned by selling other healthcare and related household products. For the large chain stores such as Clicks and Dischem 35% of sales are derived from medicines and 65% from associated goods and cross merchandise. This change in the business model and the expansion of large retail pharmacy chains such as Clicks and DisChem have all eroded the profitability and existence of smaller neighbourhood pharmacies, resulting in a decrease in the

number of such retailers in the past five years. Despite this trend, the pharmacy interface in Johannesburg is still substantial. Research shows that there are 27 pharmacies in public hospitals, 34 pharmacies in private hospitals and 390 retail pharmacies in the city. Their distribution across the city is seen in Map 7.

**Map 7: Pharmacies**



The distribution of pharmacies covers all major concentrations of population with again a visibly strong sub-cluster in the central area around Auckland park/Parktown/Rosebank and Parktown North. Sandton and Randburg are also well serviced.

## Definition of a medical device

In the new regulations a medical device is defined as:

“Any instrument, apparatus, implement, machine, appliance, implant, in vitro reagent or calibrator, software, material or other similar or related article-

- (a) intended by the manufacturer to be used, alone or in combination, for human beings for-
  - (i) diagnosis, prevention, monitoring, treatment or alleviation of 25 diseases;
  - (ii) diagnosis, prevention, monitoring, treatment or alleviation of or compensation for an injury;
  - (iii) investigation, replacement, modification or support of the anatomy or of a physiological process;
  - (iv) supporting or sustaining life;
  - (v) control of contraception;
  - (vi) disinfection of medical devices; or
  - (vii) providing information for medical or diagnostic purposes by means of in vitro examination of specimens derived from the human body; and
- (b) which does not achieve its primary intended action in or on the human body by pharmacological, immunological or metabolic means, but which may be assisted in its intended function by such means.”

## Medical devices

The medical devices market is considerably less well known and understood than its pharmaceutical input equivalent. This is despite the pervasiveness and contribution of such devices to successful patient care and health outcomes. Indeed, until December 2016, there was no regulation of the medical devices sector in South Africa and even a formal definition of what they were did not exist.

There are a staggering 300 000 different medical devices in the local market. From a lay perspective these are usually divided into five categories.

The first are **single-use devices** and cover everything designed to be used once on a patient and then discarded. These products are also called consumables and are viewed as low risk by the soon-to-be regulators. Examples of medical device consumables are: syringes, tongue depressors, bandages, plasters, and paper bed protectors. These products are traditionally high-volume, low unit-value items and are produced without a patent or under licence. While materials used in the production of these consumables is covered by ISO standards and other quality tests, production is not highly regulated because of the low-risk nature of the good.

The second category of medical devices are **invasive devices** which are also single-use devices but are inserted or absorbed into the body of the patient and remain there in perpetuity or until they need to be replaced. These invasive devices range from being moderate to high-risk and include products such as replacement heart valves, stents for arteries, pacemakers and replacement hip and knee joints. These products are high-value, low-volume products and are produced under stringent quality control to the highest standards under licence or under a patent.

---

*The South African government values the medical devices market at about R14 billion. Private sector players in the industry believe this is a substantial underestimation of the sector and value it at approximately R24 billion. If the distinctive feature of the supply of pharmaceutical inputs to the healthcare cluster in South Africa was the dominance of imports, this feature is even more prevalent in relation to medical devices. A staggering 90% of the medical devices market in South Africa is serviced by imported products.*

---

The third category of medical devices are commonly referred to as **machinery and monitoring equipment**. These products are designed to be used on multiple patients and are thus not consumed, as are the other two categories. These products are usually viewed as capital equipment given their lifespan and non-consumable nature.

Machinery and monitoring equipment includes imaging and laboratory equipment, monitoring equipment and equipment used in actual treatments. Examples include everything from a simple machine for monitoring a patient's pulse, oxygen saturation levels and blood pressure to heart bypass machines used in advanced surgeries. Machinery and monitoring equipment spans the technology spectrum ranging from relatively low-technology equipment such as an EKG machine which captures electrical impulses in the heart to highly sophisticated machinery, such as the Lodox imaging machine, which uses low level radiation to generate high quality X-rays. Almost all products in this category are produced under licence or under patent.

The fourth category of medical devices are **in vitro diagnostic (IVD)** products and kits. IVDs are used by specialised input provider laboratories. This is a very specialised category of products and includes the instruments, products and devices which pathologists use to run tests on samples collected by medical practitioners.

The category includes everyday chemical reagents, which are easily acquired and well known, to highly specific fine chemicals and cultures. It also includes instruments and equipment ranging from simple test tubes and pipettes to highly complex and expensive centrifuges to separate out blood samples.

The fifth category of medical devices relates to **mobility products** which includes wheelchairs, crutches, Zimmerframes and external prosthetics. Mobility products also includes medical furniture such as beds, traction pulleys, nursing stations and ICU stations.

Government values the medical devices market at about R14 billion. Private sector players in the industry believe this is a substantial underestimation and value it at around R24 billion. If the distinctive feature of the supply of pharmaceutical inputs to the healthcare cluster in South Africa was the dominance of imports, this feature is even more prevalent for medical devices. A staggering 90% of the medical devices market in South Africa is serviced by imported products.



This not only makes supply vulnerable to international logistics and supply chain management but it exposes domestic healthcare costs to exchange rate volatility and places a heavy burden on the current account. Given the envisaged growth under the National Health Insurance (NHI) scheme, the implications of the continued reliance on imports becomes increasingly important.

Whereas the pharmaceutical industry in South Africa is dominated by a small number of very large producers, the medical devices industry is made up of many small players plus a handful of large multinational corporations. Very little quantifiable data exists about the value of local manufacturing or who is producing what. Best-sourced information from interviews and industry association databases suggests that there are between 600 and 700 companies in the medical devices field in South Africa with 68% of them being solely distributors of imported goods with no production capabilities whatsoever. Twenty-six percent of those involved in the medical devices sector are manufacturers. Of the manufacturers, less than a dozen are large multinational corporations (MNCs), thus the manufacturing side of the industry is characterised by small and often micro firms. Of the 26% of companies manufacturing locally, 90% also act as distributors suggesting that to operate a manufacturing- only company in the current market environment is very difficult. This is partly due to the previous lack of regulations and a lack of certifying authorities to back up the industry but other factors have also impacted the industry. These are discussed in the next section. As with the pharmaceutical industry, the South African government has ambitions to support the local medical device sector and to undertake import substitution industrialisation policies.

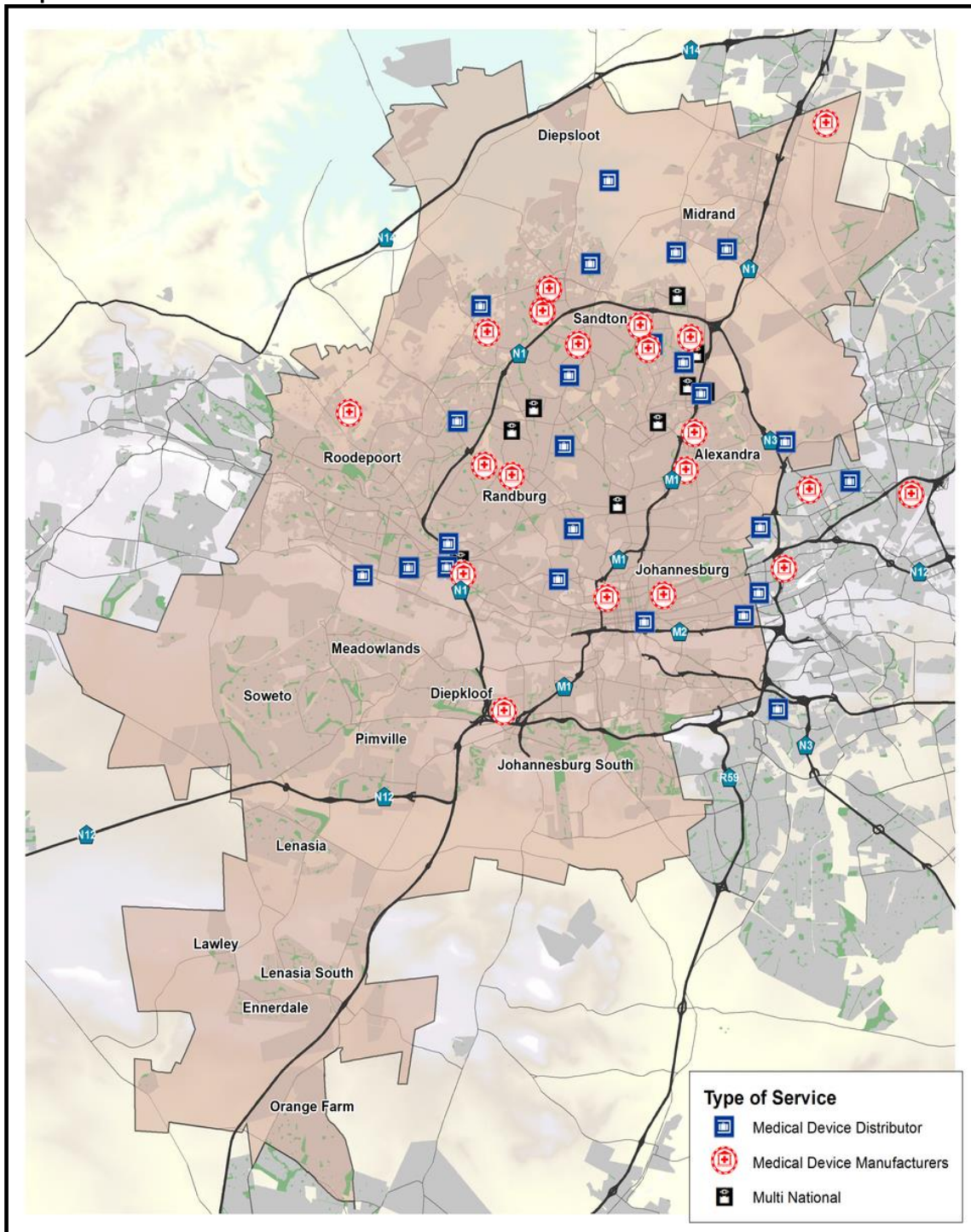
Of the 600 to 700 firms distributing medical devices nationwide, 180 are members of the South African Medical Devices Industry Association (SAMEDI). Of these 180, 56% were identified as being based in Johannesburg. A sub-association of SAMEDI is the Medical Devices Manufacturers Association of South Africa (MDMSA) which has only 35 members. These 35 companies all manufacture different types of medical devices. Only 13 are within the municipal boundaries of Johannesburg but there are eight additional firms close to the Johannesburg city boundary (Ekurhuleni and Tshwane). Although these absolute numbers are small, in reality Johannesburg and its immediate surrounds account for 60% of all national firms in the sector and would thus be an important geographic area to consider when looking to strengthen the industry. Map 6 identifies the distribution of medical device manufacturers, medical device distributors and pharmaceutical manufacturers.

Looking at the cluster participants involved in the production of pharmaceuticals and medical devices, it is overwhelmingly apparent that – from a domestic perspective – these two inputs are a domestic structural weakness in the overall healthcare cluster. From a cluster perspective the activity levels of the pharmaceutical and medical devices sectors are viewed as a gap in the domestic cluster which, according to the cluster literature, indicates the need for a government-led intervention. This analysis and conclusion are the substance of Section Three.

Map 8 shows the location of both medical device distribution companies and those involved in manufacturing medical devices. There are obviously a low number of firms represented on the map but certainly no sub-clustering patterns are identifiable. This is not surprising given the nascent, fragmented and small nature of the industry at present.

Given the profile of companies undertaking production, and the fact that most are producing products under licence or producing goods that do not require intellectual property development, it is not surprising here is no sub-cluster close to the medical school and research facilities at Wits or UJ.

**Map 8: Medical devices**



The final contributors to the healthcare cluster are the pink boxes in Diagram 2 (page 18) which refer to facilitating or supportive cluster participants.

---

*A healthcare cluster cannot operate in the absence of four other cluster components, often described as associative, supportive or related components. These are: the government, universities and training institutions, trade associations and the funders of medical services (the health department for the public sector and medical schemes in the private sector). Without these four sets of activities, service provision in the healthcare cluster would not be able to continue.*

---

## **Facilitating and supporting cluster participants**

As shown, the complete healthcare cluster (the black box in Diagram 2 on page 18) consists of direct and indirect cluster participants in patient care. Direct cluster participants include: hospitals, ambulatory facilities, medical practitioners, allied medical practitioners, specialist input providers (emergency care, imaging and laboratory services) and pharmacies, all of which have essentially a direct relationship or interface with the ultimate consumer – the patient.

Cluster participants also include those industries providing the key non-human inputs to the healthcare cluster namely, the pharmaceutical and medical devices sectors providing key inputs to medical services. These input industries ensure that medical and other practitioners and patients have access to the drugs, medicines, consumables, machinery, monitors, testing inputs, imaging consumables, materials, implements, and hardware and software necessary for all medical diagnosis, prevention, monitoring, treatment and alleviation of illnesses and injuries. These direct and input industries and services are substantial in breadth and depth and collectively account for the most obvious enterprises of a modern healthcare cluster.

However, a healthcare cluster cannot operate in the absence of four other cluster components, often described as associative, supportive or related components. These are: the government, universities and training institutions, trade associations and the funders of medical services (the health department for the public sector and medical schemes in the private sector). Without these four sets of activities, service provision in the healthcare cluster could not continue.

## **Government**

The government plays a crucial role in the South African healthcare cluster. The national government provides the funding (R187 billion in the 2016/2017 financial year) for the public healthcare system, which is delivered through all three spheres of government. This role is foreseen to expand massively in the National Health Insurance Green Paper, which suggests the implementation of a nationwide Health Insurance Scheme by 2025. If universal coverage becomes a reality, the size of the healthcare sector will need to increase substantially to absorb higher levels of demand. In addition, as the funder and provider of public healthcare, the government of South Africa's Department of Health has substantial regulatory and compliance competencies and mandates which underwrite and ensure the ethical and effective practice of healthcare within the country.



Eighteen pieces of national legislation fall under the National Department of Health ranging from the National Health Act No. 61 of 2003, to the National Health Laboratory Services Act No. 37 of 2000 to the Nursing Act No. 33 of 2005 and the Medicines and Related Substances Act No. 101 of 1965. In addition, the government is responsible for 10 entities reporting directly to the Minister of Health, listed in Table 3.

**Table 3 Entities reporting to the minister**

ENTITY	ACT	NATURE OF OPERATIONS
Council for Medical Schemes	Medical Schemes Act 1998	Regulates the private medical schemes industry
South African Medical Research Council	South African Medical research Council Act 1991	Promotes the improvement of health and quality of life through R&D and technology transfer
National Health Laboratory Service	National Health Laboratory Service Act 2000	The service supports the National department of Health by providing cost-effective laboratory services to all public clinics and hospitals
Compensation Commissioner for Occupational diseases	Occupational Diseases in Mines and Works Act 1973	Responsible for the payment of benefits to workers and ex-workers in controlled mines and works who have been certified to be suffering from cardiopulmonary diseases because of work exposures.
Health Professionals Council of South Africa	Health Professionals Act 1974	Regulates the medical, dental and related professions
South African Nursing Council	Nursing Council Act 2005	Regulates the nursing profession
South African Pharmacy Council	Pharmacy Act 1974	Regulates the pharmacy profession
Dental Technicians Council	Dental Technicians Act 1979	Regulates the dental technician profession
Allied Health Professionals Council	Allied Health Professionals Act 1982	Regulates all allied health professionals falling within the mandate of the council
Interim Traditional Health Practitioners Council	Traditional Health Practitioners Act 2007	Regulates traditional health practice and traditional health practitioners in South Africa
Medicines Control Council	Medicines and Related Substances Act 1965	Regulates the registration of medicines and medical devices
Office of Health Standards Compliance	Office of Health Standards Compliance Act 2007	Assesses and monitors compliance by health facilities with core standards of care

Source: Department of Health Annual report 2016/2017

These entities are all part of an elaborate, multi-tiered regulatory system which maintains standards and quality of care across the cluster. The only non-regulatory entity reporting to the Department of Health is the South African Medical Research Council (SAMRC), which undertakes research and development aimed at improving the health and quality of the lives of South African citizens. The scope of the SAMRC's research agenda focuses on: tuberculosis, HIV/AIDS, malaria, cardiovascular and non-communicable diseases, gender and health, and alcohol and other drug abuse. Established in 1969, the institution operates through centres based at universities or teaching hospitals. It has offices in Cape Town, Pretoria, Johannesburg (University of Johannesburg New Doornfontein Campus), Durban and Delft. The council operates through a grant and achievement award system.

All the entities in Table 3 are in Pretoria except for SAMRC, which has a centre in Johannesburg, and the National Health Laboratory Service, which operates numerous facilities in Johannesburg, as shown in the specialist input providers in Map 6 (page 31).

The management of healthcare regulation and compliance undertaken by the government is substantial and has an annual budget of R2 billion. Although most activities related to government’s oversight and administration of the system are clustered in Pretoria, the Gauteng Department of Health and the City of Johannesburg have substantial personnel and systems in place to ensure the delivery of health services to the citizens of the city.

## Universities and research institutions

As mentioned in the literature earlier, universities and research institutions are crucial for any growing cluster but are particularly important in knowledge-intensive clusters. The healthcare cluster is definitively a knowledge-intensive cluster; moreover it is a cluster where new products, process diffusion and breakthrough technology and discoveries are paramount to overall performance. To put the knowledge intensity of the healthcare cluster into perspective it was found that 50% of all R&D in the US takes place in the healthcare sector<sup>3</sup>.

The City of Johannesburg is well-served by university cluster participants through the University of the Witwatersrand and the University of Johannesburg. Wits is home to one of the premier medical schools in the country. The Faculty of Health Sciences at Wits is made up seven different Schools: Clinical Medicine, Therapeutic Sciences, Oral Health Sciences, Public Health, Pathology, Anatomical Sciences and Physiology. Medical practitioners are trained at the School of Clinical Medicine earning a MBChB degree; dentists at the School of Oral Health Sciences earning a BDS degree; and allied medical practitioners at the Therapeutic Sciences School which graduates physiotherapists (BSc Physio), pharmacists (BPharm), occupational therapists (BSc OT) and nurses (BNurs). The Medical School is also home to the 25 Colleges of Medicine of South Africa, which train the country’s specialists in the fields indicated in Table 4.

**Table 4: Colleges of Medicine of South Africa at the Wits School of Medicine**

College of anaesthetists	College of paediatric surgeons
College of cardio thoracic surgeons	College of paediatricians
College of clinical pharmacologists	College of pathologists
College of dentists	College of physicians
College of dermatologists	College of plastic surgeons
College of emergency medicine practitioners	College of psychiatrists
College of family physicians	College of public health practitioners
College of maxillo facial and oral surgeons	College of radiation oncologists
College of neurologists	College of radiologists
College of neuro surgeons	College of general surgeons
College of obstetricians and gynaecologists	College of urologists
College of ophthalmologists	
College of orthopaedic surgeons	
College of otorhinolaryngologists (ENTs)	

Source: [www.wits.org.za](http://www.wits.org.za)

<sup>3</sup> This figure is inclusive of pharmaceutical R&D, the single largest contributor of R&D expenditure.

---

*Together the University of the Witwatersrand and the University of Johannesburg provide a strong and diverse input to the Johannesburg healthcare cluster ensuring that medical practitioners, allied medical practitioners and specialist input service providers of the highest calibre are graduated and available to the labour market in the city.*

---

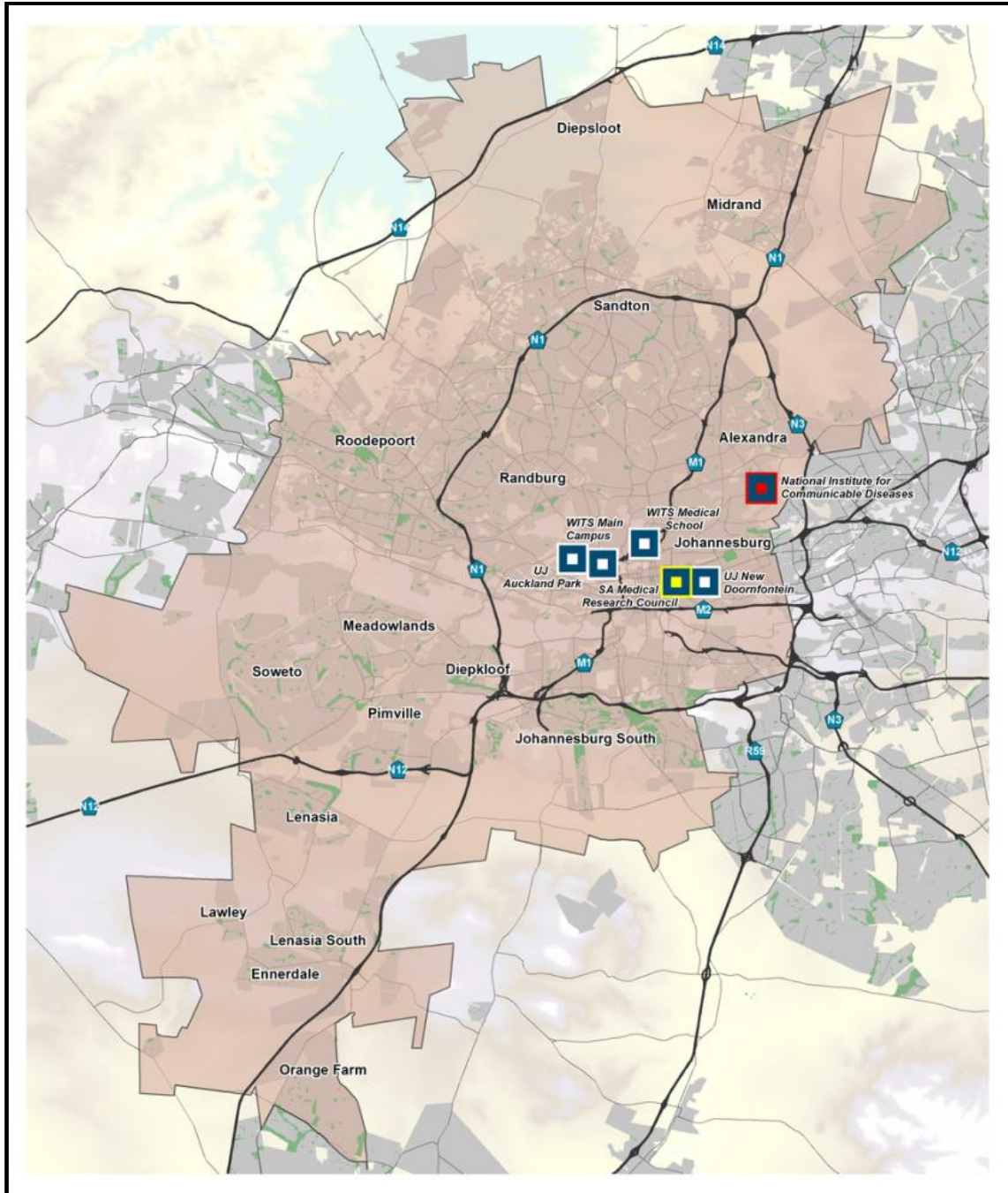
The Wits Faculty of Health Sciences had a total enrolment of just over 6 000 in 2016, slightly down (0.61%) from 2015. The faculty has a high proportion (44%) of post graduate students and nearly 500 PhD candidates. Students from Wits, after completing their classroom-based studies, undertake practical experience training through Wits at the Rahima Moosa Hospital, Helen Jospeh Academic Hospital, Charlotte Maxeke Johannesburg Hospital and Chris Hani Baragwaneth Hospital. Wits claims that it is the biggest contributor to sitters of the Colleges of Medicine of South Africa examinations and has a pass rate higher than the average. Although Wits enjoys higher than average achievements with its graduates, as with all national health science faculties countrywide, the attrition rate in these subjects is high with only 43% of students enrolled in the first year continuing through to graduation.

The University of Johannesburg Health Sciences Faculty is not as extensive as that of Wits but nevertheless provides the Johannesburg healthcare cluster with a large number of graduates in important allied medical practitioner fields and specialised input services. UJ does not offer medical, dentistry, pharmacy, occupational therapy or physiotherapy degrees. It does, however, offer degrees in: biomedical technology, chiropody, emergency medical care, homeopathy, human anatomy and physiology, medical imaging and radiation sciences, nursing, optometry, podiatry, somatology and sports and movement studies. Of importance at UJ is its National Diploma in Biomedical technology, which is a requirement for employees wanting to work in laboratories and imaging centres, as described in the section on specialised input providers. The only other accredited diploma in biomedical technology is available from the Vaal University of Technology which although adjacent to the Johannesburg healthcare cluster is not geographically part of the City of Johannesburg.

Together Wits and UJ provide a strong and diverse input to the Johannesburg healthcare cluster, ensuring that medical practitioners, allied medical practitioners and specialist input service providers of the highest calibre are graduated and available to the labour market in the city. The university's graduates are crucial for the attraction of healthcare cluster participants who know that the medical labour market in Johannesburg is one of the most robust and well serviced in the country.

Crucially, the 25 Medical Colleges of Wits ensure that the healthcare sector in Johannesburg is not just competitive in generalist medical and allied medical skills but is also home to many highly specialised providers.

**Map 9: Universities and research institutes**



Over and above the role of universities in the development of the necessary skills base, capacities and capabilities needed in a healthcare cluster, universities also play a key role in knowledge creation and diffusion as it applies to research and development. UJ's research competencies in the field of health sciences is rather limited and focuses on its Laser Research Centre, which was established to investigate the field of phototherapy with specific emphasis on Low Intensity Laser Irradiation (LILI) or Photobiomodulation (PBM), Photodynamic Therapy (PDT) and Stem Cell Therapy. The therapeutic value of the research will be for application in wound healing, stem cell therapy (regenerative medicine) and laser irradiation of cancer cells that contribute to cell death.

The research effort of Wits in the field of health sciences is considerably more extensive. Across the seven schools there are 18 research entities at Wits, as well as two nationally sponsored Centres of Excellence and two Africa Development Networks. The highly innovative Health Sciences Faculty is also home to the Carnegie-Wits Alumni Diaspora programme. The 24 research entities, listed in Table 5, reflect a diverse range of R&D specialities.

**Table 5: University of the Witwatersrand research entities**

<b>Human Variation and Identification Research Unit</b>
<b>Carbohydrate and Lipid Metabolism Research Unit</b>
<b>Clinical HIV Research Unit</b>
<b>Developmental Pathways for Health Research Unit (MRC)</b>
<b>Effective Care Research Unit</b>
<b>Empilweni Services and Research Unit</b>
<b>Hepatitis Virus Diversity Research Unit</b>
<b>Maternal, Adolescent and Child Health (MatCH) Research Unit</b>
<b>Perinatal HIV Research Unit</b>
<b>Pulmonary Infections Research Unit</b>
<b>Project for Improving Neonatal Care (PRINCE) Research programme</b>
<b>Wits Reproductive Health Institute</b>
<b>Bone Research Laboratory Unit</b>
<b>Systematic Review Initiative for Evidence-based Minimum Intervention in Dentistry</b>
<b>Antiviral Gene Therapy Research Unit</b>
<b>Respiratory and Meningeal Pathogens Research Unit (MRC)</b>
<b>HIV Pathogenesis Research Unit</b>
<b>Wits Research Institute for Malaria</b>
<b>Centre for Health Policy (URC)/Health Policy Research Group (MRC)</b>
<b>Rural Public Health and Health Transitions Research Unit (MRC)</b>
<b>Brain Function Research Group</b>
<b>Cardiovascular Pathophysiology and Genomics Research Unit</b>
<b>Wits Advanced Drug Delivery Platform</b>
<b>Sydney Brenner Institute for Molecular Bioscience</b>

Source: [www.wits.ac.za](http://www.wits.ac.za)

Wits is also home to the Department of Science and Technology (DST)/NRF Centre of Excellence for Biomedical TB Research and the Centre of Excellence in Human Development. At a continental level, the university is home to the African Network for Drugs and Diagnostics Innovation Centre of Excellence in Advanced Drug Delivery Technology and the African Network for Drugs and Diagnostics Innovation Centre of Excellence for Viral Gene Therapy.

A final Wits research collaboration is particularly interesting and is looked at in more detail in the next section. It is well known that since 1994 South Africa has seen an exodus of many of its medical practitioners and researchers. Although a substantial skills base and capacity continues to reside in the country's academic hospitals and tertiary education institutions there is no escaping that substantial skills have emigrated. The Carnegie-Wits Alumni Diaspora Programme is an innovative mechanism to stimulate research collaboration and networking between Wits's leading health sciences alumni, who now live and work in academic institutions around the globe, and their counterparts in Johannesburg. The programme aims to capitalise on and strengthen research networks which already exist; to stimulate dialogue; and to help establish further collaborative and exchange partnerships with Wits Alumni at international health research institutions.



In particular, the programme seeks to link with research-active alumni who would be willing to “come home” for short periods of time to encourage and foster research and development in the Faculty of Health Sciences.

R&D in the health sciences may be driven by clinicians but as with most knowledge-intensive areas of R&D in the modern era, multi-disciplinary teams are often required. Nowhere is this more apparent than in relation to R&D in medical devices, where information technology (IT) and engineering skills are large contributors to new technologies, instruments, equipment and testing systems.

Wits is one of the few national universities with a dedicated biomedical engineering degree within the Faculty of Engineering. Biomedical engineering is the discipline in which engineering and quantitative sciences are applied to the solution of medical and biological problems. Examples of biomedical solutions include the development of sophisticated X-ray imaging systems, the creation of artificial organs, and IT-brain interfaces to assist in the movement of artificial limbs. Over and above the interface between the health sciences faculty and the biomedical engineering department, clinical researchers are also involved in collaborative projects with other engineering departments, the chemistry department, the physics department, and the IT department of the university. This massive interdisciplinary web of connectedness available through the university bodes well for the development of a larger medical devices sector for the country.

### **Institutions and associations**

The definition and population of the key participants in the healthcare cluster covered above has been peppered with examples of professional bodies and associations playing multiple mandated and voluntary roles. The cluster is characterised by high levels of regulation and as such many of the Boards, Councils and Associations listed in Table 6 are prescribed in various Acts governing participation, behaviour and responsibilities in the cluster. As is evident in Table 6, there are institutions or associations representing all categories of healthcare sector cluster participants from doctors and nurses to input supplier sectors such as the pharmaceutical and medical device distributors and manufacturers. Interestingly, even hospitals are well organised and this is mainly as a response to the power of the medical schemes which try to keep hospital costs down (explained below).

Cluster theory points out that trade associations, boards, councils and other representative forums are important for co-ordinating the work of a cluster and ensuring that participants feel part of a joint project. However, while it is positive that so many formal representative forums are part of the healthcare cluster – in reality – the depth, breadth and diversity of such forums would make practical co-ordination and sharing impossible at an operational level. In addition, in interviews conducted with some of these representative bodies it is clear that individual organisations do not generally feel that they are part of a larger picture or that there is a common purpose or pursuit across participating organisations. A cluster intervention in the healthcare space it would therefore require focused smaller grouping of cluster participants.

**Table 6: Key representative forums**

<b>INSTITUTION/ ASSOCIATION/BOARD</b>	<b>REPRESENTATION</b>
Hospital Association of South Africa	private hospitals
National Hospital Network	independently owned private hospitals
Health Professions Council of SA	medical and allied medical practitioners
Dental Assisting, Dental Therapy and Hygiene Board	dental assistants and hygienists
Dieticians and Nutrition Board	dieticians and nutritionists
Emergency Care Board	paramedics and emergency care workers
Medical and Dental Board	doctors and dentists
Medical Technology Board	medical technicians
Occupational Therapy Board	occupational therapists
Optometry and Dispensing Opticians Board	optometrists and opticians
Physiotherapy, Podiatry and Biokinetics Board	physiotherapists, biokineticists and podiatrists
Psychology Board	psychologists
Radiography and Clinical Technology Board	radiologists and technicians
Speech, Language and Hearing Professionals Board	speech therapists and audiologists
South African Nursing Council	nurses
Allied Health Professionals Council of South Africa	allied health professionals
South African Medical Association	doctors
Radiology Association of South Africa	radiologists
Psychology Association of South Africa	psychologists
Psychiatric Association of South Africa	psychiatrists
Ophthalmologist Association of South Africa	Ophthalmologists
Optical Association of South Africa	Opticians
Physiotherapy Association of South Africa	physiotherapists, biokineticists and podiatrists
Dental Association of South Africa	dentists
Dieticians Association of South Africa	dieticians
Emergency Medicine Association of South Africa	emergency care doctors
Occupational Therapy Association of South Africa	occupational therapists
Occupational Health Association of South Africa	occupational therapists
South African Private Ambulance and Emergency Services Association	private ambulance companies
Medical Schemes Council	medical schemes
South African Medical Device Industry Association	medical device manufacturers and distributors
Medical Imaging Systems Association	producers and distributors of imaging equipment in the healthcare sector
Medical Device Manufacturers Association of South Africa	manufacturers of medical devices
South African Laboratory and Diagnostics Association	manufacturers and distributors of diagnostic and laboratory equipment
Clinical Engineers Association of South Africa	clinical engineers (who service and maintain medical devices)
Medical Technology association of South Africa	medical technologists and technology companies
Heart Association of South Africa	awareness, research and education on heart disease
Cancer Association of South Africa	awareness, research and education on cancer
SA National Tuberculosis Association	awareness, research and education on TB
South African National Aids Council	awareness, research and education on AIDS

Source: S Lowitt, TIPS

---

*Medical schemes are the key gatekeepers to the private healthcare sector and will be the pivotal players in the success or failure of the government's drive to develop the domestic pharmaceutical and medical device input sectors.*

---

## Medical schemes

The final participants playing a facilitating role in the Johannesburg healthcare cluster are the medical schemes. As mentioned at the beginning of the paper – these institutions are crucial to the operating of the private healthcare sector. More importantly, as will be shown in the next section, they are the key gatekeepers to the private healthcare sector and will be the pivotal players in the success or failure of the government's drive to develop the domestic pharmaceutical and medical device input sectors.

Medical schemes are financial institutions offering healthcare insurance to private individuals able to pay for such services. Being a member of a medical scheme assures private citizens that they can access the private healthcare system in an affordable manner. Medical schemes in South Africa must be registered with the Registrar of Medical Schemes as per the Medical Schemes Act No. 131 of 1998. The Act calls for a Council of Medical Schemes (CMS) which has the strategic objectives of protecting the interests of medical schemes and their members; monitoring the solvency and financial soundness of schemes; controlling and co-ordinating the functioning of medical schemes in a manner that is complementary with national health policy; and investigating complaints and settling disputes (CMS, online).

The Act includes two regulations which are particularly important for the operations and business model of domestic medical schemes. First the Act requires medical schemes to maintain 25% of gross annual contributions as accumulated funds or reserves. These reserves are designed to protect the interests of members and to guarantee the continued operation (solvency) of schemes. Indeed this reserve regulation has proved vital in the sustainability of the industry. In 2016, for example, for all schemes together, after paying for relevant healthcare services and operating expenses the industry incurred a R2.4 billion deficit which was funded by investment income earned off the investing of the industry's reserves. Reserves are generally invested in cash, bonds, equities and property.

The second regulation laid out in the Medical Schemes Act which impacts the operation of medical schemes in the domestic market are regulations related to Prescribed Minimum Benefits (PMB). The Act regulates that any medical scheme is required by law to pay PMB which include: emergency conditions, 270 listed medical conditions and 26 chronic conditions.

The definitions of PMB are constantly under review and for any given year the CMS publishes a PMB Code of Conduct which is the current industry-wide consensus of the interpretation of PMB regulations. The Act and the CMS allow for medical schemes to use tools such as networks, designated service providers and formularies to manage PMB costs.

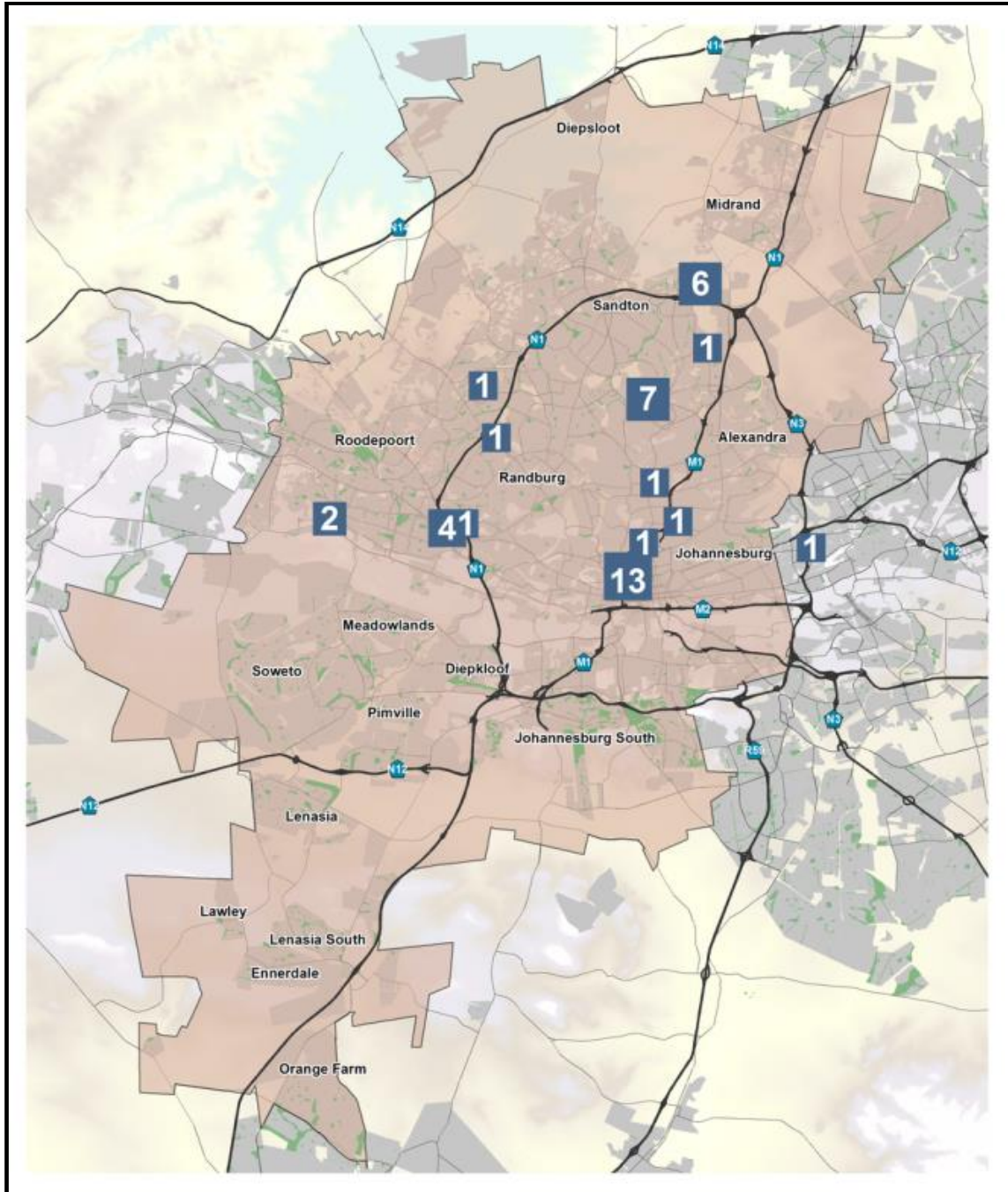
Medical situations outside of those covered by PMB are dealt with by the medical scheme in terms of benefits package descriptions, terms and conditions and other scheme mechanisms as may be considered in their contract with their client.

The medical scheme sector in South Africa is substantial. There are 82 registered schemes. Closed schemes are administered on behalf of a company, their staff and families. Only employees of the firm can sign up to the scheme. Examples include the Lonmin Medical Scheme, the imperial Group Medical Scheme, the Pick n Pay Medical Scheme and Profmed. There are 57 closed schemes in South Africa. The remaining 25 schemes are known as open or unrestricted schemes and are open to the general public. Examples include Discovery Health, BestMed, Medihelp and Fedhealth. South Africa has legislation protecting open enrolment which means that all medical schemes must accept a qualifying applicant and charge them the same monthly premium per benefit plan regardless of their age or health status. Open and closed schemes jointly have 8.9 million beneficiaries, which accounts for around 17% of the population. The industry is valued at R163.9 billion with R54 billion net assets. The number of beneficiaries covered by private medical schemes has remained relatively constant over the past five years with a slight decrease of 0.61% between 2015 and 2016. Some of this decline may be due to cost pressures which have seen premiums increased between 10% and 12% a year over a five-year period. The CMS claim that premium increases are being driven by increased costs at private hospitals, increased rates charged by specialists, and increases in medicine prices due to the devaluation of the rand.

It may appear that the crucial role of the medical scheme industry is to ensure the affordable access of beneficiaries to private healthcare, but the role of these schemes is considerably more pivotal and complex. Medical schemes are essentially the funders of the private healthcare system. Annually they negotiate the “rate” and the “treatment” they will support across PMB. This includes tests to be authorised, medicines on an approved schedule, treatment types and doctors’ and specialists’ fees. Any expense over and above PMB thresholds is for the patient’s own account and is called a co-payment. For example, a medical scheme will have an approved list of specialist service providers and the rate they will pay such medical practitioners. If a patient chooses to use a doctor which is not on the said list, and who is more expensive, the medical scheme will pay the maximum rate as per its approved service provider list and the patient will have to pay the difference (a co-payment) or change doctors. Similarly, if a doctor prescribes a drug for a patient which is not on the approved medicines list of the scheme for that condition the patient will need to pay for the medication or make a co-payment for the difference in price unless the doctor can convince the scheme to cover the payment. Medical schemes will always seek to minimise the costs they are responsible for. Doctors will always want to offer the best care to their patients and will seek to use new and innovative techniques, medications and devices which are most often not on PMB lists. As such medical schemes become the gatekeepers of new and innovative products and procedures being used in the healthcare system. This will be discussed in more detail in the next section.

Due to the importance of the role of medical schemes as gatekeepers to the private healthcare sector, the location of head offices has been plotted – see Map 10 (page 49).

**Map 10: Medical schemes (location of head office)**



Proximity to these head offices is seen as important because, as highlighted in the cluster theory, face-to-face interaction and contact is often crucial to the operations and dissemination of information across a cluster. As will be argued in the next section – if a more robust medical devices sector and/or pharmaceutical sector is to be developed, manufacturers and researchers of such products and processes will need face-to-face contact with the medical scheme gatekeepers who will essentially have the power to make or break new product development and market access in the domestic context. This personal access issue was validated by members of SAMED and MDMSA interviewed.



## Summary of the Johannesburg healthcare sector

The healthcare cluster consists of considerably more participants than doctors and patients. Patients access medical assistance through two interfaces: hospitals and ambulatory health care services. They receive care through a variety of integrated service providers including: medical practitioners, allied medical practitioners and specialised input service providers such as pathology laboratories, imaging centres and emergency care workers. These direct service providers operate and are often located in such a manner as to provide a seamless and convenient service to end users as seen, for example, by the clustering of lab services around clusters of doctors rooms and hospitals and clinics. Most often such clustering is driven by the need to achieve economies of scale or simply access to a common client base.

The concept of a cluster extends beyond direct service provision or what would in economic terms be considered a sector such as the medical sector. Over and above the direct healthcare service providers that interface with patients are two additional categories of cluster participants: input participants (pharmaceutical and medical device manufacturers and distributors) and cluster-facilitating participants (universities, associations, government and medical schemes).

The pharmaceutical and medical device manufacturers and distributors to the healthcare cluster in South Africa in general, and in Johannesburg in particular, are interesting because of the dominance of distribution activity over manufacturing activity. Direct medical service providers in the cluster are unable to complete their service offering without ready access to high quality pharmaceuticals, testing and medical devices. As such these input providers are integral to a well-functioning cluster. The fact that such inputs are predominantly imported means that from a local perspective, the domestic healthcare cluster has a highly visible gap. According to cluster theory and literature when such a gap emerges or is identified it is a signal to policymakers that the efficiency and competitiveness of the cluster as a whole could be improved if such a gap were filled. Methods and options to fill such a gap are considered in Section 3. Sufficient to say that, from a local perspective – given the forecast growth of the domestic healthcare cluster under the NHI scheme – this gap in the cluster should be seen as a massive growth opportunity to be leveraged and taken advantage of.

The final category of cluster participants includes what are known as facilitative or enabling cluster participants and include associations, universities and research organisations, government and medical schemes. The local healthcare cluster enjoys a strongly facilitative environment within which to operate with few glaring gaps or deficiencies. The government directly and through its variously mandated bodies and councils regulates the sector and its participants to the very highest standards to ensure the sustainability of the cluster and its ability to offer high quality services to patients.

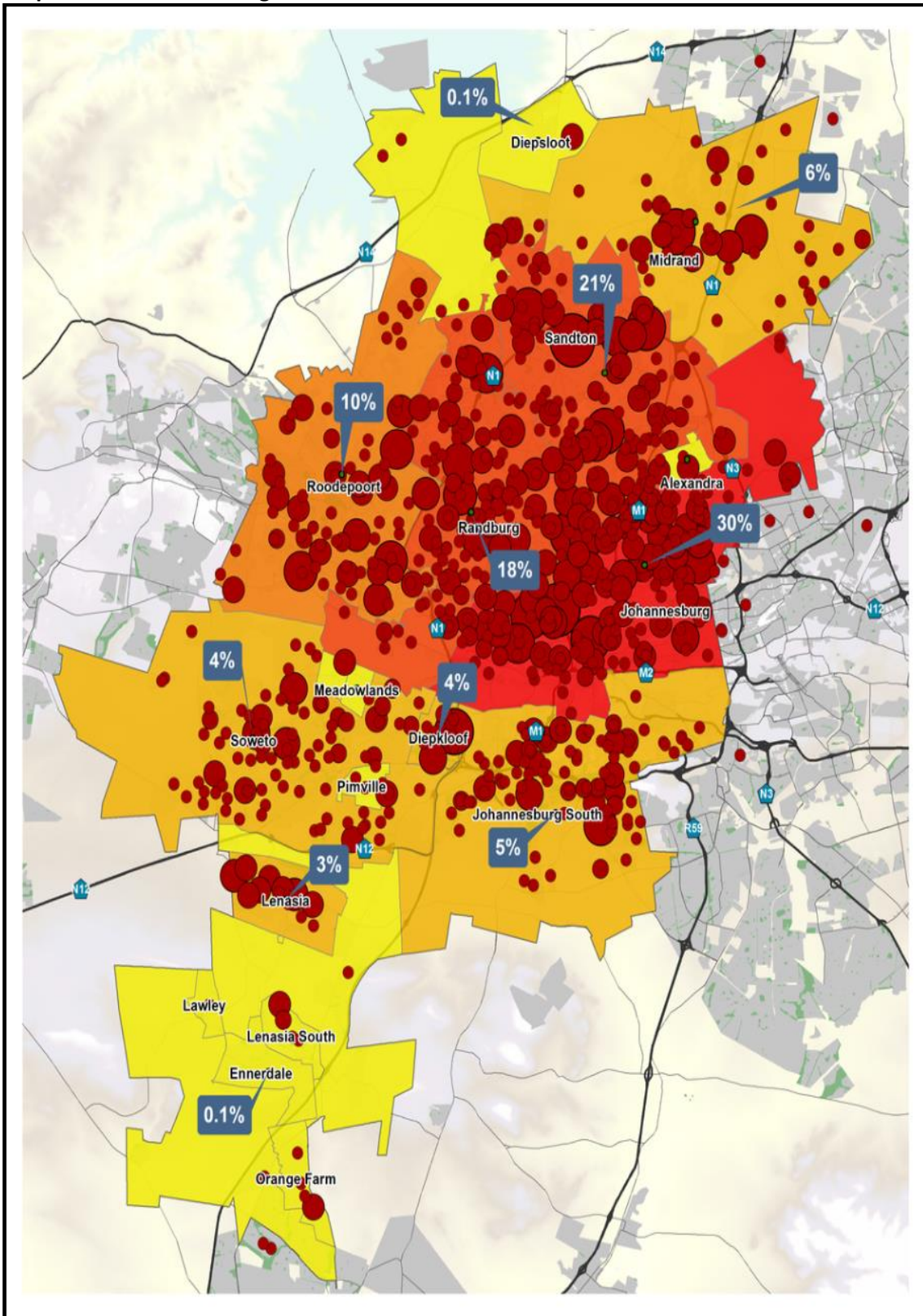
The regulation of the South African healthcare cluster is viewed as being on an equal footing to that of developed nations. Recently, however, administration and day-to-day management of these regulations have become a cause for concern, with many resources being tied up in delayed registration processes. These are generally viewed as administrative rather than regulatory delays.

Crucial to all the inputs in the healthcare cluster is labour market access and the ability of cluster participants to be able to access appropriately skilled staff for their given operations. Whether it is a hospital looking for a registrar or a surgeon, a specialist looking for a nurse, or a radiographer looking for a medical technician, the healthcare cluster is predicated on a robust pool of skills. The cluster in Johannesburg is well serviced by two universities and a host of nursing training colleges that produce the full spectrum of necessary skills. Shortages of key skills do exist, but this is largely in the public sector where institutions and practitioners are unable to compete with salaries paid and earned in the private sector. The two universities in Johannesburg also importantly have robust research capacities and capabilities and this bodes well for any potential growth in the pharmaceutical or medical device input sectors.

Finally, the cluster operates successfully because of two funders to the system – the national government on behalf of the public sector and medical schemes on behalf of the private healthcare cluster. Through the funding priorities and rules and regulations of public sector procurement policy in hospitals, and through the PMBs of private medical schemes, these funders are the final gatekeepers to product use in the healthcare cluster. They hold the power as to what treatments and tests are approved, what medications are prescribed and administered, what equipment is used and paid for, and what fees can and cannot be charged. The facilitating role of the funders of the healthcare system cannot be emphasised sufficiently. As will be seen in Section 3 – current participants in the medical devices manufacturing sector identify these funders as the key to whether the medical devices sector will grow in South Africa or not.

Summarising the geography of the cluster, Maps 11, 12 and 13 (pages 52-54) show that although there is coverage across the whole of the city, there exists a strong central core of the cluster or a sub-cluster located in the centre of the city stretching from Auckland Park through Parktown, Parktown North and Rosebank into a northerly band covering Sandton, Bryanston, Sunninghill and Fourways (red and dark orange in Map 11). There is also high density to the east of the core sub-cluster, including areas such as Sandringham and Linksfield. This strong central core collectively accounts for 70% of all healthcare cluster participants across the whole city. The far North and far South of the City exhibit lower activity levels than the core and the East of the city has more cluster participants than the West.

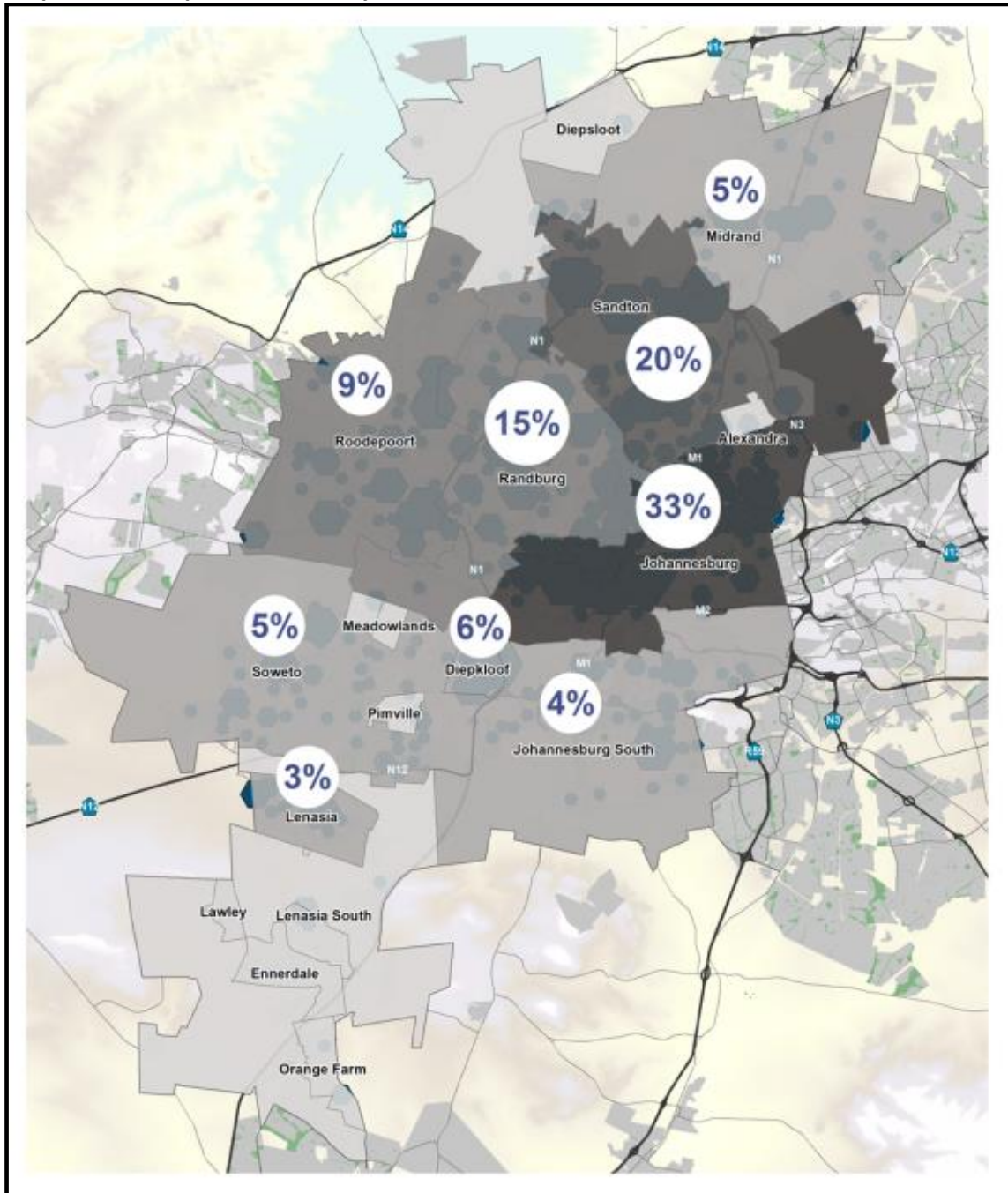
Map 11: The Johannesburg Health Cluster



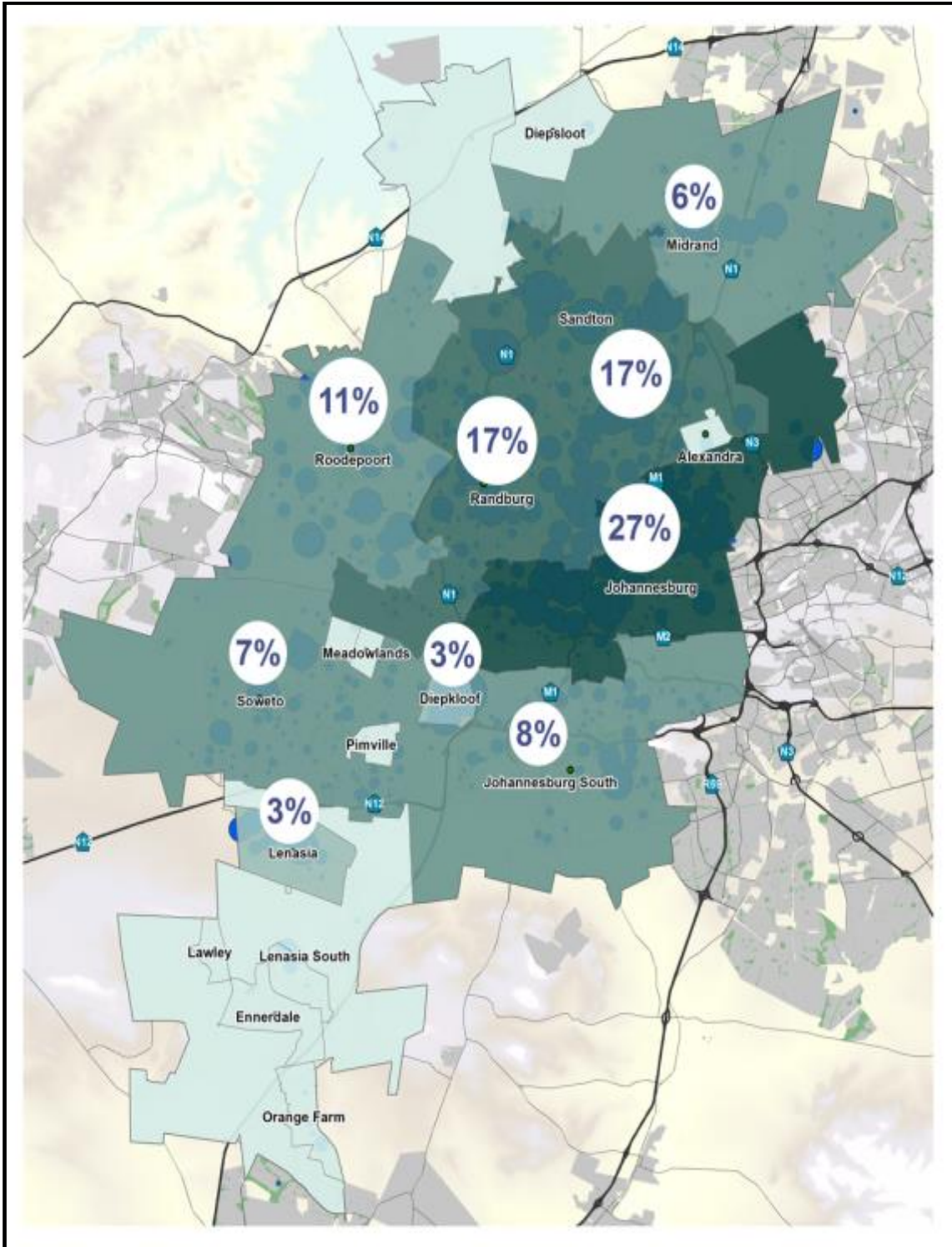


Maps 12 and 13 show some of the detail included in Map 11 and support the analysis that while the city does represent a strong cluster there exists a core central cluster within the broader cluster which would be relevant in any future consideration of a cluster initiative which involved geographically placed infrastructure such as a specialist industrial park. This area would be the central city corridor from Bryanston, Sandton, Fourways and Sunninghill in the North running down through Rosebank, Parktown North, Parktown and Auckland Park, including an arch towards the east to include Linksfield and Sandringham.

**Map 12 Medical practitioners – by district**



Map 13: Ambulatory care by district





---

*The identified gap is the lack of local production of pharmaceutical and medical device inputs to the healthcare cluster ..... however, it is suggested that the city concentrate on filling the medical devices input gap and not the pharmaceutical input gap.*

---

### **Section 3: A medical device cluster for Johannesburg**

Clusters are groups of enterprises and institutions co-located in a specific geographic region and linked by interdependencies in providing a related group of products or services. By this understanding, the activities related to healthcare provision in the City of Johannesburg clearly constitutes a cluster. The existence of marked relative and absolute concentrations of hospital and ambulatory care provision, supportive services and inputs is clearly shown in the maps in the previous section. The participants function in an integrated manner as seen in the relationships described, such as medical practitioners using imaging and laboratory services or pharmaceutical and medical device companies selling products to hospitals and clinics. Inter-firm collaboration and complementarity is high in order to supply seamless patient care. The area is a magnet for new medical and allied medical practices and services because of access to a skilled labour market, specialist labour market placement institutions, cluster-specific infrastructure and high concentrations of end users. To date the cluster has strengthened and developed organically without purposive public or collective action. The cluster could continue to function as it has, but research has uncovered eight drivers which all suggest that demand for, and supply of, healthcare services in the country (and the city) will rise significantly over time and that with this expansion comes an opportunity to leverage accelerated growth particularly for key input sectors.

Healthcare demand in South Africa is a growing – propelled by both medical and economic drivers. On the medical side, demand is forecast to increase because of increased life expectancy, the growth of non-communicable or lifestyle diseases such as diabetes, heart attacks and obesity, and the continued high prevalence of communicable diseases most especially tuberculosis and HIV/Aids. On the economic side, the introduction of the NHI scheme will be the most significant driver of future demand and supply pressures, but growth will also come from increasing per capita spend on healthcare, increasing per capita numbers of health professionals and growing demand for private sector healthcare (Deloitte and Touche, 2014). With these growth drivers, and the reality that Johannesburg is a major destination city for local and regional in-migration and urbanisation, there can be little doubt about the growth potential of the cluster going forward.

The cluster appears to enjoy all the theoretically described benefits of co-location and proximity but the research reveals a substantial gap which if addressed could improve the overall competitiveness of the cluster in such a way as to: increase the tax base of the city, contribute to citywide GDP and growth, create much needed employment opportunities, contribute to increased export performance, and assist at a national level to support the dti's industrial policy aims and the need to reduce the country's trade deficit.

---

*The size, breadth, efficiency and robustness of the healthcare cluster evident in the City of Johannesburg in general, and the specific competencies of academia and an existing base of medical device manufacturers, make the city a prime location for any policy intervention related to growing the medical devices input sector*

---

The identified gap is the lack of local production of pharmaceutical and medical device inputs to the healthcare cluster. As shown in the previous section - 65% of pharmaceuticals inputs and 90% of medical device inputs used in the cluster are imported. Based on conservative estimates, this collectively amounts to a R32 billion direct opportunity with estimated multiplier effects of 1.3 (KPMG 2014).

It is argued that the size, breadth, efficiency and robustness of the healthcare cluster evident in the City of Johannesburg in general, and the specific competencies of academia and an existing base of medical device manufacturers, make the city a prime location for any policy intervention related to growing the medical devices input sector. Given that there is no strong cluster of pharmaceutical manufacturers in the city, and that such manufacturers will enjoy a competitive advantage by locating close to sea ports, it is suggested that the city concentrate on filling the medical devices input gap and not the pharmaceutical input gap. As will be shown, the City of Cape Town enjoys similar competencies in its regional healthcare cluster and have already taken steps to develop a medical devices and pharmaceutical cluster to service its own (and the broader country's) healthcare cluster needs.

This should not detract from any proposed or planned intervention in Johannesburg, as the cluster literature clearly shows that similar clusters can thrive in multiple geographic locations simultaneously (Porter, 2000). This is especially true in instances where a cluster offers a service which is consumed on site. Indeed Porter goes on to argue that similar clusters competing in different geographic locations are beneficial to firms in both locations because it increases competition for limited resources (finance and labour) and hence engenders specialisation, diversification and productivity improvements.

### **The medical device industry status quo**

Despite a local medical fraternity which is considered world class, and which gave the world the first heart transplant in 1967, a Nobel prize for computerised tomography in 1979, and the globally successful Lodox scanner in 2015 – systemically – globally competitive knowledge generation and innovation from the South African medical fraternity has not been converted into a thriving medical device industry.

Indeed the industry has been so marginalised and so far off the radar screen of industrial policymakers and economists that until 2015 the industry was completely unregulated and not even a legal definition of a medical device existed.

---

*Since 2013, the dti has been co-operating with relevant stakeholders and commissioning research to develop a comprehensive Medical Devices Sector Strategy.*

---

The first official signs of interest and recognition of the industry came from the DST in 2006. The department was reacting to an incident in which two South Africans had patented a groundbreaking, sea change in the software used to operate CAT scanners. Rather than the patent being exploited in the local market it was sold to a MNC (General Electric Healthcare) and no local advantage was garnered over and above a once-off financial payment. On the back of this incident, DST convened an indaba of medical professionals, researchers, inventors and medical device producers to discuss how the country could leverage its intellectual and knowledge capital to support industrial growth and the substitution of imported products. Right from the beginning it was noted that the industry held enormous promise not only as an import-substitution industry and manufacturing driver but also as an exporter of high-value items.

The outcome of the indaba was threefold. First it brought the spotlight onto the sector and placed it on the radar screen of the dti and development finance institutions such as the Industrial Development Corporation. Second it created the first formal industry structure by funding the formation of SAMED which represented private sector distributors and manufacturers of medical devices. Third the indaba allocated funding to an initiative called Cape Bio Tech – later to become MD2M (Medical Devices to Market) under the management of the Technology Innovation Agency – which was meant to kickstart the support of a local manufacturing industry. Initial financial support was a paltry R8 million.

Although the DST indaba was important in raising awareness of the medical device sector, the process gained little traction and not much developed by way of industry support until the dti started paying attention to the sector in the Industrial Policy Action Plan (IPAP) 2013 in which the production of syringes and other low-value disposable consumables was first identified as a growth opportunity. Since 2013, the dti has been co-operating with relevant stakeholders and commissioning research to develop a comprehensive Medical Devices Sector Strategy. The strategy will be a “multi-faceted intervention focussed on: stimulating growth in the domestic industry; reducing the sector’s trade deficit; rationalising imports; creating jobs in manufacturing and specialised services; using the instrument of tender designation to facilitate SA’s manufacturers’ access to both domestic and global markets” (IPAP 2014/2015-2016/2017).

In Johannesburg and its surrounds there are 16 manufacturers of medical devices, as listed in Table 7.

The table reflects that most manufacturers produce single-use, disposable consumables.

**Table 7: Medical device manufacturers in Johannesburg and its surrounds**

Company	Product	Intellectual Property	category of product
Adcock Ingram	intravenous bags for all uses	patent	single-use disposable consumable
B.Braun	IV sets, sterile and dressing trays	patent	single-use disposable consumable
Bone SA	bone transplantation	patent	single-use, invasive consumable
Brittan Healthcare	uroflowmetry, urodynamics, gastroenterology	licence	diagnostics
CE Mobility	wheelchair production	none	mobility product
Malachite Medical	disposable surgical drapes and gowns	none	single-use disposable consumable
MDG health solutions	mobile clinics for rural areas	licence	
NuAngle	endourology sector equipment	patent	machinery and monitoring equipment
Omnimed	sterile IV solutions	licence	single-use disposable consumable
Obsidian Heath	suction tubes with moulded connectors		single-use disposable consumable
Respitek	dressing trays, venting filters, suction filters, mouthpieces, nose clips, wound dressings	licence	single-use disposable consumable
Safmed	decontamination surgical support, infection-prevention products	none	single-use disposable consumable
Southern Implants	dental implants	patent	single-use, invasive consumable
Southern Medical	orthopaedic implant devices	patent	single-use, invasive consumable
Suprahealth Care	wound care, infection control, gloves	none	single-use disposable consumable
Zebra	sterile dressing trays and kits	none	single-use disposable consumable

Source: MDMSA database, interviews

These are high-volume, low-value items which have a low-risk rating in usage and are thus able to be produced without any intellectual property and with no levels of government regulation at present. Products are produced and sold directly to hospitals and practitioners.

Research done by PATH<sup>4</sup> in association with the MRC in 2014, and this research effort, found that not one local company relied on the South African public tender process for its underlying revenue stream. Rather sales were made to the private healthcare sector or to both the public and private sectors.

Many producers export to the region through distributors with Mozambique, Zimbabwe, Kenya, Zambia and Angola being the most important export markets in order of sales value (KPMG, 2014).

<sup>4</sup> PATH is an international not-for-profit organisation which is a leader in global health innovation. It works across five platforms: vaccines, drugs, diagnostics, devices and systems innovation. It operates through partnerships with governments and civil society institutions looking for health solutions.

---

*As there is no accreditation and quality control system for medical devices in place, and given that medical schemes require internationally recognised quality standards for invasive consumables, local producing companies have all invested heavily in obtaining overseas, internationally accepted accreditation and quality compliance certificates for their products.*

---

Only three firms were found to be producing invasive, single-use consumables such as implants. All are producing under their own patents, which supports the argument that South Africa has substantial knowledge and innovative skills in the healthcare field. These are low-volume, high-value products which carry with them substantial patient risk and are thus highly regulated and controlled.

Due to the fact that to date there is no accreditation and quality control system for medical devices in place, and given that medical schemes require internationally recognised quality standards for invasive consumables, local producing companies have all invested heavily in obtaining overseas, internationally accepted accreditation and quality compliance certificates for their products. Various reports and interviews suggest that the cost of such compliance and certification runs from between R200 000 to R500 000 for simple products and upwards of R1 000 000 for more complex products<sup>5</sup>. Local producers of these goods face some additional challenges. The first is that most single-use invasive consumables are not directly sold to hospitals and medical practitioners but are rather made available on consignment. This business model (which is extensively used in the local market) places considerable financial strain on medical device producers – especially young companies with weak balance sheets and low levels of retained earnings.

In the consignment model a medical device company makes its product (for example a stent or an artificial hip) available to a hospital or surgeon up-front at no expense. An entire array of the product in all sizes and formats must be made available on consignment. This ensures that the hospital or surgeon always have access to stock of the consumable. However, the manufacturer is only paid once a unit has been used in a patient. This means that at any given time a device manufacturer is holding the cost of substantial stock on its books without having any cash flow associated with actual usage. Added to this, notoriously long lead times in payments from hospitals and particularly state hospitals makes cash flow in the industry particularly challenging. It is suggested that one of the ways such firms deal with the challenge is to also be distributors of disposable consumable items, which takes the form of direct sales. Revenue from these sales can be used to cross-subsidise consignments of locally produced stock.

An additional challenge facing producers of higher-value, higher-risk consumable items is getting practitioners and then medical schemes to approve the product for use. An interview with a purchasing agent for a large hospital group found that 10 criteria are commonly used when considering a new device producer.

---

<sup>5</sup> Figures reported in interviews.



---

*While South African medical device companies do not produce many final goods or finished products, in the machinery and equipment category several companies have been given contracts by foreign firms to supply inputs to final machinery and equipment.*

---

The criteria include: the quality standard of the product, access to spare parts, the regulatory environment, end-user (clinician) product preference, brand perception, delivery and lead time, cost, support training, servicing and maintenance, and the availability of supply. In the event a manufacturer adequately meets these criteria for a potential purchaser, the manufacturer would then still have to persuade the medical schemes to add the product to their approved list and/or persuade the state tenderer to place the product on its approved list for state hospitals. For these reasons adoption rates in the industry are remarkably low and lead times for firms from innovation to commercial viability are highly attenuated.

Returning to Table 7, the list shows that there are low levels of manufacturing activity in the machinery and monitoring equipment category of devices and even less activity in diagnostics. Interestingly in the interviews it was suggested that while South African medical device companies do not produce many final goods or finished products, in the machinery and equipment category several companies have been given contracts by foreign firms to supply inputs to final machinery and equipment.

For example, one company in Johannesburg was contracted by a German company to produce the extruded plastic moulded casing which would house a new machine's functioning components. The company designed and manufactured such casings and the product is now successfully sold on a global scale, with all casings originating from South Africa. These small-batch, non-medical engineering skills are a crucial component for supporting a local medical devices sector. They also open the possibility to opportunities for the local medical device sector to consider assembly production models in tandem with component production models to produce finished goods.

One of the themes which consistently arose during the interviews with the local cluster participants was why the medical devices sector had its current manufacturing profile and where within that profile the sectors' growth challenges and opportunities lie. Understanding the drivers that determine the current mix of manufacturing activities is crucial to understanding what the impediments are to a larger and more robust sector. Several interesting perspectives emerged from different players in the cluster.

In the field of disposable single-use consumables (such as syringes, wound dressings, tongue depressors) local manufacturers claim to be unable to compete on price with imports originating from India and China. Indian and Chinese prices are lower than domestic prices due to higher volume production runs which allow for economies of scale and lower per unit costs.

It is also argued that imported products are made from lower grade inputs and materials which gives them an added cost advantage. With no regulation, certification and quality control of such consumables on the books, to date almost all public sector facilities and most private sector facilities and practitioners use cheaper imported disposable, single-use consumables. All interviewees, and research undertaken by PATH and the MRC (2014) see this market as a high potential growth market for South Africa, especially if regional exports are supported and if such products are designated and purchased on scale by the public sector.

The medical device association SAMED and MDMSA both cited mobility products and medical furniture as niche markets where South African firms were active and where they could compete with imports because of the bulky nature of the product. They claim that hospital beds, wheelchairs, crutches and multi-functional boards used in ICU units and at nurses stations are all produced locally.

The research and interviews did not support this view but the most likely reason for the difference in findings is that such firms may not be captured as medical device manufacturers per se but might be found in associations and economically active players in the furniture and fittings sectors instead. With the investment in public health infrastructure due to increase with the rollout of the NHI scheme, demand for such products is likely to rise in the country and the city and there is no reason why local firms should not meet this demand.

Systemic constraints and hindrances appear most overt in relation to the production of more sophisticated medical device products such as invasive single-use consumables, machinery and monitoring equipment and diagnostics. These are all knowledge-intensive products and involve the highest levels of innovation. They are also products for which barriers to entry into the market are highest, especially for certification, quality control, proof of concept, clinical trials and post-market surveillance<sup>6</sup>.

In addition, these products face the additional challenges of operating in a market with very low volumes in the domestic market, substantial push back and risk adversity from practitioners and medical schemes alike – and constraining funding and revenue limitations.

Despite all these commercialisation challenges, these types of knowledge-intensive products are the products in which South Africa enjoys considerable competitive advantage given the quality of the R&D and medical research sectors in the domestic economy. The innovation pipeline related to knowledge-intensive medical devices in South Africa is very interesting and is different from many countries in the world.

In countries with well-developed and mature medical device sectors, manufacturers in the sector are the key drivers of new and innovative products, instruments, equipment. New technology is thus pushed into the market place. In a nascent industry, as in South Africa, it is suggested that innovation runs in the opposite direction with clinicians being the source of innovative new ideas for new instruments, or gadgets or machines and that manufacturers then meet such demand through a technology demand-pull effect.

---

<sup>6</sup> Post-market surveillance monitors adverse incidents with the product after it has been placed in the market.

Several medical practitioners, academics and manufacturers interviewed all agreed with the view that in South Africa it is medical practitioners and allied medical practitioners who generally come up with an idea for a new device. Unfortunately, once this idea is sparked there is no systemic framework, pipeline or institutional structures or signposts in place to realise such an idea. Indeed when TIPS interviewed several doctors who had attempted to design an innovative device they suggested that they had been able to find academic support and development of their idea but that when it came to commercialising or manufacturing a prototype they struggled to find appropriate fabrication skills. This is unsurprising given the small size of the sector but it does create a sizable challenge moving forward. It was also interesting to note that when local producers were identified they were unable to compete with European competitors on price.

### Key constraints

When all different participants in the cluster were asked to identify the key constraints to developing a medical device manufacturing sector in South Africa a host of issues were identified:

- A lack of government support.
- High cost of compliance with international regulations.
- Lack of South African regulations and particularly quality standards.
- Lack of skilled and semi-skilled labour in supportive manufacturing sectors (engineering, IT, moulding, dies and casts).
- High local production costs which are internationally uncompetitive.
- Cost and quality of raw material inputs (plastics, metals, certain chemicals).
- Access to project funding especially early in the development process.
- Lack of incentives for R&D.
- Lack of co-ordination between and within spheres of government.
- Poor linkages between academia and industry.
- Poor commercialisation skills in universities and research institutions.
- Lack of clinical trials and post-market surveillance\* institutions.
- Lack of public sector procurement.
- Unwillingness of medical schemes to adopt new measures which offer better patient outcomes but at higher costs than traditional measures.
- Consignment and rental\*\* business models employed in most hospitals.
- Small size of the local market.

*\*Post-market surveillance is the monitoring and reporting of adverse incidences and other data parameters of a new device.*

*\*\*For some medical device machinery and equipment hospital usage is so lumpy and intermittent that they rent certain machines from medical device companies as opposed to buying them out right. In a scenario similar to that of consignments, in the case of rental stock the manufacturer or distributor only earns revenue on their asset once it is used.*

The Medical Devices Sector Strategy, envisaged in IPAP 2014/2015 and being formulated by the dti, will need to address all these issues if the sector is to flourish. The list is extensive and many of the elements require competencies and mandates that can be dealt with only by the national government. Assuming national government is committed to its undertaking to grow and develop the local manufacture of medical devices, and assuming that over time the government will be successful in addressing some of the key constraints identified in this report, then the question that arises is what role can the CoJ play and what advantages can be gleaned by the city in assisting in the growth and development of the sector?

### **National government medical device sector support policies and strategies**

The national government, through the soon to be drafted Medical Devices Sector Strategy will aim at providing an enabling environment in which the sector can thrive. In an initial study undertaken on behalf of the dti, Deloitte and Touche (2014) recommend four areas of national government intervention that will need to be part of the final sector strategy.

The first is the need for stakeholder collaboration. The sector will be able to develop only if industry, government and academia all pull in the same direction and co-ordinate their growth plans and activities. The recommendation goes further to suggest that such collaboration will need to take place within a formalised structure. The second area of intervention is the need to introduce and enforce effective regulatory policy and processes including much needed quality standards. It is agreed that all regulations and standards should be harmonised and consistent with international standards so that global market access (exporting) is available to local producers. The third set of recommendations by Deloitte and Touche is to create a more favourable investment climate for sector participants. This would include appropriate incentives to benefit local manufacture and to attract foreign direct investment. Finally, the study recommends that government consider and analyse the possible effects of product designation. At present there are no designations in place regarding any medical devices, but most researchers agree that designation via the Preferential Procurement Policy Act may be a forceful instrument in ensuring demand for locally manufactured medical devices.

From these recommendations together with those of the PATH/MRC (2014) report (page 65), it is obvious that substantial work at a national level is needed to create a facilitating environment for the medical devices sector to grow to the next level. Cluster theory, and discussions with Johannesburg cluster participants, however, suggest there is a role for the CoJ in advance of, and in tandem with, initiatives that are and will be forthcoming from national government. Indeed it is suggested that if the city does not begin to undertake initiatives to support the cluster and specifically the medical devices sector in the immediate term, it is possible it will lose out on potential future investment and growth to the Western Cape where medical device cluster initiatives are well underway. The national government is supportive of sub-national initiatives that dovetail with its overall ambitions for the sector and earlier this year the dti gave the Western Cape R9 million to support its medical devices cluster, which is in the form a dedicated health technology industrial park. The park currently has five tenants and the objective is to create a strategic clustering of pharmaceutical companies, research institutes and groups, clinical trial facilities and R&D facilities (Wesgro 2016).

## Government intervention to support the growth of the industry

The PATH/MRC (2014) report concurs with the Deloitte and Touche findings but adds details of possible spaces for government intervention to support the growth of the industry:

- Obtain alignment between different government departments interested in the cluster.
- Hold a medical device development summit.
- Ensure that the strategy (derived from the summit or through the IPAP process) remains stable over the long term with strong leadership.
- Use the health cluster and medical device strategy to provide focus along the health technology, research and product development innovation pipeline.
- Improve the advocacy and incentives at research institutions to optimise innovation outcomes and drive research through to the market place (i.e. make sure commercialisation occurs).
- Establish local and international partnerships (industry, government and academia).
- Capitalise on South Africa being the gateway to Africa and consider novel technology development and commercial partnership models (the point here is to look at adaptive technology for specifically the African market's needs).
- Encourage co-location of start-ups to facilitate resource, asset and knowledge sharing.
- Leverage existing international certifications as regulatory requirements. Use international standards and definitions and risk classifications of medical devices.
- Create a simple, easy to use method of licensing low-risk devices.
- Develop and implement comprehensive regulatory enforcement strategies.
- Support the harmonisation of local and international ISO certification and provide government-supported financial incentives for local companies to this end.
- Support the development of a local quality system capability through training and enforcement.
- Develop accredited local product testing capabilities with required training support.
- Create an easily accessible and well promoted information resource that describes types and availability of appropriate government funding.
- Consider healthcare spend holistically to include lost productivity and lost revenue in taxes (e.g. technology assessments should take better patient outcomes into account when considering higher cost technologies).
- Monitor the venture capital market for organic development and consider stimulation mechanisms if it does not emerge.
- Leverage grant aid funding from international NGOs and donors.
- Increase the transparency of the state tender process.
- Perform national tenders where possible (to create economies of scale for local manufacturers).
- Require local regulatory approval that is internationally harmonised for all devices covered by the state tender process.
- Evaluate tendering companies for their ability to provide ongoing service and maintenance support.
- Form administrative and clinical tender committees with increasing levels of clinical input as the device complexity increases.
- Award preferential points to locally manufactured medical devices and diagnostics that meet tender and regulatory requirements.
- Regulatory and quality assurance training should be made available either through industry associations or dedicated university offerings.
- Actively encourage collaboration with existing local knowledge area experts and facilitate commercial partnerships with multinational organisations to build the local skills base.



---

*The University of the Witwatersrand Health Sciences Faculty is particularly interested in playing a championing role ... in a medical devices cluster.*

---

## **Growing the Medical Device Cluster in the City of Johannesburg**

Global cluster research supports the idea of local governments initiating, resourcing and facilitating partnerships in a prioritised cluster in support of industrial capacity development and expansion. In a cluster with key gaps, the enabling role of government increases. This research and the interviews conducted strongly suggest a key catalytic role for CoJ to play in catalysing and supporting the growth of the medical devices cluster in the city.

The largest and most inhibiting gap in the current CoJ healthcare sector is a lack of knowledge about, and collaboration between, the cluster's stakeholders – most specifically the city's higher education institutions and researchers, its key (especially teaching) hospitals and its current population of medical device manufacturers and those with engineering capacities and capabilities which could be utilised in an expanded medical device sector. This gap was identified in interviews with all industry participants: medical doctors, representatives of the Wits Health Sciences Faculty, SAMED and MDMSA representatives and industry players. All identified that there is little knowledge of who is doing what in all three areas of the cluster. There is limited interaction between the cluster participants and hence there are low (if any) transfers of knowledge and skills. Industry manufacturers are not in contact with either of the universities based in the city, the MRC office in New Doornfontein or the hospitals and their staff. University representatives acknowledge not only that they have little contact with industry players, but that when they need commercialisation support they do not have networks or processes to follow that give them access to the right commercial and manufacturing capabilities and skills in the real economy.

While the general lack of knowledge about other relevant stakeholders was raised as a constraining factor, this lack of knowledge appeared to be most binding in entrepreneurial situations in which relevant parties do not have access to the right networks and information that could see research or ideas complete their innovative journey and result in commercialised products in the market.

All parties interviewed are keen to address this gap and the University of the Witwatersrand's Health Sciences Faculty is particularly interested in playing a championing role. This is a massive potential boon for the city as most successful international medical device clusters have grown off the back of strong academic research and industry support services.

Against this background and input from cluster participants, it is obvious that the first (most pressing) intervention to be undertaken by CoJ is an initiative to identify and subsequently bring together all relevant stakeholders who can contribute to the city developing a dynamic and robust medical device cluster. Although cluster theory is adamant that cluster initiatives should include, but not be run, by government participants there is widespread consensus that government is the best-positioned participant to catalyse and initiate a formal cluster process.

There is also agreement that government facilitation and financing of a formal institutional structure for the cluster is required. As such it is recommended that the city hold a medical devices summit as a means of identifying stakeholders and participants and laying the groundwork for the creation of a formal, dedicated CoJ medical devices cluster institution.

The current research provides a starting population matrix which can be expanded later using a referral cascading sample methodology. In this approach identified stakeholders are asked to supply the contacts of their associates and network partners such that the stakeholder matrix becomes deeper, more specialised and more representative of the cluster's extended stakeholders. Initial stakeholders to be approached include: the dti cluster support unit, the dti medical devices desk, MRC, Wits, UJ, SAMED and MDMSA.

The output of the stakeholder summit should be a proposal to the dti cluster support unit to seek funding to undertake future research and activity aimed at developing a formal medical devices cluster in CoJ. It is recommended that the first initiative to be undertaken with such funding (whether it comes from dti or CoJ or elsewhere) is the creation of a formal institutional structure which will have dedicated human resources able to take forward the work of the cluster participants. The Western Cape Provincial Government, eThekweni Municipality, and Gauteng's infrastructure project Blue IQ have all over time successfully used the creation of SPVs to house their sector-specific and cluster-specific programmes of work. SPVs represent the triple helix partnership between industry, academia and government.

At their broadest level, SPVs essentially provide a network brokering role between the private sector and the public sector. They act as a neutral platform to build social capital, trust and relationships across parties. SPVs should also be able to provide an efficient implementation mechanism across all areas of work in the cluster and to act as an aggregator of projects. Finally a crucial role of an SPV is to unblock critical constraints to growth. Practically almost all cluster-focused SPVs in South Africa take the form of a not-for-profit company incorporated under the Companies Act. Best practice shows that such SPVs perform best when they are resourced by a full-time CEO who should have specific industry expertise and exceptional networking skills. In all current domestic SPVs, the CEO is supported by non-remunerated executive directors who represent all three of the triple helix participants.

Researching local examples of successful SPVs in South Africa, a range of SPV activities were noted, including activities related to:

- Targeting trade and investment opportunities
- Firm level support
- Support for small and medium sized businesses
- Incubator development
- Venture capital and angel finance development
- Provision of lobbying/influencing the role of the industry through to provincial and national government
- Co-ordination to overcome market failures
- Competitiveness research and benchmarking
- Branding and communications

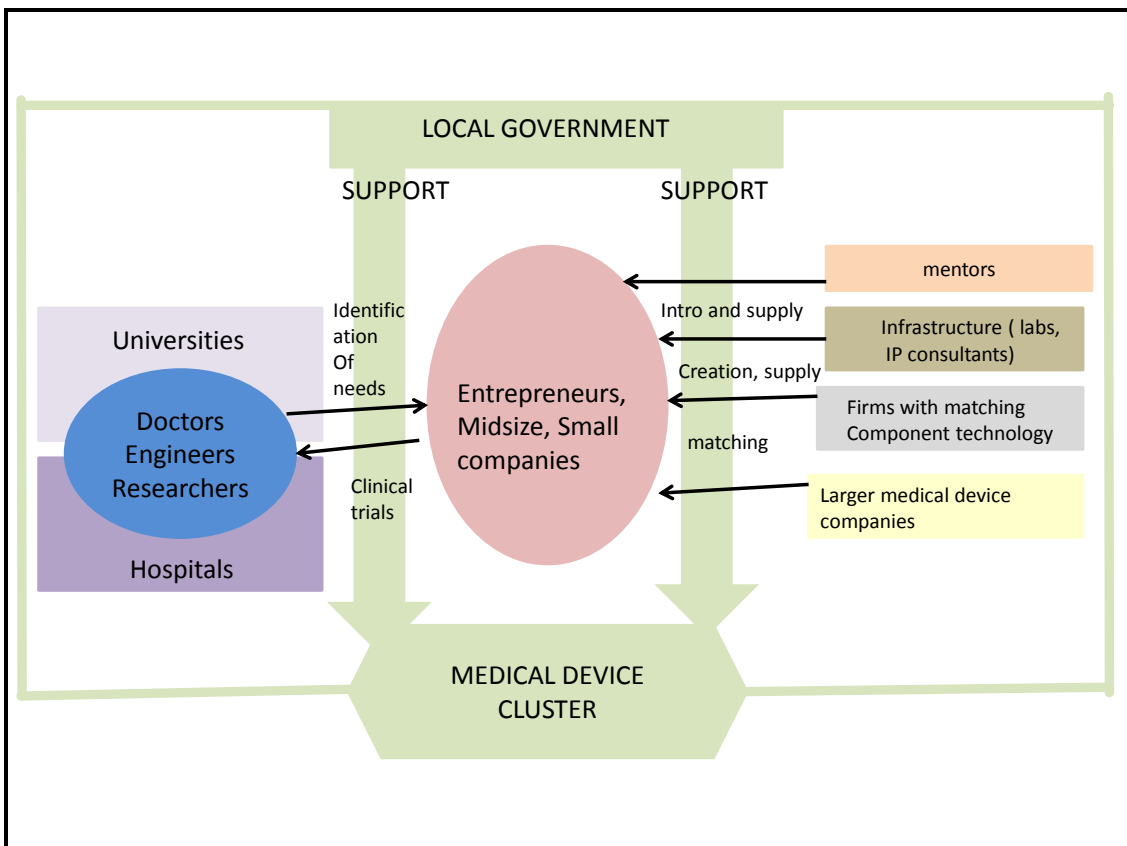
- Shared infrastructure provision
- Industry data provision
- Value chain data provision
- Networking contact database development
- Export development and promotion
- Localisation
- Articulation of skills requirements and plans to address skills shortages
- Enhancing the overall business environment
- Provision of specialised consulting services

This list dovetails well with the national activities identified in the previous section and provides an indication of how national and local initiatives can be rolled out in parallel and become complementary and supportive of each other.

There are numerous methods by which the work of a local authority-supported medical cluster SPV can be approached, and indeed one of the initial roles of the formal institution created will be to collectively identify this future course.

Diagram 3 shows one possible illustrative configuration of a local government led medical device cluster. The configuration and initial activities illustrated highlight several issues which were raised during the research process and which suggested to the researchers that the configuration might be particularly appropriate in the CoJ context.

**Diagram 3: Illustrative configuration of a government-led medical device cluster**



Source: Adapted from Yasuo Fujji, 2011

The key reason this configuration was chosen for illustrative purposes is that it highlights three areas identified in the interview process and desktop research. These are: i) the crucial role of clinicians and doctors in generating the needs analysis and opportunity identification of the cluster which then seamlessly need to be shared with multi-disciplinary teams at universities; ii) the reality that almost all medical device manufacturing entities are small or medium-sized businesses, which is beneficial in their relationships with doctors, clinicians and universities but creates challenges in commercialisation. For this reason, the third appealing characteristic of the configuration in Diagram 3 is the emphasis that the cluster support system to be created must include iii) access to commercialisation and business mentors and access to large multinational companies.

In an interesting study of the medical device sector in California it was found that 53% of new medical device start-up companies were started by ex-employees of large MNCs. Similarly, in Ireland, its medical device cluster in 1973 was 100% foreign firms (lured with zero tax incentives). By 2011, 64% of medical device companies in Ireland were local. This suggests that MNCs play a crucial role in new knowledge-intensive clusters – first and initially as routes to market and market access and penetration but later as a source of indigenous entrepreneurs.

The final element that is particularly appropriate for the CoJ medical device cluster is the idea of ensuring matching between medical device companies and other manufacturing and technology input manufacturers. This is a complex and important area of analysis of the SPV to take forward as early as possible. The underlying idea is that the SPV should undertake a capabilities audit. This will achieve two goals. First it will identify areas where the city has a competitive or comparative advantage in a field of specialisation within the broader array of medical devices. For example, in Alsace BioValley, France the region's capabilities in traditional watchmaking were leveraged to support the development of micro-medical devices as it used a similar set of skills and capabilities. In Emilia Romagna, Italy, 45 new biomedical start-ups have clustered in a period of only 10 years not because of a specific capabilities set, as in the French example, but because of what is termed in a promotional website as the presence of proxy producers of excellent technological competitiveness. In this example, access to this high-level technological capability allows medical device start-ups to link with existing manufacturing capabilities to give birth to a new sector for the region. It is also interesting to note that because of this manufacturing capability the origin of start-ups in Emilia Romagna is fundamentally different from those in California. In Italy, most medical device start-ups emerge from university research projects spun off into commercial entities whereas in California most new companies emerged from ex-employees of large MNCs going it on their own.

The fifth and final area of activity illustrated in the possible medical device cluster configuration is the idea that the SPV must support the provision of shared infrastructure for the participants of the cluster in line with Porter's shared inputs argument. In the analysis, these shared infrastructural inputs will include traditional shared infrastructure – most specifically – clinical testing and trial infrastructure, materials and standards certification infrastructure. It will also include crucial support infrastructure given the composition and nature of the firms that populate the cluster. These softer infrastructure provisions will include access to angel and early-stage investors and funding mechanisms and options; access to commercialisation

experts and mentors; access to specialised skills in the field of intellectual property; negotiated entry to relevant incubators and national research programmes and firm level support tools; matching with input suppliers and manufacturers; and contact with large MNCs related to market access and penetration. In a specifically South African context, relations and networking with the gatekeepers of hospital procurement and the medical aid schemes will also be a crucial activity for the cluster institution and staff to deal with.

Over and above the recommendations that CoJ initiate a cluster process, set up a medical devices cluster SPV with a Board and a CEO, and begin to look at an agenda of action including possible activities, as suggested in the illustrative configuration presented above, a final recommendation is to consider the development and operation of a medical devices industrial park. The entire principle of clustering is based on the theory and notions that benefits arise from proximate location. The research shows these benefits would include: input sharing, labour pooling, and knowledge sharing as per Marshall's original economies of localisation. As per the Porter argument this would lead to increased specialisation and diversification which would improve overall productivity and hence international competitiveness. In the South African context, although much has been made of the need for information and knowledge sharing and the future infrastructural needs of the cluster, it is the view of the research and some interviewees that the most important benefit of a CoJ medical devices cluster would be the benefits of labour pooling – especially of complementary and supportive capabilities. This labour pooling and the ability to attract relevantly skilled labour is hard to achieve in a nascent industry and any activity that would provide a first port of call of skilled labour to potentially migrate towards would be an enormous boon to a future medical device cluster.

The research shows a dense and strong healthcare clustering around the Auckland park, Rosebank, Parktown, Parktown North geographic node. This dense clustering of healthcare sector facilities, infrastructure and practitioners also overlaps with the location of the city's two universities and areas of greatest research competency. It therefore appears to be the premier location for a medical device healthcare cluster, at least in the early days of the cluster's development. Because of the Wits Health Sciences Faculty's interest in the development of a medical devices industry in the city, and its desire to take a championing role in developing the cluster, it is highly probable that at least initially the cluster could be housed at the university and its extended campuses or adjacent land. Although it may be pre-emptive, it is important to note at the outset that although the Auckland Park, Rosebank, Parktown, Parktown North area is the optimal location for a medical devices industrial park – in reality the area is already too highly developed and concentrated to allow for a commercially viable industrial estate. It is suggested that a dual park concept possibly be considered. In this model the Wits/Parks area could operate as a head office park for the R&D and knowledge-intensive side of a medical device business – with manufacturing facilities being in a centre with higher land availability and lower costs such as Midrand or the South. As long as the two centres are not too far from each other proximity should not become an issue. Evidence was found of international experiences with dual clusters where production takes place far from head office and product design and development activities. A robust and extreme example was found in the US where head offices of medical device companies are clustered around universities in San Francisco in California, while manufacturing activities are undertaken across the border in Tijuana Mexico.



## CONCLUSION

A consideration of the healthcare cluster as a potential source of future city-based growth and employment is extremely timeous. The dti is committed to growing the medical devices sector in South Africa and is determined to create an enabling environment for local producers to substitute their products for currently imported products. This market opportunity in the current market is estimated to be roughly R42 billion a year but will increase substantially in the future as the NHI scheme is rolled out.

The research shows that the city is particularly well positioned to take advantage of this growth opportunity, but that substantial intervention would be required to support the development of such a nascent cluster.

At present the city's healthcare cluster is large, robust and growing organically to deliver healthcare services to the population. In the activity field of direct patient care offered either through hospitals or ambulatory care facilities the city is extremely well provisioned and there appear no obvious gaps in either general or specialised health care. The cluster is populated by a host of medical practitioners, allied medical practitioners, and specialised input service providers such as imaging and laboratory specialists. This direct patient care is dependent on inputs from two key industrial sectors – the pharmaceutical sector, which provides medicines and drugs, and the medical devices sector, which provides instruments, consumables, implants, machinery and diagnostic devices. While the direct patient care activity of the cluster is strong and robust with few (if any) visible gaps – the input sector to the cluster is a source of weakness and vulnerability. Sixty-five percent of pharmaceuticals and 90% of medical devices are imported, showing a gaping hole in the local healthcare cluster.

It is around these input weaknesses that an argument for city-based government intervention can be made. First it is suggested that the city not attempt to intervene or take forward the growth of the pharmaceutical manufacturing sector in Johannesburg. This is due partly to the reality that currently there are only two such manufacturers in the city; and partly because there is little commercial or competitive advantage for pharmaceutical manufacturers basing themselves inland away from their key input of active pharmaceutical ingredients, which are all imported by sea. It is argued that there are several reasons why the City should intervene to support the growth of the medical devices manufacturing sector.

It has been shown that the demand for medical devices in South Africa is almost certain to grow with increasing urbanisation, a growing middle class, increased incidence of non-communicable diseases, a high and persistent prevalence of communicable diseases, and the introduction of the NHI scheme. It has, however, been shown that to date a domestic industry has not organically developed to meet these needs and that the country remains dependant on imported devices.

Domestic growth of the industry has been limited by the lack of regulatory and certification systems, the small size of the local market, the gatekeeper role of medical funders, the cost-driven nature of the public sector device procurers, funding constraints, and a lack of collaboration and relationship building between participants and stakeholders in the cluster. Many of the interventions required by the government to support a strong and robust future medical devices sector lie entirely in the hands of the national government and are not within the constitutional or operating mandate of the City. However, with the official commitment of the national government to support the sector; and with the draft of a Medical Devices Sector Strategy imminent, there is little to no risk of the city advancing an intervention agenda which will not be supported by and complementary to the national drive.

The pace of national progress on issues such as regulation, quality control and designation will obviously influence the pace at which city-based interventions can and should occur; but there are three distinct city-based interventions that have been recommended, all of which can be undertaken (and indeed should be) as a matter of urgency with little risk of timing and co-ordination constraints.

The first and most important contribution the city can make in supporting a domestic medical devices sector is to assist in a crucial gap in the current functioning of the sector as part of the cluster at present. The missing element is a core of all industrial policy at a national level and all cluster policy at a locational level – the need for collaboration and knowledge sharing across the participants necessary to bring R&D and innovative ideas to commercial reality. In the healthcare cluster academic institutions often possess specialised instrumentation and equipment and are the centres of codified knowledge in a given field. Hospitals in the cluster are best positioned to understand patient needs and have the first-hand knowledge of the shortcomings of medical devices available to them. Industry on the other hand has knowledge and access to current technology and production processes used in manufacturing. Any innovation in the medical field requires these three parties to collaborate, interact and share knowledge. In the City of Johannesburg such collaboration is weak and there is no systematised or formal mechanism by which the three parties can be introduced to each other and interact.

As such the first recommendation is that CoJ undertake to run a medical device stakeholder development summit as a first step towards developing a medical devices cluster based on a triple helix collaboration between industry, government and academia. Cluster theory and benchmarked experiences show that such collaboration efforts are most effective when considered within a formal structure and as such it is recommended that the city set up a medical devices cluster as a SPV organisational entity as a not-for-profit company under the Companies Act with a dedicated CEO and a Board of Directors.

The second recommendation is that CoJ set up a dedicated industrial park to take advantage of the benefits of agglomeration – especially labour pooling, shared inputs and knowledge sharing. It is recommended that initially the head office of the cluster be sited at the Wits Health Sciences Faculty, given its resources and geographical location and that a manufacturing park be established in an area more conducive to light industry (the South or Midrand).

The third recommendation is that the activity agenda of the SPV consider, inter alia, a cluster configuration which is particularly attuned to the nature of the firms which dominate the cluster – namely small, medium and start-up firms which will require support to access to finance, intellectual property (IP) advice, commercialisation skills and mentors and market access.

It is strongly believed that the dti's medical devices desk, it's cluster support desk and the National Treasury would endorse such an initiative, and given the experience of the Western Cape, CoJ could reasonably anticipate attaining financial support from national to at least initially set up an SPV and appoint a CEO.

While the signs look encouraging that a supportive and co-ordinated effort by government to support the growth of a domestic medical devices sector in South Africa will be successful, it is necessary to temper such optimism with a few microeconomic qualifiers and realities.

First, new and innovative medical device and equipment development has a long lead time (seven to 12 years), is very expensive, and has high initial unit costs. This means that support measures and involvement will need to be long-term commitments and any eye to growing domestic production will need to be supported by measures to ensure regional and global market access and penetration.

Second, at present the capacity of the healthcare system to generate ideas and innovations is greater than the system's ability to fabricate and manufacture such new products. It will take time for the manufacturing capacities and capabilities to catch up and policies and funding mechanisms will be required to bridge this period. A capabilities audit may go some way to minimise this gap.

Finally, it must be remembered that public hospital and clinic administrators and medical scheme representatives are the ultimate gatekeepers of the healthcare cluster and have the power to determine what treatments, what devices and what equipment is used in healthcare delivery. Bringing these parties on board to the process is absolutely crucial.

## REFERENCES

Benneworth, P., Henry, N., 2004. Where is the value add in the cluster approach? Hermeneutic theorising, economic geography and clusters as a multi perspectival approach. *Urban Studies*, Vol 41, No. 5/6.

Cotright, J., 2006. Making sense of clusters: regional competitiveness and economic development. Brookings Institute, Discussion paper, Metropolitan Policy Program, Washington D.C.

Council for Medical Schemes (CMS), online. CMS Overview. [www.medicalschemes.com](http://www.medicalschemes.com). Accessed in 2018.

Deloitte and Touche, 2014. Research to guide the development of strategy for the medical devices sector of South Africa. Johannesburg.

Department of Trade and Industry (the dti), 2014. Industrial Policy Action Plan 2014/2015 – 2016/2017. Government of South Africa, Pretoria.

Duranton, G., 2005. From sectoral to functional urban specialisation. *Journal of Urban economics*, 57(2).

Feser, E.J., 2008. Old and New Theories of Industrial Clusters in *Clusters and Regional Specialisation*. Ed. Steiner, M., London, Pion.

Gauteng Department of Health, 2015. Submission to the Health Market Enquiry. Johannesburg.

Gauteng Department of Health, 2017. Gauteng Department of Health Overview. Johannesburg.

Gordon I.R, McCaan P., 2000. Industrial clusters: Complexes, agglomeration and/or social networks. *Urban Studies*, 37(3).

KPMG, 2014. South African medical technology Industry: Overview and economic impact assessment.

Langendijk, A., Cornford, J., 2000. Regional institutions and knowledge: tracking new forms of regional development policy. *Geoforum*, 31.

Madubuld, N., English, R.G.T., Padyachee T, and Mkhize, N., 2014. Adequacy and efficiency in primary healthcare financing. Input to the 2015/2016 Submission for the Division of Revenue Report. National Treasury.

Marshall, A., 1890. *Principles of Economics*. MacMillan (1920 edition)

Martin, R., Sunley, P., 2003. Deconstructing clusters: chaotic concept or policy panacea? *Journal of Economic Geography*, 3(1).

Massachusetts Institute of Technology (MIT), 2005. Universities, innovation and the competitiveness of local economies. Summary Report, Industrial Performance Centre.

Newlands, D., 2003. Competition and cooperation in industrial clusters: the implications for public policy. *European Planning Studies* 15(1).

- OECD, 2010. Clusters policy. OECD Innovation Policy Handbook.
- PATH/MRC, 2014. Developing an ecosystem to support the local medical devices and diagnostic industry in South Africa: Recommendations from an international perspective.
- Porter, M.E., 1990. The Competitive Advantage of Nations. Harvard.
- Porter, M.E., 1998. Clusters and the New Economic Competition. Harvard Business review, November-December 1998.
- Porter, M.E., 2000. Location, Competition and Economic Development: Local Clusters in a Global Economy. Economic Development Quarterly, Vol 14, Issue 1.
- Rosenfeld, S., 2000. Cluster Connections: specialisation and competitiveness in the United States and Europe. Economic Development Quarterly, 14(1).
- Rosenfeld, S., 2010. Discussions at Implementing Clusters Workshop. Federal Reserve bank, Chicago.
- Weber, M., 1929. The Theory of Industrial Location. Chicago University Press.
- Wesgro, 2016. Sector: medical devices. Wesgro, Cape Town and Western Cape research.
- Wolman, H., Hincapie, D., 2010. Clusters and cluster based development: A literature review and policy discussion. George Washington Institute of Public Policy, Working Paper.
- Yasuo, F., 2011. Silicon Valley's ecosystem for the development of medical devices – What are the lessons for Japan? Development Bank of Japan, Economic and Industrial Research Department, New York.



## ABBREVIATIONS

APIs	Active Pharmaceutical Ingredients
ARV	Antiretroviral (drugs)
CEO	Chief Executive Officer
CoJ	City of Johannesburg
CMS	Council of Medical Schemes
DST	Department of Science and Technology
EKG	Electrocardiogram
ENTs	Ear, Nose and Throat Specialists
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GIS	Geographic Information Systems
HPCSA	Health Professional Council of South Africa
ICT	Information and Communication Technology
ICU	Intensive Care Unit
IPAP	Industrial Policy Action Plan
ISO	International Organization for Standardization
IT	Intermediate Technology
IVD	In Vitro Diagnostic
MCC	Medicines Control Council
MD2M	Medical Devices to Market
MDMSA	Medical Devices Manufacturers Association of South Africa
MIT	Massachusetts Institute of Technology
MNC	Multinational Corporation
MRI	Magnetic Resonance Imaging
NGO	Non-Governmental Organisation
NHI	National Health Insurance
NHLS	National Health Laboratory Services
SAMED	South African Medical Devices Industry Association
SAMRC	South African Medical Research Council
SANAS	South African National Accreditation System
SPECT	Single-Photon Emission Computed Tomography
PET	Positron Emission Tomography
PMB	Prescribed Minimum Benefits
R&D	Research and Development
SANC	South African Nursing Council
SAPC	South African Pharmacy Council
SIC	Standard Industrialisation Classification
SPV	Special Purpose Vehicle
UJ	University of Johannesburg
US	United States
Wits	University of the Witwatersrand

## ANNEXURE A: OVERVIEW OF DATA ANALYSIS PROCESS AND FINDINGS

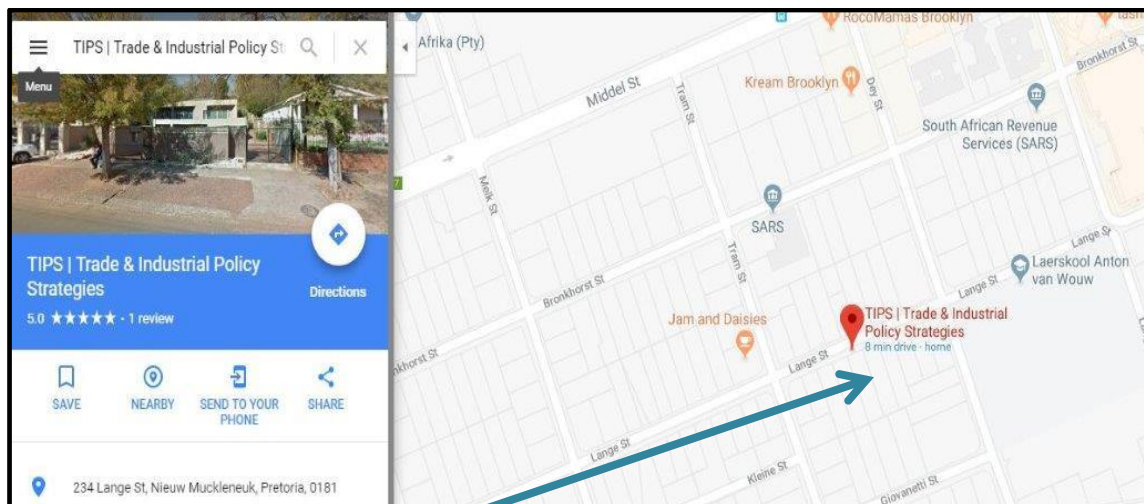
### Collection of data

A range of relevant data was sourced and collected from various institutions. One of the major sources of data was the Medpages – the largest, most accurate, most up to date and most complete healthcare database available for Africa.

Additional data, and specifically address data, was scrubbed directly from the relevant organisations' websites to ensure the most accurate and current locational data.

### Preparation of data

The next step in the process was to create a custom-built geodatabase, containing all the sourced data. To do this, all relevant data was scrubbed and prepared for importation into the geo-database. During this preparation process, the sourced data is formatted to conform to a singular standard. In line with the main objective of the study, the next step in the process required the association of a Longitude and Latitude coordinate to each and every healthcare entity. Following on that, the relevant data was grouped into the different map categories as intended to be reported on. A Geocoding process was used to prepare the data for the mapping process.



Geocoding is a process of transforming a description of a location, for example a pair of coordinates, an address, or a name of a place, into a location on the earth's surface. The resulting locations are output as geographic features with embedded intelligence and specific attributes. Once the entity addresses are geocoded, the address locations can be spatially displayed and recognisable patterns within the information can be analysed. This can be done by simply looking at the information or by using more advanced GIS (Geographic Information System) software analysis tools. By using a Geocoding process, the data captured in the geodatabase can therefore be analysed for a wide range of applications.

One of the geocoding tools used for this study was the address data analysis tool. Once the addresses of all healthcare entities were geocoded, it was possible to spatially display their address locations in map format. By grouping the different types of entities, it was possible to identify and analyse specific locational patterns of health care clusters within the study area.

## **Data analysis processes**

### **Grouping and counts**

For each different healthcare category, such as medical doctors, pharmacies, allied services, etc., healthcare entity groups were created to display these groups as spatial entities on separate maps. Based on the principle of cluster analysis, the main purpose of these groupings was to identify the quantities of specific healthcare entity groups located within a specific geographic area. Starting off by using the smallest mappable geographic entity, it becomes possible to roll up the numbers of entities from that point onwards to demonstrate the grouping of these entities and spatial distribution thereof within the designated study area. This initial identification of the health sector entities are then be mapped and show how tabular data sets are to be aggregated or disaggregated.

### **Cluster mapping**

A type of mapping called cluster maps was used to display the data analysis output. Cluster maps display data through proportional symbols that vary in size relative to the number of entities displayed in a specific geographic area. The varying quantities are visually reinforced by using graduated colours over the same geographic area. Since the purpose of this study was to identify potential geographic clusters of healthcare entities within the City of Johannesburg Metropolitan Municipality, cluster maps provide the ideal tool to visually capture the geographic distribution of healthcare entities. Through the use of proportional symbols, the potential existence of healthcare entity clusters, as well as the location thereof, become instantly recognisable in this map format.

### **Hot spot analysis**

In conjunction with the cluster mapping, a hot spot analysis process was also utilised to identify the spatial location of entities with either very high or very low cluster values spatially. This tool works by looking at each feature within the context of its neighbouring features. For example, a feature with a high value may be interesting, but it may not be a statistically significant hot spot. To be a statistically significant hot spot, a feature will have a high value and be surrounded by other features with high values as well. Hence a hot spot will be identified when the local sum for a feature and its neighbours is very different when compared proportionally to the sum of all features than what was originally expected, and that difference is too large to be the result of random chance.

## **Area of analysis**

The area of analysis was restricted to the City of Johannesburg Metropolitan Municipality.

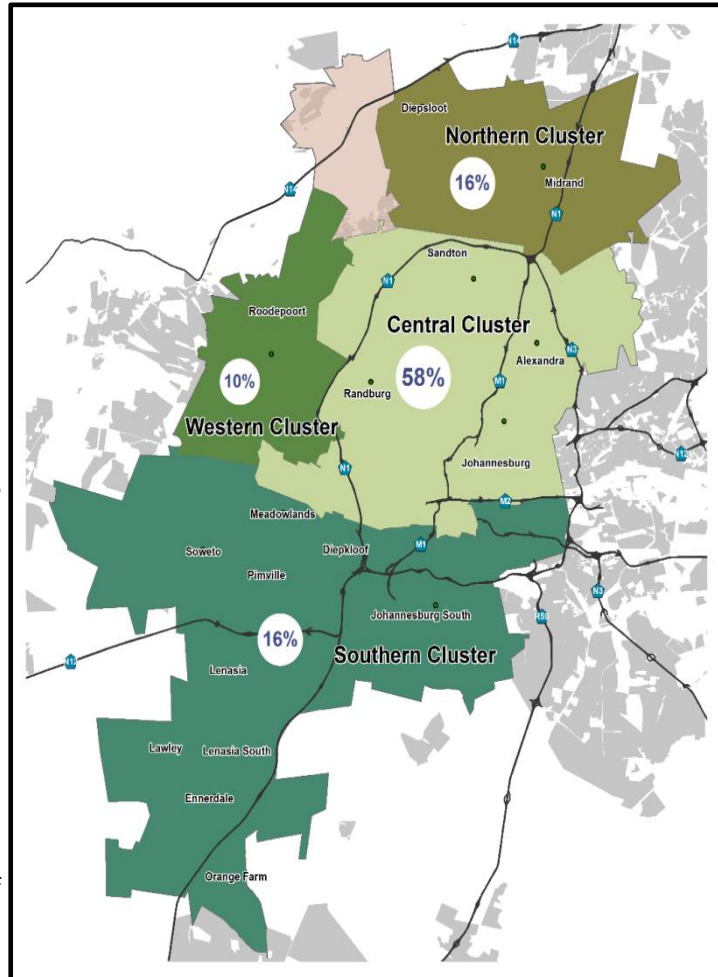
## Analysis of data output

Following the analysis process outlined in the previous sections, and with reference to the enclosed maps, the existence of four healthcare entity clusters were confirmed and identified within the City of Johannesburg Metropolitan Municipality; namely the Northern Sub-cluster, the Central Sub-cluster, the Southern Sub-cluster and the Western Sub-cluster.

It is clear from the analysis results that the **Central Sub-cluster** is a very significant and dominating healthcare entity cluster within the City of Johannesburg, with almost 60% of all healthcare entities located within this area.

This region consists of the township areas of central Johannesburg, Randburg and parts of Sandton – with the most prominent suburbs being Parktown, Richmond, Braamfontein, Fourways and Rosebank as well as areas including Bryanston, Sunninghill, Sandringham, Linksfield, Northcliff and Rivonia.

**The Northern Sub-cluster** which predominantly consists of Midrand and Diepsloot includes 16% of the healthcare entities.



As evident from the map, there is a clear North/South division. **The Southern Sub-cluster** also contains 16% of all healthcare entities, but it represents a significantly bigger geographic area. The Southern Sub-cluster includes townships such as Soweto, Lenasia, Orange Farm and Diepkloof. The sub-cluster in itself has pockets of areas with a high number of entities but with little or no entities in between these pockets.

**The Western Sub-cluster** has the smallest number of entities with just over 10% – however, this cluster also represents the smallest geographic area. The main townships in this area include Floracliffe, Radiokop, Roodepoort, Constantia Kloof, Florida and Honeydew.



**TRADE & INDUSTRIAL POLICY STRATEGIES**

Trade & Industrial Policies Strategies (TIPS) is an independent, non-profit, economic research institution established in 1996 to support economic policy development. TIPS undertakes quantitative and qualitative research, project management, dialogue facilitation, capacity building and knowledge sharing. Its areas of focus are: trade and industrial policy, inequality and economic inclusion, and sustainable growth.

[info@tips.org.za](mailto:info@tips.org.za)

+27 12 433 9340

[www.tips.org.za](http://www.tips.org.za)