ABSTRACT
Service quality and customer satisfaction are inseparable issues that would lead to higher service recognition and improve organization performance. This research sets to provide some understanding on how reliability, responsiveness and turnaround time affects the customer satisfaction through service quality. SERQUAL scale was used to assess the customer perceptions of the service quality delivered by Medical Laboratory Service Provider (MLSP) in Malaysia. A total of 122 self-administered questionnaires were distributed amongst medical professionals in Malaysia. Multiple regression analysis was used to test the research hypotheses. The research found that reliability, responsiveness and turnaround time has a significant influence on service quality. The results may provide some direction for employers and policymakers to maintain excellence service quality, conserve the customer and some bearing for the future research.

Keywords: Service Quality, Customer Satisfaction, SERQUAL, Medical Laboratory Service
2. Problem Statement
The Medical Diagnostics Laboratory Services is an ancillary department in healthcare sector. Medical diagnostics laboratory plays a vital role in the screening, diagnosis and monitoring diseases. Medical diagnostics lab helps and provides medical practitioners a healthcare service of high standard to patients (Ramessur, Hurreeram & Maistry, 2015). Medical diagnostic lab and medical practitioners are being required to operate in-tandem for synchronized actions leading to more outcome-oriented, patient-focused and evidence-based approaches to service quality (Ramessur et al., 2015). Medical diagnostic labs in public sector face so much pressure from its customers for service and quality timelines. This is due to the increasing number of samples each year and lack of medical diagnostic technician and scientist (Ramseook-Munhurrun, Lukea-Bhiwajee & Naidoo, 2010).

In private sector, the major concern is to know the performance of the medical diagnostic laboratory providers from the customers’ perspectives – the medical practitioners. The medical diagnostic laboratory providers must also aware that the services offered must be parallel with the demand and expectations of their customer (Wisniewski, 2001). Reliability of results, turnaround time, and responsiveness are some of the important factors to consider in customer-oriented market. In order to do this, we need to measure service quality by comparing their expectations of service with their perceptions of service received (McGriffen, Steward & Wisniewski, 1999). Moreover, Malaysian government is now looking forward to put the nation as a medical tourism destination, the players of this industry try to expand their business by establishing more services and at the same time improve the quality of services to the clinicians (Ramessur et al., 2015) This provides the basis for the research which aims at developing a service quality framework specific to medical diagnostics laboratory. Specifically the research will use reliability, turnaround time and responsiveness in medical diagnostics laboratory as means to generate customer satisfaction.

2.1 Reliability and Customer Satisfaction
Reliability of the services given is basically related to customer satisfaction. Reliability refers to the compliance of the medical diagnostics lab to deliver whatever they have promises earlier. This includes the accuracy of the test, turnaround time and few other determining requirements (Chakraborty & Roy, 2011). Increase in workforce, chains of medical diagnostics laboratories and medical suppliers, complex lab tests or services to offer and market competitiveness has become major concerns in setting the quality to a higher standards. An effective quality control must be set up from the very beginning of the service or product lifecycle. The process must be consistent and efficient so that it would not affect the other phase.

The lab personnel must understand and clear about the process so that any management decision that needs empirical data can be roll out easily. By implementing a good practice of service reliability, medical diagnostics lab can understand major problems that they are regularly encountered in daily operations. This will then help them to take corrective actions for the benefit of both providers and customers (Saghier & Nathan, 2013). Shrestha and Mishra (2015) suggested more research on the relationship between reliability and Customer Satisfaction.

H1: There is a relationship between the service quality delivery (reliability) and customer satisfaction.

2.2 Responsiveness and Customer Satisfaction
Responsiveness of the lab services refers to the willingness of the medical diagnostic lab providers to their customer’s by facilitating them with a faster, precise and dedicated service. Customer Satisfaction increased if they get a prompt response and the best quality outcomes (Srivastav & Mittal, 2016). Shrestha and Mishra (2015) found that the largest gap in the SERVQUAL model is of responsiveness. Chakraborty and Roy (2011) found that empathy, tangibility, reliability, responsiveness, and assurance have a positive effect on customer satisfaction. Shrestha and Mishra (2015) suggested more research on responsiveness and Customer Satisfaction.
H2: There is a relationship between the service quality delivery (responsiveness) and the customer satisfaction.

2.3 Turnaround time and Customer Satisfaction
The turnaround time refers to the time taken of a service rendered from the specimen reception up to report validation and delivery. Management of report authorization and report delivery are vital essential. Turnaround time has become the leading factor affecting ordering customer satisfaction (Chan, Carroll, Linnau & Lehnert, 2015). Depending on the logistically arranged dispatch to release the results to all clinics will absolutely consuming time. There is a need of medical diagnostic lab to adopt the Laboratory Information System (LIS) to deliver the report direct from the workbench into doctors’ office (Ramessur et al., 2015). Ramessur et al. (2015) high-lighted that turnaround time, test report, technology and laboratory staff attitude and behaviour were significantly affect service quality in laboratory services. The adoption of online system has enabled doctors’ to assess their patients’ medical report at their fingertips. Timely analysis of lab tests will have a significant impact on the doctors’ decision and help patients’ management. Nevertheless, the customers’ perception of time as well as their expectations for responsiveness in quality service delivery is needed (Chung & Koo, 2015). As such, more research between turnaround time and customer satisfaction is need (Chung & Koo, 2015).

H3: There is a relationship between the service quality delivery (turnaround time) and the customer satisfaction.

2.4 The Relationship between Perceived Value, Reliability and Customer Satisfaction
Perceived value has been defined as the consumers' overall assessment of the utility of a product based on perceptions of what is received and what is given (Caruana, Money & Berthon, 2000). Perceived value is a trade-off between perceived benefits and sacrifices (Weinstein & Johnson, 1999). Service quality is positively influenced perceived value and customer satisfaction (Kuo, Wu & Deng, 2009). Many empirical studies found that perceived value positively influence customer satisfaction (Eggert & Ulaga, 2002; Hsu, 2006; Kuo et al, 2009; Lin & Wang, 2006; Turel & Serenko, 2006). Hence, greater perceived value would lead to higher customer satisfaction (Kuo et al, 2009). When perceived quality is greater than perceived costs, then it is said that customer value is high; in contrast if the cost higher than the quality received, then customer value is determined as low (Matzler, Bailom, Hinterhuber, Renzl & Pichler, 2004). Moreover, “reliability” is most influential on perceived value and customer satisfaction (Kuo, 2003). Nevertheless, the moderating relationship between perceived quality and customer satisfaction is still inconclusive and more research is needed in this area (Li, et al., 2015). Thus, the following hypothesis was proposed.

H4: Perceived value moderates the relationship between service quality delivery (reliability) and the customer satisfaction.

2.5 The relationship between perceived value service quality delivery (turnaround time) and the customer satisfaction
The relationship between perceived value, responsiveness and customer satisfaction is very important in the marketing broad area (Prebensen, Woo, Chen, & Uysal, 2013). Perceived beholds judgments of value based upon the consumers experience. Perceived value is important in determining customers’ satisfaction (Jhandir, 2012). Turnaround time has become the leading factor affecting ordering customer satisfaction (Chan et al., 2015). Ramessur et al. (2015) argued that turnaround time is one of the most important factors that could affect the service quality in laboratory services. Hence, customer satisfaction is increased if they get a prompt respond and the best quality outcomes (Srivastav & Mittal, 2016). There is high possibility that perceived value moderates the relationship between service quality delivery (turnaround time) and the customer satisfaction. As such, the moderating role of perceived value, between turnaround time and customer satisfaction could be explored (Ryu, Lee, & Gon Kim, 2012)). Thus, the following hypothesis was proposed.

H5: Perceived value moderates the relationship between service quality delivery (turnaround time) and the customer satisfaction.
2.6 The Relationship between Perceived Value, Responsiveness and Customer Satisfaction

According to Chakraborty and Roy et al. (2011) empathy, tangibility, reliability, responsiveness, and assurance have a significant impact of customer satisfaction. Customer satisfaction is highly generated through quick response and action for customers (Srivastav & Mittal, 2016). Customer perceived value is derived by comparing perceived benefits and perceived sacrifices/costs paid by the customer (Zeithaml, Parasuraman, Berry & Berry, 1990). Service quality features such as responsiveness is positively related to perceived value and customer satisfaction (Eggert & Ulaga, 2002). Shrestha and Mishra (2015) suggested more research on responsiveness and Customer Satisfaction. According to (Clemes, Gan & Ren, 2011) perceived service quality is affected by interaction quality, physical environment quality and outcome quality (customer satisfaction). Many past studies paid attention to the relationship between service quality and customer satisfaction (Caruana et al., 2000; Srivastav & Mittal, 2016; Prebensen et al., 2013; Zeithaml, 1988). There is also high possibility that perceived value moderates the relationship between service quality delivery (responsiveness) and the customer satisfaction (Chen & Tsai, 2007). Nevertheless, the moderating role of perceived value between service quality delivery (responsiveness) and the customer satisfaction received less attention (Caruana et al., 2000; Chen & Tsai, 2007). Thus, the following hypothesis was proposed.

H6: Perceived value moderates the relationship between service quality delivery (responsiveness) and the customer satisfaction.

2.7 Three-Factor Theories

By looking at these three (3) gaps, it is clear that the medical diagnostics lab providers must evaluate the expectation and perception from their customer towards the service quality performed. These facts will help them to meet the customers’ satisfaction to a higher level. Three (3) factors theory is the main theories used in the study. This theory justifies the relationship between customer satisfaction and service quality. The Three Factors theory developed by Kano, (1984) has provided a theory that can differentiate the variety of dimensions of quality.

This theory characterized service quality dimensions as three (3) main groups which is must-be, attractive, one-dimensional and these groups result customer satisfaction in different way. Brandt (1988) however suggested another three (3) categories – performance indicator, basic factor and excitement factors. (Matzler et al., 2004) explained these factors in his research. Basic factors or dissatisfies considered as the minimum requirement needed as a results in unhappy or dissatisfaction. Only the fulfilment of the service rendered can give them full of satisfaction. Negative performance of such attributes will have a strong influence on total satisfaction of customers compared to positive performance. Excitement or satisfier factors will increase the customers’ satisfaction if properly delivered. This factor also can results in no dissatisfaction at all if the service is not being provided. The positive performance of this attributes will significantly impact consumers’ satisfaction in comparison to negative performance. Last but not least, the performance factor. Performance factors can lead to total satisfaction if only there is a high performance rendered. Low performance however will lead to customer’s dissatisfaction.
3.0 Research Framework
Based on the literature review, the following research framework in Figure 1 was developed.

![Research Framework](image)

The sampling data was based in Kuala Lumpur, Malaysia. Kuala Lumpur was chosen because most of the medical diagnostic laboratory both private and public is established in this area. The total numbers of medical diagnostic laboratory in Kuala Lumpur was determined as 250. Respondents must have specific knowledge about the business of research (Ottenbacher, Harrington, & Parsa, 2009). Hence, the respondents for this study were owners of the Laboratory service providers in Klang Valley. As such, the research targeted its respondents who were medical professionals (Medical Doctors, General Practitioners, and Clinicians etc.) in healthcare settings for both public and private sectors. Hence, based on (Krejcie & Morgan, 1970) with a confident interval of 95%, a sample size of 148 was determined.

Judgmental sampling method was chosen as the researcher required specific information from the owner of business. A Service quality framework developed by Parasuraman, Zeithaml and Berry (2002). SERVQUAL will be used as the basic to measure the impact of both variables. The SERVQUAL scale proposed by Parasuraman is widely accepted tools for measuring service quality Ladhari, (2008). Nonetheless, some modification suggested by in LabSERV will be implemented to specify the needs of medical lab industry. The perceived value instruments were adopted from (Zeithaml, 1988). The respondents were required to choose the scores based on their perceptions and expectation in every statement on a Likert scale, range from 1 (Strongly disagree) to 5 (Strongly agree).

The data analysis was conducted using Statistical Package for Social Sciences (SPSS). The ideal value of Cronbach’s alpha must be more than 0.7. The acceptable coefficient value of above 0.7; however the data that obtained scores showed more than 0.8 coefficient values which are preferable (Pallant, 2011).

The Cronbach’s alpha coefficient reliability (α) test shows that the Cronbach’s alpha value ranged between 0.982 and 0.845. The value indicates a high level of internal consistency for the scale an acceptable level of reliability. Statistical test was performed to ensure the appropriateness of data for factor analysis.
The Barlett’s test of sphericity (BTS = 1128.174, p<0.00) and the Kaiser-Meyor-Olkin measure of sampling adequacy (KMO = 0.895). The results indicated that the data set was appropriate for conducting factor analysis. Pearson correlation analysis was used to determine the connotation of reliability, responsiveness, and turnaround time and customer satisfaction.

The correlation results suggested that responsiveness has stronger relationship with customer satisfaction compared with the other variables. Perceived responsiveness is strongly correlated with customer satisfaction (Wu, 2013). Hence, when service responsiveness is high, then it will generate higher customer satisfaction. The SPSS program will mark a 0.05 significance level with one asterisk (*) and a 0.01 significance level with two asterisks (0.01). Table 2, shows Pearson correlation coefficient results reliability, responsiveness and turnaround time are significant (p< 0.001 for a two-tailed test), based on 250 complete observations. The correlation analysis also showed that from the three variables responsiveness appears to have highest correlation against customer satisfaction.

Table 2: Pearson Correlation Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reliability</th>
<th>Turnaround</th>
<th>Perceived Value</th>
<th>Customer Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsiveness</td>
<td>0.81**</td>
<td>0.60**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Turnaround time</td>
<td>0.60**</td>
<td>0.35**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Perceived Value</td>
<td>0.45**</td>
<td>0.52**</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level (2-tailed)
Regression analysis is a statistical method which is used to measure the impact of independent variables on dependent variables. Since there are multiple variables to be tested; multiple regression analysis was performed to test the research hypothesis; the results of the regression analysis is shown in Table 3.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>0.59</td>
<td>0.53</td>
<td>0.53</td>
</tr>
<tr>
<td>Reliability</td>
<td>0.19</td>
<td>0.19</td>
<td>0.19</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Turnaround time</td>
<td>0.11</td>
<td>0.11</td>
<td>0.11</td>
</tr>
<tr>
<td>Perceived Value</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Hierarchical regression analysis was used to test the interaction effects. While having interaction effect, the variance inflation factors may upsurge and result multicollinearity effect. Hence, the variables mean were centred before testing the interaction effect (Aiken, West & Reno, 1991). The Hierarchical regression analysis procedure was conducted in three steps. Multiple regressions of control variables was run in the first step, three variables (reliability responsiveness, turnaround time were added in the second step; lastly the perceived value were added in the last step. The regression results is showed in Table 2.0.

### 4.0 Results

F test can be used to determine if new predictors could add additional predictive power. Hence, the variables are added hierarchically rather than together. Based on the hierarchical regression (Step 1) the regression model was supported ($R^2 = 5.5\%$, $p< 0.001$). According to the regression coefficients, income ($\beta = 0.59$, $p = 0.00$) has a significant effect on customer satisfaction, meaning that customers who has higher incomes will have get best services as compared to customer with lower incomes.

In (Step 2) with the addition, of the three dimensions of service quality (reliability, turnaround time and responsiveness) increased the $R^2$ to 54 percent ($F$ value = 141.44, $F = 0.00$). The regression model is also supported. All of the three variables have positive relationships with customer satisfaction.

Meaning, reliability, turnaround time and responsiveness has a direct and positive influence on customer satisfaction ($\beta = 0.53$, $p = 0.00$). Thus, hypotheses H1, H2 and H3 are supported.
The findings concurs with past empirical that turnaround time has a direct and significant relationship with customer satisfaction (Shrestha & Mishra, 2015; Srivastav & Mittal, 2016).

The findings concurs with past empirical findings that reliability has a significant relationship with customer satisfaction (Chakraborty & Roy, 2011).

The research findings also concurs with past empirical findings that responsiveness has a positive relationship with customer satisfaction (Eggert & Ulaga, 2002; Srivastav & Mittal, 2016).

In step 3, by adding the interaction terms to the main model, the $R^2$ increased to 58.0 percent ($F_{change} = 82.43, F = 0.00$). In this study, the researchers found that turnaround time, responsiveness, and reliability is negatively associated with customer satisfaction ($BTan*Sat = -0.05, p = 0.01; BRes*Sat = -0.03, p = 0.00; BRelXSat = -0.04, p = 0.00$).

Turnaround time has a negative association with customer satisfaction. Thus, it can be implied that shorter turnaround time would lead to higher customer satisfaction.

Responsiveness has a negative association with customer satisfaction. Shorter service response time would generate higher customer satisfaction.

Reliability has a negative associated with customer satisfaction. The result implies that when lab results are more reliable; none or minimum errors, then customer satisfaction is also increased. Research results suggested that turnaround time, responsiveness and reliability are factors that can significantly impact of customer satisfaction. In addition, customer perceived value moderates the relationship between turnaround time, responsiveness, reliability and customer satisfaction.

5.0 Discussion

The relationship between service tangibility and customer satisfaction encompasses the appearance of the medical diagnostic laboratory personnel, facilities, materials and equipment. Many of the medical diagnostic labs now are employing online result delivery for faster result tracking. All Laboratory Information System (LIS) can be linked to the web page to let the doctor accessing their patients report. Some of the labs are also adopt the online application via smart phone. This is some portion of service tangibility in the medical diagnostic lab industry that can increase customer satisfaction.

Service reliability is all about accuracy and in the medical line reliability of the test performed is very important. Most of the medical diagnostic labs now are bound to the Quality Assurance Program (QAP) to assess their reliability of operation. MS15189 is one of the example of the accreditation to measure the standard of the medical diagnostic lab are at the highest level. Other International audit programs (External QAP) are also available now. In order to achieve this, the lab must enroll and meet certain criteria that have been set up by the auditing body. Thus, service reliability will enhance customer satisfaction.

Service responsiveness is the timely reaction towards the customers’ requirements. In order to be responsive, lab staff must have the skills and knowledge to answer the entire requirement by medical professionals. The requirement may come from various sources; such as list of test menu, requirement on sample collection, suitable patients’ condition before collecting samples and even tracing lab results. As such, a highly responsive lab staff who produce shorter responsive time would capture higher customer satisfaction.

Time is very essential in the medical industry. As such, reporting of lab test must be met within a specific time agreed between the medical laboratory and the doctors. Nevertheless, they are some weaknesses in the service given by the medical laboratory provider. There are times, when the medical laboratory provider is unable to meet doctors or customer request especially; when it comes to urgent samples.
Service turnaround time must be cleared for every test menu. Service turnaround time will then help the doctor to estimate result release and the time for them to interpret the result to his/her patients. Service turnaround time is part of LabSERV dimension that could increase customer satisfaction.

Technology and customer satisfaction plays an important role in medical diagnostic lab industry. Modern medicines acknowledge this important factor, as it can bring a lot of benefit to the patients. Currently, there are many research and development (R&D) conducted to provide better healthcare services. The (R&D) industry will have a significant impact on the overall performance of healthcare service provider. In the medical diagnostic laboratory industry, advanced technology would enhance the laboratory services and generate higher customer satisfaction. Modern, equipment and state of the art technology could process laboratory test swiftly, which would the increase service value in the eyes of customer.

Test reports are the end product of all the medical diagnostic laboratory. A clear, easy to read and comprehensive report will enable medical professionals to interpret the result easily. Hence, laboratory report must have complete patient details including patient’s name, identification no, MRN no, Lab no, sex and other details. A comprehensive test report will has a significant impact to customer satisfaction.

Service communication seems to be very important especially when a request of laboratory test is requested by a doctor. A confidential medical communication in discussing patient reports must be adhered. Unclear information can lead to a lot of problems. Consequently, medical diagnostic laboratories should maintain a clear communication and good rapport with doctor to avoid any misunderstanding and problems. Nonetheless, clear communication could ensure greater customer satisfaction.

Laboratory staff, attitude and behavior could also have a positive or negative impact on customer satisfaction. The research measured the attitude and behavior attributes on lab staff based on factors such as courteous, committed, knowledgeable, and refrain from being rude. The research found that staffs attitude and behavior could also influence customer satisfaction.

6.0 Contribution of the Study
The research is extended the current body of knowledge by examining the association among responsiveness, reliability, and turnaround time and customer satisfaction from the medical laboratory perspective. The research found that responsiveness, reliability and turnaround time have a positive and significant impact on customer satisfaction. The research also found that customer perceived value moderates the relationship between responsiveness, reliability and turnaround time and customer satisfaction. However, the moderating relationship is negatively associated with customer satisfaction. As such, reduced response rate and turnaround time has a negative relationship with customer satisfaction. On the other hand, reliability also have a negative impact on customer satisfaction. As such, reduce or error free lab results would generate higher customer satisfaction; while unreliable results would reduce customer satisfaction.

The research made some recommendations to the laboratory service provider in improving their current working environment and operating procedures which could result in higher customer satisfaction. Highly satisfied customers will become loyal customer to the laboratory service provider and this will increase its profitability. Positive customer feedback though website would also attract more potential customer to the laboratory service provider. The research also extended the current theoretical knowledge by reaffirming the result of previous studies.

7.0 Limitation of the Study
There are a limited number of perfect researches; this research however is not without flaws. Nonetheless, proper measures were taken to limit its errors. Hence, the interpretation of the result findings must be coinciding with its limitation. The research employed a cross-sectional survey study, which would just show results based on a specific period of time. Future research could extend the current research through longitudinal studies. In addition, the sample size used in the study was also small, future studies could use a bigger sample size to get a more accurate result. In addition, the research was based on samples from
Kuala Lumpur; hence the result cannot be generalized to the entire population.

8.0 Conclusion
These research findings can help medical diagnostics laboratory providers to evaluate the impact of service quality delivery towards customer satisfaction especially in the private sector to ensure a high quality delivered and meet customers’ expectation. The era of evidence-based medicine has forced medical diagnostics laboratory to struggle as the medical professionals are relying to a much accuracy and excellent service delivery. Delivery of service quality is important for medical diagnostics laboratory as there is increase in customers’ demand, higher service expectations that forced medical diagnostics laboratory to provide the excellent service to the customers at all times. Future studies may replicate this research in other cultural settings and examine other variables that could increase customer satisfaction in other industry. Future studies should explore other moderating or mediating relationship that could influence the customer satisfaction.

References


