Impact of school-based allied health therapy via telehealth on children’s speech and language, class participation and educational outcomes

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Impact of school-based allied health therapy via telehealth on children’s speech and language, class participation and educational outcomes

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Abstract
Introduction: Access to telehealth services for children living in rural and remote areas of Australia is very limited. The delivery of allied health therapies to children in school via telehealth may help reduce inequality and improve academic outcomes over time.

Methods: A service delivering speech and language therapy (SLT) and occupational therapy (OT) via videoconferencing to children at five rural schools was prospectively evaluated. Each child’s teacher rated their speech and language, participation in class and educational outcomes at the beginning and end of semester. Change in the summative teacher-rating index over the first and subsequent semesters in which a child received therapy was examined. Independent predictors of change were identified using multivariable linear regression.

Results: Over two years, 1029 sessions of SLT and 531 sessions of OT were delivered to 98 children (67% male, 38% in Prep at commencement) via telehealth. In their first semester of therapy, 57 children received SLT, 37 OT and four both therapies. The mean teacher-rating index significantly improved from the beginning (35.05 ± 10.68) to end (40.02 ± 11.75) of the first semester of therapy (p < 0.001). In multivariable linear regression, grade, school and baseline rating were significantly associated with the end-of-semester teacher-rating index.

Discussion: Delivering allied health therapy by videoconference may enable children to better engage with schooling. Differences in improvements by grade suggest improvements may be maximised by targeting therapy at certain year levels. This model may be useful in areas with limited access to allied health services.

Keywords
Child, speech therapy, occupational therapy, academic performance, telehealth, telemedicine

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Introduction
People living in rural and remote areas/regions of Australia experience reduced access to a broad range of specialist health services compared to their urban counterparts, mainly due to the logistical challenges of travel to city locations.1 Conventional health services typically require travel to a specialist, which may result in hours of commuting for a very brief appointment. Alternative service delivery models – such as visiting outreach programs and telehealth – offer people the opportunity to access services closer to home.2 In the case of allied health services, access to speech and language therapy (SLT) and occupational therapy (OT) for children in rural areas is very limited, yet the demand remains very high. The delivery of telehealth services into the classroom has been shown to be feasible and acceptable.3-5

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The Health-e-Regions project commenced in 2012 with the primary aim to expand the use of telehealth within the Western Downs region of Queensland. Initially, the focus was on a broad range of telehealth services for patients of all ages and in a variety of settings such as hospitals, general practice and nursing homes. In 2015, the focus of the project was directed towards schools in the region and the expressed need for telehealth services (especially SLT) among school-aged children. Following a successful pilot phase involving SLT, the project was expanded to deliver SLT and OT to five schools across four towns in the region.

Children with untreated therapy needs are known to experience a range of consequences, including poorer educational, psychological and social outcomes as they get older. Some studies have demonstrated the validity of and satisfaction with telehealth services in the context of speech and language development. A systematic review of studies describing the efficacy of telerehabilitation services for primary-school-aged children showed limited but promising evidence, but also reported that most studies involved adult participants rather than children. In the USA, a study that used iPads to deliver SLT into schools showed that children involved in the telehealth program were more likely to achieve therapy goals associated with language skills than those related to speech. The expansion of the Health-e-Regions program provided a further opportunity to examine the impact of school-based telehealth services not only on speech and language ability, but also on participation and social outcomes.

This study aimed to quantitatively address the following research question: what is the impact of speech and language and occupational therapy delivered by telehealth into a school on children’s speech and language outcomes, participation in class activities and educational outcomes?

**Methods**

**Service model**

The telehealth service offered SLT and OT via videoconferencing to children at five rural Queensland schools teaching at least grades Prep (the first year of schooling in Queensland) to grade six. The service model and evaluation design are shown in Figure 1. At the beginning of each semester, children were chosen for participation in SLT and/or OT via telehealth following local processes at each school, including identification of problems, assessment for suitability and consent by parent/guardian. Selection was not by formal clinical diagnosis; however, some children may have had a prior diagnosis of a speech/language disorder. Therapy was delivered to children individually in weekly sessions over 12 weeks accompanied by a teacher aide or equivalent at the child’s school, by final-year undergraduate allied health students from The University of Queensland Telerehabilitation Clinic.

**Figure 1.** Service model and evaluation design.
under the supervision of clinical educators. Telehealth sessions were conducted using iPad Air devices (Apple, Cupertino, CA, USA) using eHAB telerehabilitation software (NeoRehab, Brisbane, Australia) and/or room-based videoconferencing equipment, depending on the preferences of the school. School staff coordinating the program were trained in equipment use and troubleshooting. No restrictions were placed on children receiving therapy in person through the school and/or private providers.

**Study design and data collection**

A prospective evaluation study was conducted of the service over a two-year period. The study received ethical approval from The University of Queensland Human Research Ethics Committee (#2016001116) and the schools and educational systems involved. Both quantitative and qualitative data were collected from multiple perspectives to allow triangulation of findings. This article reports findings related to the primary research question; additional findings will be reported subsequently. Consent for participation in the evaluation was independent of and not required for participation in the service.

The primary study outcome measure was a classroom teacher rating of a child’s speech and language abilities, educational outcomes and participation in class. As no suitable validated instrument to measure these outcomes could be identified, a study-specific tool was developed using an online Delphi panel process involving three rounds. In the first round, participants suggested items for the tool; in subsequent rounds, they rated and then ranked the items in terms of their usefulness, with the aim of achieving a consensus on the most useful items with which to assess the impact of allied health therapies on school-related behaviour and outcomes. Nine teachers and therapists involved in the establishment of the therapy program participated, resulting in a tool containing 10 items (Box 1). Teachers completed the teacher rating form at the beginning and end of each semester in which a child received therapy via telehealth, with each item scored on a seven-point Likert-type scale from ‘poor/not at all’ to ‘excellent’. Teachers also used this form to report if the child received therapy in person over the course of the semester.

Additional data reported herein were collected by allied health therapy providers. As therapeutic alliance, or the collaborative relationship between therapist and therapy recipient, may impact on child outcomes,16 allied health therapy providers completed two questions at the completion of each therapy session: ‘In this session, how engaged (on task) was the child?’ (engagement) and ‘How much did the child enjoy this session?’ (enjoyment), rating each on a five-point scale. Data routinely collected as part of normal service delivery by The University of Queensland Telerehabilitation Clinic, such as child demographics (age, grade) and type of therapy delivered, were also reviewed.

**Data analyses**

Descriptive statistics were used to report the sample and services delivered. Scores on the teacher rating scale were combined into a summative index, with missing data imputed as the mean of the other items, provided at least 80% of items were completed. The internal consistency of the resultant scale was acceptable (Cronbach’s alpha 0.884–0.949 at each time point). Measures of engagement and enjoyment for each child over the course of each semester were summarised using means and standard deviations (SDs). As children could receive therapy via telehealth for up to four semesters, and to account for clustering by child, teacher-rating index data were not combined across semesters. Furthermore, it was expected that children receiving therapy across multiple semesters may differ from those receiving fewer semesters of therapy. Thus, analyses were stratified by the semester of therapy, defined as the first, second, third or fourth semester.

**Box 1** Items rated by teachers on a seven-point Likert-type scale at the beginning and end of semester for each child who received telehealth therapy.

1. Student is confident to express themselves orally in a variety of situations
2. Student can speak in complete sentences
3. Student has an appropriate vocabulary for their age
4. Student pronounces sounds and words well
5. Student can communicate with peers
6. Student understands verbal instructions easily
7. Student participates and engages in class
8. Student can communicate effectively so that they can be understood
9. Student demonstrates age-appropriate social skills
10. Student follows multi-step directions
semester in which a child received therapy (regardless of the time period in which the therapy was delivered). Multivariable linear regression was used to assess change in the teacher-rating index from the beginning to the end of the first semester in which children received therapy, and to identify independent predictors of change. Possible relationships between demographics (sex, grade, school), therapeutic alliance (engagement, enjoyment), therapy received (type and volume of telehealth therapy, receipt of in-person therapy) and teacher-rating index were explored using correlations, repeated measures t-tests and analysis of variance (ANOVAs) and the Welch test (when assumptions of homogeneity of variances were not met with the ANOVA), with variables significant at the bivariable level entered into the regression model. Similar analyses were used to assess change over subsequent semesters of therapy, although smaller numbers of children receiving multiple semesters of therapy limited the ability to identify predictors. Predictors of change are reported for the first semester of therapy only. Statistical significance was set at $p < 0.05$.

**Results**

Over the two years, 1560 sessions of therapy (1029 sessions of SLT and 531 sessions of OT) were delivered to 98 children via telehealth. Approximately two-thirds of the children were male, and most were in Prep or grade one at the time of their first semester of therapy (Table 1). While 57% of children received SLT via telehealth and 38% OT alone via telehealth, five children received both SLT and OT via telehealth, either concurrently or in different semesters. Just under half of the children (47%) received therapy via telehealth in one semester only; only 9% of the sample received therapy via telehealth across all four semesters. Approximately 17% of children received in-person SLT and 6% in-person OT in the child's first semester of therapy.

**Impact on child speech and language, educational outcomes and participation in class**

A teacher-rating index could be calculated at both the beginning and end of semester for 173 of 182 semesters of therapy delivered. Forty-eight teachers provided ratings for the 98 children. The mean teacher-rating index significantly improved from the beginning (35.05, SD 10.68) to the end (39.79, SD 11.77) of the first semester of therapy received ($R^2 = 0.563$, $F(1, 92) = 120.924$, $p < 0.001$). Mean scores similarly improved in subsequent semesters of therapy (Table 2).

**Predictors of improvement**

Further analyses were conducted to identify possible independent predictors of change in mean teacher ratings over the first semester of therapy. Bivariate analyses identified that the teacher-rating index at the end of semester significantly varied by grade (Welch’s $F(4, 37.471) = 4.028$, $p = 0.008$), school ($F(4, 91) = 3.320$, $p = 0.014$), receipt of in-person OT ($t(94) = -2.384$, $p = 0.019$) and beginning-of-semester teacher-rating index (paired $t(93) = -5.884$, $p < 0.001$). When these variables were added to the regression, the model explained 65.0% of the variance ($R^2 = 0.650$, $F(15, 78) = 12.498$, $p < 0.001$). The beginning-of-semester teacher-rating index significantly predicted the end-of-semester value ($\beta = 0.751$, $p < 0.001$). Significant differences were also seen within some categories of both grade and school, as shown in Figure 2. Compared to children attending School A, children attending School C and School D had significantly higher teacher-rating index scores at the end of semester, controlling for start-of-semester scores ($\beta = 0.165$, $p = 0.033$ and $\beta = 0.233$, $p = 0.023$, respectively). No significant differences were seen for schools B and E. Compared to children in Prep, children in grade two had a significantly higher teacher-rating index score at the end of semester, controlling for their start-of-semester score ($\beta = 0.210$, $p = 0.005$). No significant differences were seen for other grades, and no other variables in the model were significant.

**Discussion**

This research demonstrates some of the benefits of telehealth services for children, from the perspective of the classroom teacher. The majority of children who received telehealth services (SLT and OT) through the Health-e-Regions program showed consistent improvement over time. According to teacher ratings of students at the beginning and end of each semester, speech and language skills, educational outcomes and participation in class had all improved. These positive changes were sustained in the children who received therapy services over multiple semesters.

The results of this study also indicated some variations in improvement of the children involved in the program. Whilst it is important to note that improvements were seen overall, when the average rating per child was compared by school, variations were observed. We also found that the children most responsive to the program were those in Grade 2 (approximate age seven years), compared to children in other grades. These observations warrant further investigation to determine whether factors such as the child’s age, their level of speech and language development during the program and the schools’ administration
of the program (dedicated teaching resources, alignment with classroom activities and coordination of sessions) are directly related to performance outcomes. Previous work by researchers in the USA demonstrated similar outcomes when comparing SLT services delivered in person and by telehealth. Interestingly, while children receiving therapy in either model showed significant improvements overall, there were no significant differences between the two modalities on individual education goals. These findings are consistent with a recent systematic review, which showed (in only a small selection of articles, n = 7) promising evidence to support the efficacy of telehealth for the delivery of SLT services to school-age children. Our study provides further evidence to support the delivery of SLT telehealth services in the school environment, by demonstrating positive outcomes related to goal attainment, classroom participation and educational

Table 1. Characteristics of children receiving services via telehealth.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>%</th>
<th>Characteristic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td></td>
<td></td>
<td>Grade</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| A              | 27 | 27.6%| Prep           | 37 | 37.8%
| B              | 19 | 19.4%| 1              | 17 | 17.3%
| C              | 10 | 10.2%| 2              | 15 | 15.3%
| D              | 24 | 24.5%| 3              | 13 | 13.3%
| E              | 18 | 18.4%| 4–6            | 16 | 16.3%|
| Type of therapy received by telehealtha |     |     | Type of telehealth therapy received |     |     |
| SLT            | 56 | 57.1%| SLT            | 57 | 58.2%
| OT             | 37 | 37.8%| OT             | 37 | 37.8%
| Both           | 5  | 5.1% | Both           | 4  | 4.1% |
| Gender         |    |     | Received in-person therapy |     |     |
| Female         | 32 | 32.7%| SLT            | 17 | 17.3%
| Male           | 66 | 67.3%| OT             | 6  | 6.1% |
| Number of semesters of therapy via telehealth received |  |     | Number of sessions of therapy via telehealth received – median (range)b |  |     |
| 1              | 46 | 46.9%| Total          | 9  | (1–21)|
| 2              | 29 | 29.6%| SLT            | 9  | (2–10)|
| 3              | 14 | 14.3%| OT             | 9  | (1–12)|
| 4              | 9  | 9.2% | Therapeutic alliancec – mean (SD) |  |     |
| Total number of telehealth sessions – mean (SD) | 15.92 (10.0) |     | Enjoyment      | 3.95 (0.51) |
| SD: standard deviation; SLT: speech-language therapy; OT: occupational therapy. |  |     | Engagement     | 3.98 (0.57) |
| aType of therapy received by telehealth across entire program; children may receive SLT and OT in concurrent or consecutive semesters. |  |     |  |     |
| bNumber of sessions of therapy via telehealth calculated for SLT and OT only for children who received that therapy type via telehealth in their first semester of telehealth therapy; median (range) reported as data skewed. |  |     |  |     |
| cTherapeutic alliance as rated by allied health therapist; reflects mean rating across all sessions of a child's first semester of telehealth therapy. |  |     |  |     |

Table 2. Change in mean teacher ratings from beginning to end of semester in children's first and subsequent semesters of therapy received by telehealth.

<table>
<thead>
<tr>
<th>Semester of therapy</th>
<th>Number of children who received therapy</th>
<th>Mean (SD) number of consultations</th>
<th>Mean (SD) teacher rating</th>
<th>Mean (SD) teacher rating</th>
<th>P-value for differenceb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Beginning of semester</td>
<td>End of semester</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>98</td>
<td>35.05 (10.68)</td>
<td>40.02 (11.75)</td>
<td>96</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Second</td>
<td>52</td>
<td>36.15 (10.99)</td>
<td>44.08 (11.29)</td>
<td>52</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Third</td>
<td>23</td>
<td>37.91 (11.36)</td>
<td>42.00 (9.88)</td>
<td>23</td>
<td>0.001</td>
</tr>
<tr>
<td>Fourth</td>
<td>9</td>
<td>38.67 (7.97)</td>
<td>44.78 (11.26)</td>
<td>9</td>
<td>0.002</td>
</tr>
</tbody>
</table>

SD: standard deviation.

aNumber of children for whom teacher rating data was available.

bP-value for linear regression with beginning of semester rating as covariate.

of the program (dedicated teaching resources, alignment with classroom activities and coordination of sessions) are directly related to performance outcomes. Previous work by researchers in the USA demonstrated similar outcomes when comparing SLT services delivered in person and by telehealth. Interestingly, while children receiving therapy in either model showed significant improvements overall, there were no significant differences between the two modalities on individual education goals. These findings are consistent with a recent systematic review, which showed (in only a small selection of articles, n = 7) promising evidence to support the efficacy of telehealth for the delivery of SLT services to school-age children. Our study provides further evidence to support the delivery of SLT telehealth services in the school environment, by demonstrating positive outcomes related to goal attainment, classroom participation and educational...
outcomes over time. We also describe the use of a novel teacher-rating scale, which was developed for the reporting of outcomes associated with this study.

Limitations
Our study has some limitations. First, since there was no validated teaching-rating scale, we had to develop our own for the study. This instrument needs further validation, but has proven useful for the assessment of a child’s performance in the school setting. Second, there may be a perceived risk of bias because teachers reported on the child’s outcomes. Third, we did not compare performance outcomes of children receiving therapy using different modalities (such as in person). This was impractical, since there remains very limited capacity to deliver the same services in person.
Conclusion
Delivering allied health therapy by videoconference seems to have positive benefits on a child’s ability to better engage with schooling. Differences in improvements by grade suggest improvements may be maximised by targeting therapy at certain year levels. This model may be useful in other communities where access to allied health services is limited.

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